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Nondestructive Inspection Journeyman

Volume 1. Career Field Fundamentals

Air Force Career Development Academy

The Air University

Air Education and Training Command

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WELCOME to career development course (CDC) 2A752. We sincerely hope you enjoy your training in the nondestructive inspection (NDI) career field. NDI testing methods were originally developed to allow personnel to locate and identify a wide range of potential defects in high performance aerospace components without harming or affecting the serviceability of the parts. As technology continues to advance, so does the NDI career field. For example advancements in microcircuitry, advanced composites, and computer capabilities have led to new and improved NDI testing methods that are capable of detecting hidden defects impossible to see with the naked eye.

This first volume covers the fundamental subjects of your career field.

Unit 1 covers technical orders (TO). We explore the Air Force TO system and how to use, maintain, and improve TO files.

Unit 2 deals with supply management and documentation. After learning the purpose and scope of the supply system we'll get into the forms and tags used to document transactions, account for equipment, and report condition of equipment.

Unit 3 is geared towards maintenance management. We first cover the Air Force maintenance concept. Then, you'll learn all about maintenance documentation and the information systems used to record your inspections.

Unit 4 covers the all-important subject of safety. We approach the safety subject from two aspects: laboratory safety and flightline safety.

Unit 5 is where we begin learning the different methods of aircraft and ground equipment construction. We conclude the unit with basic aircraft markings and flightline hazards as it is important to know this while working around aircraft.

The second volume introduces you to metallurgy, inspection techniques, and the optical, penetrant and magnetic particle inspection methods.

The third volume covers the advanced inspection methods of eddy current, ultrasonic, bond testing, and spectromentric oil analysis.

The fourth volume is almost entirely devoted to the radiographic inspection method, with a short unit on the end that gives an overview of several specialized inspection methods.

A glossary is included for your use.

Code numbers on figures are for preparing agency identification only.

The use of a name of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by the Air Force.

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This volume is valued at 12 hours and 4 points.

NOTE:

In this volume, the subject matter is divided into self-contained units. A unit menu begins each unit, identifying the lesson headings and numbers. After reading the unit menu page and unit introduction, study the section, answer the self-test questions, and compare your answers with those given at the end of the unit. Then complete the unit review exercises.

Unit 1. Technical Orders

WHAT A CHAOTIC PLACE the maintenance complex would be without technical orders (TO). Suppose you were asked to perform a task and you had no idea how to do the job, where to start, or what you may need to complete it. Now imagine everyone in maintenance doing the same; even the best workforce would deteriorate rapidly. Thankfully, the Air Force has developed publications to cover almost all of the tasks involved in all the specialties in the Air Force. These publications are designed to promote clear and concise instructions for safe and effective maintenance operations. As you progress in your career, you will find nearly every task you are asked to accomplish is probably outlined in detail somewhere in a publication that explains work procedures or methods. You will also find it is your responsibility to learn to locate and use the information needed to do a job. This information will be found in TOs, instructions, manuals, and other reference materials.

1–1. Air Force Technical Order System

From your first day on the job, you will be bombarded with many different types of Air Force and commercial publications. This career development course (CDC), plus instructions, checklists, manuals, and TOs, are just a few examples. The number of publications you will need to use will increase as your responsibilities increase. Properly understanding publications and their uses will greatly help you to meet your obligations as a member of the Air Force. Everyone—from the newest airman to the oldest chief—needs to know how to look up and use information in technical publications. By properly understanding and using publications, you will set the example for your coworkers and Airmen working for you. In this section, we will focus on the publications you will see and use most often—Air Force technical manuals and technical orders.

001. Purpose and types of technical orders

A TO is an official Air Force publication that provides technical information, instructions, and safety procedures pertaining to the inspection, operation, maintenance, and modification of Air Force equipment and material. TOs are intended to ensure tasks performed in support of the Air Force mission are accomplished with the greatest possibility of success and the least chance for loss of life or damage to equipment. Air Force policy directives (AFPD) concerning technical orders leave no doubt that all weapon systems must be operated and maintained by the use of TOs. Simply stated, a technical order is a publication that is a military order and must be followed until it is rescinded or modified by proper authority.

What is a technical order's purpose, scope, and policy?

TO 00–5–1, *Air Force Technical Order System*, directs how official TOs are established, numbered, and issued. This publication also outlines the purpose, scope, and policy for TO use in the Air Force.

Purpose

The purpose of the Air Force TO system is to provide concise and clear instructions for safe and effective operation and maintenance of Air Force military systems.

Scope

The TO system includes all manuals developed or acquired for operation, maintenance, inspection, modification, or management of Air Force military systems. This includes paper and digital TOs as well as approved commercial-off-the-shelf (COTS) manuals. All manuals managed in the TO system are given a TO number.

Policy

In a word, compliance with Air Force TOs is *mandatory*! Air Force personnel are responsible for controlling and using TOs as organizational property in conjunction with official duties. All Air Force military systems, except those specifically excluded, will be operated and maintained according to procedures specified in TOs. To receive the full benefits of TOs, you must be familiar with the technical order system. This is why your supervisor and everyone connected with maintenance stresses the use of technical data. Any change in the technical data you are using will be brought to your attention. *The importance of following TO instructions cannot be overstressed.* Failure to properly comply with TO instructions is a serious infraction and could lead to punishment for the Air Force member involved.

Types of technical orders

There are nine basic types of technical orders:

1. Operations and maintenance (O&M) TOs.
2. General methods and procedures TOs.
3. Index TOs.
4. Abbreviated TOs.
5. Brief manuals
6. Time compliance TOs (TCTO).
7. Supplemental manual TOs.
8. Joint-use publications.
9. COTS manuals.

Let's look at each type, their function, and purpose.

O&M technical orders

O&M TOs cover installation, operation, troubleshooting, repairing, removing, calibration, servicing or handling of Air Force military systems. Examples include the following:

- Flight Manual Program (FMP) publications.
- On-equipment organization maintenance manual sets.
- Nuclear weapons manuals.
- Nonnuclear weapons delivery manuals.
- Aircraft emergency rescue information.
- Communications-electronics manuals.
- Work package TOs.
- Calibration TOs.

- Calibration TOs.
- Computer-related manuals.

General methods and procedures technical orders

Figure 1–1 illustrates a few examples of general methods and procedures TOs. These TOs are general in content and do not deal with specific aircraft or equipment. There are two classes of these TOs:

1. General TOs: If the number 1 is used in lieu of a specific equipment identifier, the TO is a general technical order.
2. Methods and procedures TOs: If the category number is 00, then these TOs are general in content and are not issued against specific military systems. These type publication are used in the following ways:
    a. To specify policy or methods and procedures relating to the TO system, maintenance management, administration, inspection of Air Force equipment, and control and use of repairable assets.
    b. To specify policy or methods and procedures relating to ground handling of air and space vehicles, general maintenance practices, management of precision measurement equipment, and the safe use of Air Force equipment. A good example is TO 00-25-234, *General Shop Practice Requirement for Repair, Maintenance, and Test of Electrical Equipment.*

They may also specify common procedures for arrangement of maintenance facilities or special inspection functions such as the joint oil analysis program. A good example is TO 33B–1–1, *Nondestructive Inspection Methods, Basic Theory*, which you used during technical training to learn theory about general nondestructive inspection (NDI) methods. Another example would be 33B–1–2, *Nondestructive Inspection General Procedures and Process Controls*.

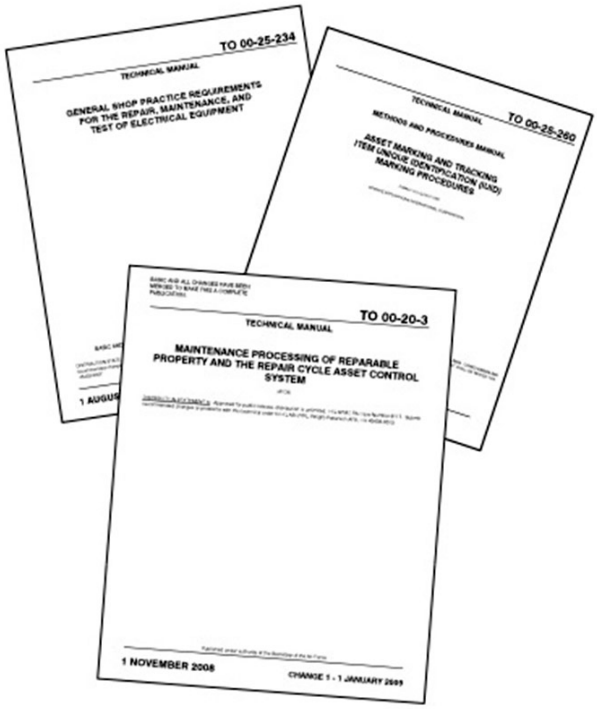


Figure 1–1. Example of general methods and procedures TOs.

Index technical orders

Indexes TOs provide a means of identifying needed TOs, group TOs pertaining to specific items of equipment, and show the status of all TOs. Examples of index TOs follow:

- TO Catalog.
- Special TO indexes.
- Enhanced Technical Information Management System (ETIMS).
- Lists of Applicable Publications (LOAP).

Abbreviated technical orders

Abbreviated TOs are excerpts from one or more basic TOs that organize and simplify instruction. These publications include the following:

- Aircraft inspection workcards.
- Inspection sequence charts.
- Checklists.

The usefulness of abbreviated TOs is apparent when you consider the use of a TO during aircraft periodic inspections. Inspection workcards, sequence charts, and checklists condense the applicable information from all of the various inspection manuals needed for an aircraft into one convenient reference. They save a great deal of time that would be lost if each technician had to research inspection steps individually. A good example can be found in checklists that may be published for any of these reasons:

1. When sequential steps must be followed to avoid potential damage to equipment and would reduce operational readiness or cause catastrophic failure.
2. To prevent potential injury to personnel or damage to equipment unless a prescribed sequence time-phased procedures are followed.
3. When interaction or communication between two or more differing specialty skills is involved in accomplishing a function.

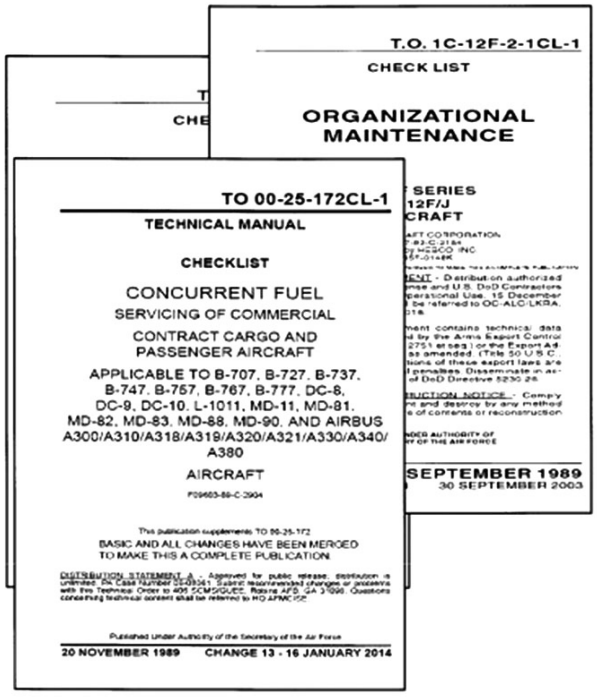


Figure 1–2. Example of abbreviated TOs.

Brief manuals

TOs are considered to be brief manuals when they are twenty pages or less in length. Brief manuals only require an abbreviated title page with no additional front matter. These manuals can,

- have chapters or sections that begin on left or right hand pages with no blank pages.
- contain more than one chapter or section on a page, have pages, paragraphs, illustrations and tables numbered consecutively throughout the manual with single Arabic numerals.
- contain the words “THE END” following text on the last page.

Brief manuals are always revised, never changed.

Time compliance technical order

The TCTO is the authorized method of directing and providing instructions for modifying military systems and end items or performing one-time inspections. TCTOs are similar to technical manuals (TM) except they provide a detailed explanation of a particular job that must be done within a specific time limit. As an example, let’s say a manufacturer installed the wrong-sized fasteners in an aircraft wing and the fasteners are popping out. Let’s further say that the defect is not discovered until the aircraft is delivered to a squadron. Once the defect is discovered, a TCTO is issued in accordance with TO 00–5–15, *Air Force Time Compliance Technical Order Process*. The issued TCTO explains which fasteners are defective, gives instructions on how to repair the defective fasteners, and specifies the time limit for the repair to be accomplished. There are three authorized categories of TCTOs:

1. Immediate action.
2. Urgent action.
3. Routine action.

Immediate action TCTOs

A border of red Xs (XXX) and the words IMMEDIATE ACTION printed in red at the top center of the first page identify immediate action TCTOs. These orders contain emergency procedures that must be complied with at once. They are only issued when a condition exists that, if not corrected, could result in fatality or serious injury to personnel or extensive damage to or destruction of valuable property. When such a TO is received, the forms for the affected aircraft or system is immediately put on a red X and grounded or removed from service until the required work is done. The instructions contained in immediate action TCTOs are of vital importance and nearly always require you to give precedence to this item over all other work. Commanders are responsible for ensuring immediate action TCTOs are distributed to all affected personnel within four hours after receipt because of their critical nature. These TCTOs carry a rescission date of no more than one year after the issue date. Figure 1–3 shows you an example of an immediate action TCTO.

Urgent action TCTOs

This type of technical order is identified by alternating red Xs and diagonals (X/X/X/) around the border of the first page. Additionally, the words URGENT ACTION are printed in red at the top center of the first page. Urgent action TCTOs are concerned with correcting hazardous conditions which, if uncorrected, could result in injury to personnel, damage to property, or unacceptable reductions in combat efficiency. Work specified must be done within the time limit given in the technical order. The time limit may be from 1 to 10 days. If the TCTO isn’t completed within the specified time frame, the aircraft or system involved is removed from service. No one can use or operate affected equipment or aircraft until it meets the condition of the technical order. Urgent action TCTOs are distributed to all affected personnel within 24 hours of receipt and carry a rescission date of one year after the issue date. Figure 1–3 shows you an example of an urgent action TCTO.

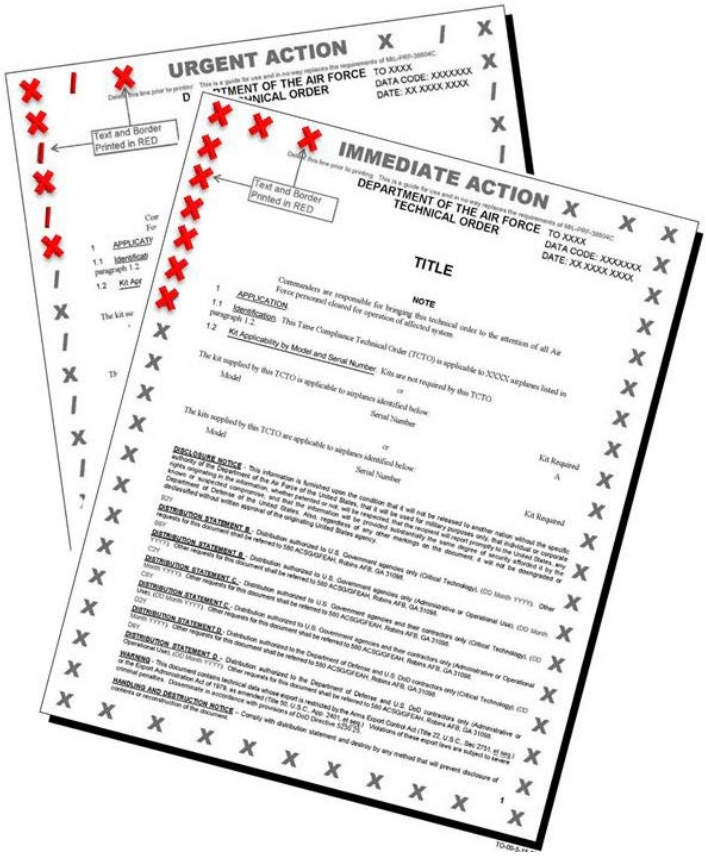


Figure 1–3. Example of an immediate and urgent action TCTO.

Routine action TCTOs

Since the actions required are not particularly urgent, routine action TCTOs have no special markings and there is no set time required for distribution. They are issued to correct discrepancies that do not present an existing hazard, but could become hazardous through prolonged use, impair the efficiency of a unit or system, or reduce the operational life of a piece of equipment. Although no current hazard exists, a time limit for completion of these technical orders is also set. Depending on the circumstances, the time limit can be between 11 days and 540 days, during the next periodic inspection, or after a specified number of landings. In all cases, the work must be done when directed.

In addition to the three categories above, there are four other types of special TCTOs:

1. Inspection TCTOs.
2. Record TCTOs.
3. TCTO supplements.
4. Interim TCTOs (ITCTO).

Inspection TCTOs

These TCTOs may be issued when a deficiency and affected parts are identified, but either the extent of the deficiency or quantity of replacement parts required for corrective action are unknown or may vary. Inspection TCTOs are sometimes referred to as a one-time inspection (OTI). On many occasions, an OTI is issued following an operational component failure so engineers can determine whether the failure is an isolated incident or an indication of discrepancies in the component Air Force-wide. Inspection TCTOs are not issued with kits containing replacement parts for those found defective during the inspection. They specify whether any previous inspections or work satisfies the requirements of the OTI and if the inspection is being included in the normal inspection manual for the equipment.

Record TCTOs

Record TCTOs contain information on complex modifications. They do not explain in detail how a contractor or Air Force depot is to perform a modification, but they do contain installation drawings and a parts list to enable field units to maintain the modified system or structure.

TCTO supplements

These are issued to change or amend a basic TCTO. They are normally issued to describe additional work not included in the original TCTO and any changes to man-hour or personnel requirements. They may also extend the rescission date, if required. Supplements automatically assume the same urgency of the basic TCTO, whether it is immediate, urgent, or routine.

Interim TCTO

When circumstances prevent timely publication of emergency instructions as a formal TCTO, they are issued electronically. The most common form of an ITCTO is a message sent to all concerned units to correct a hazardous situation. An ITCTO usually involves an unsafe situation that requires attention faster than would be possible with a formally published TCTO.

Supplemental manuals

Supplemental manuals contain instructions for use in conjunction with data contained in their parent TOs and are not stand-alone publications. The title page will state, “This manual is incomplete without TO” and give a TO number. Supplemental manuals are not temporary updates like TO supplements (which we will cover later), and are assigned a separate TO “dash” number. Although supplemental manuals are ordered like any other TO, the basic TO must also be ordered to provide complete procedures and data. The supplemental manual may contain classified information while allowing the parent manual to remain unclassified. Examples are as follows:

- A table containing classified weapon data used with a weapons delivery TO in building mission profiles.
- Aircraft de-icing criteria provided by the Federal Aviation Administration (FAA).
- Rapidly-changing data published on the Internet to improve the timeliness and accuracy of the technical data.

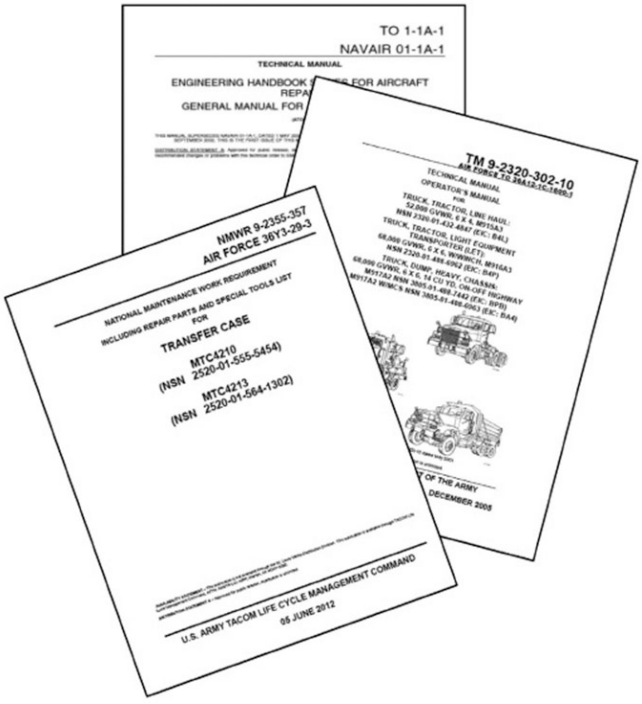


Figure 1–4. Example of a joint publication.

Joint-use Army, Navy, Marine Corps, and other Department of Defense agency publications

Technical manuals developed for other services or government departments can be used by the Air Force if they meet operational and maintenance needs. The publications are integrated into the TO system, assigned TO numbers, indexed, distributed, stored, reprinted, maintained and rescinded in the same manner as any other TO (fig. 1–4).

Commercial-off-the-shelf manuals

Commercial-off-the-shelf (COTS) manuals support equipment designed and manufactured for commercial use. They provide operating instructions, technical information for installing, servicing and repairing the equipment item and a parts list to assist in ordering replacement parts. All COTS manuals are approved for Air Force use and are assigned a TO number, managed, referenced and used like any other TO. They may include paper, CD/DVD (compact disc/digital versatile disc) or electronic online file.

002. Location of the correct technical order

Now that you understand the different types of TOs, you will need to know how to effectively find the TO you need. Although there are literally thousands of TOs in use throughout the Air Force, finding the one you need is not nearly as difficult as you might think. The Air Force system may differ from the public library or your local bookstore, but over the years, the Air Force has made it easier by creating a highly efficient system for referencing and indexing TMs. We will look at both paper and electronic systems.

Enhanced Technical Information Management System

ETIMS is an electronic system that is used to acquire, improve, publish, catalog, manage, store, distribute and display official TOs needed for a safe and effective operation of the Air Force weapon systems and equipment. It is a principal automated TO management application which was created to establish and manage information about Air Force technical orders. It disseminates current information on available TOs, manages the technical order distribution office (TODO) accounts for the ordering of TOs and the maintenance of TO records, and enables the viewing of electronic TOs.

ETIMS provides a direct on-line connectivity from every base into the management system to allow TO ordering, submission of improvements, TO account status, and even on-line distribution to your base.

The TO numbering system

The TO numbering system used by the Air Force is a logical, consistent system used to number both aircraft and equipment technical orders. The TO numbering system consists of groups of numbers and letters in a definite sequence, with the groups separated by a dash (i.e., 1F–16C–2–3).

The first two digits in the TO number designates the major category under which the TO is grouped. As you would expect there are numerous categories used by the Air Force. As an NDI specialist, you will not be required to know all of the categories; instead, you will be mainly concerned with only a few particular category numbers.

These category numbers and the topics assigned to them are as follows:

- Category 0—indexes.
- Category 00—general.
- Category 1—aircraft.
- Category 33—test equipment.

In addition to these categories, the following table lists some of the major categories used to group technical orders.

TO CATEGORY	TITLE
0	TO Catalog, Indexes and Cross-Reference Table
00	General Methods & Procedures Technical Orders
1	Aircraft Technical Orders
2	Airborne Engine and Associated Equipment Technical Orders
3	Aircraft Propellers and Rotors Technical Orders
4	Aircraft Landing Gear Technical Orders
5	Airborne Instrument Technical Orders
6	Aircraft and Missile Fuel Systems Technical Orders
31	Ground Electronic Equipment Technical Orders
32	Standard and Special Tools Technical Orders
33	Test Equipment Technical Orders
34	Shop Machinery and Shop Support Equipment Technical Orders
35	Ground Handling, Support, Air and Missile Base Operating Equipment Technical Orders
36	Vehicles, Construction and Material-Handling Equipment Technical Orders
37	Fuel, Oil and Propellant-Handling Equipment Technical Orders

Following the initial digit(s) in the TO number you will find a letter that designates the type of aircraft or equipment. For instance, 1F refers to fighter aircraft, and 1B refers to bombers.

In the second part of the TO number, the initial letter of an aircraft TO or manual is followed by a dash and the aircraft model number. The aircraft model is further identified by a letter, which denotes the series of the aircraft. When major modifications are made to an aircraft, technical orders are revised to include the major changes. For example, there are technical orders 1B–52G–3 and 1B–52H–3 for both the G model and H model B–52. Be sure you check these second groups of symbols to ensure you are using the correct TO when you work on a particular series of aircraft.

Additional number and letter groups may be added to provide a further breakdown into subsystems. The last number that appears on a technical manual usually tells you the primary function of the manual. This number is often referred to as the dash number of the publication. For example, the –2 manual contains organizational, intermediate, and field maintenance instructions. Other dash numbers you should become familiar with are as follows:

- The –1, which are operating instructions.
- The –3, which are depot Maintenance and overhaul manuals.
- The –4, which is the illustrated parts breakdown (IPB).
- The –6, which covers all aircraft inspection requirements.
- The –36, which has all the NDI inspections for a particular aircraft.

For example, the most important TO you will use to find F–15 aircraft inspections is the –36, *Nondestructive Inspection* procedures TO.

NOTE: There are some exceptions to the meaning of the last digits of the TO number. One exception deals with TCTOs. These are numbered like other TOs except the last number is 501 or higher and has no special significance, other than to identify them as TCTOs.

The following table shows what each dash number represents. The table listing provides brief definitions of dedicated numbers used in all TO categories, except categories 1, 21, and 22. Additional numbers are required in these categories of TO data.

–01	List of Applicable Publications
–06	Work Unit Code Manuals
–1	Operating Instructions
–2	Organizational, Intermediate, Field Maintenance, or Service Manuals
–3	Depot Maintenance, Overhaul, Schematic, or Wiring Diagram Manuals
–4	Parts List, Parts Breakdown, or Illustrated Parts Breakdown Manuals
–6	Inspection Requirement Manuals
–7	Installation and Installation Test Procedure Manuals
–8	Test Procedures, User Manuals, Reference Manuals, Programmed Test Manuals, or Software Related Instruction Manuals
–9	Alignment Instruction Manuals
NOTE: The number 5 is used to identify a variety of types of TOs, depending on the applicable TO category.	

TO 00–5–18, *USAF Technical Order Numbering System,* breaks down every major category and describes how to number every TO associated with the grouping. To give you an example, we will look at a complete technical manual and breakdown the meaning of each part of a TO number. Note how the TO numbers become more specific with each additional number or letter.

1F-16B-2-32JG-30-3	
1	Category 1
F	Basic Mission Fighter
16	Aircraft Production Model
B	Aircraft Production Series
2	Number Reserved for Maintenance Instructions
32	Landing Gear System (MIL-STD-1808, Chapter 32)
JG	Job Guide Manual
30	Extension and Retraction Subsystem
3	Third in a Series of Manuals

If you understand the numbering system, you can find many TOs without referring to an index. In fact, you are not expected to remember the numbers of all of the equipment TOs you will need. However, there will be times when you need to find a specific TO and verify the date it was last published. To do this, you must use a technical order index.

TO indexes

TO indexes provide much information. For example, indexes show the following:

- The most current publication date of TOs.
- What TOs have been renumbered, replaced, or rescinded.
- The issue date, security classification, and title of the TO.
- The ability to cross reference part number to applicable TO.

In the past, individual indexes were produced on microfiche, CDs or in paper form. Today, all the information is available on a military internet website index. TO monitors in your shop use the online searchable index every month to verify that the TOs that you use in your shop and on the flight line are the most current ones available.

The Internet website index enables users to research TO information using the same categories we discussed earlier. For example, you will find TOs for test equipment in category 33 and shop machinery TOs in category 34. This is great if you know the number of the TO—but what if you don't? Not to worry! If you know the part number of the equipment, you can enter it into the search box on the website to find which TOs apply.

003. Maintenance Integrated Data Access System technical orders

As you go through this lesson, you will see there are differences between this system and the one discussed in the last lesson. In this lesson, we refer to the F–16 TOs because they are representative of most of the newer aircraft in the AF inventory. Most weapon systems are either currently using or going to use this TO system. In this lesson we cover each of the different types of TOs and their functions. By understanding both systems, you will be able to troubleshoot and repair any aircraft. The Maintenance Integrated Data Access System (MIDAS) TO numbering system is similar to the basic TO numbering system in that the aircraft designation codes are the same for both. Unless TOs are for specific components, such as flight controls, all aircraft TOs start with the TO category, type of aircraft, model, and production series code. For instance, you can tell that TO 1F–16A–3 contains maintenance instructions for the F–16 aircraft. But after the 1F–16A–3, the remaining portion of the TO numbers are based on the MIDAS system. Figure 1–5 shows a MIDAS TO number breakdown.

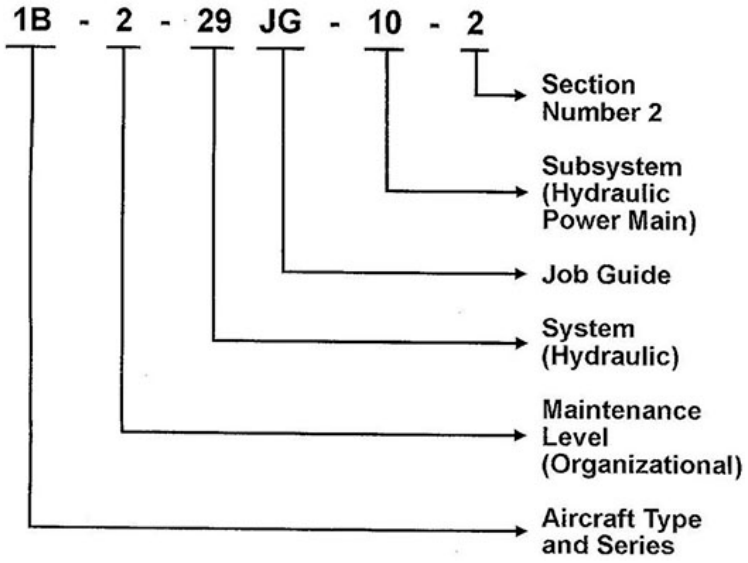


Figure 1–5. MIDAS technical order number.

Numbering

The MIDAS TO number is a six-digit numbering system expressed by three elements of two digits each. Look again at figure 1–5 to see what each element stands for. Consider this example: 28–40–00. The first two digits represent the major system, in this case the fuel system. The third digit (4) indicates the fuel indicating system, which is a subsystem of the fuel system. The fourth digit (0) indicates a sub-subsystem. The last two digits (00) represent the function number that is tied to the job guide (JG) manuals and are used for operational checks or repair of aircraft systems. The MIDAS number appears on the lower outer corner of every page of pertinent manuals. This provides a ready reference index number from one manual to another. For instance, using MIDAS number 28–40–00, you would refer to job guide 1F–16A–2–28JG–40–1 to work on the fuel indicating subsystem within the fuel system.

TMs are numbered in increments of 10 to show modifications to the equipment. For example, –3 overhaul instructions include –13, –23, –33, and up through –493.

General vehicle manuals

General vehicle (GV) manuals have the letters GV in the TO number; for instance, 1F–16A-00GV–00–1. This tells you it is a general vehicle manual for the F–16 aircraft and describes the overall aircraft. This technical order provides a brief description of the systems and subsystems installed in the F–16A and F–16B aircraft. This manual also provides an overview of the complete TO system for the F–16, which is called the Organizational Maintenance Manual Set (OMMS). Also explained are the TO numbering system and MIDAS. The GV manual is the first place you look for a brief description of the F–16 systems and to learn about the TO and MIDAS numbering systems. By understanding these systems, you will have all the information a maintainer would need to inspect, troubleshoot, operationally check, and repair aircraft. Now take a look at a couple of the different sections of the GV that, as aircraft maintainers, you may need to use.

Introduction

The introduction contains the purpose, scope, arrangement, and use of the GV manual, as well as abbreviations, terms, special tools, and a list of consumable items. It also has the definitions of warnings, cautions, and notes that may be found within the text. You must pay strict attention to these definitions and understand them completely; they are used throughout all maintenance TOs. When they appear, read them before you operate any equipment or aircraft system.

Organizational maintenance manual set

The first part, section I of the GV, gives an in-depth breakdown of each maintenance manual and a master listing of all maintenance TOs so you will know which manual is needed to do each task you are assigned. To be able to select the proper TO for a specific system, you must know the TO numbering system. The OMMS contains the information you will need on the MIDAS numbering system.

Section VI

In section VI, you can learn how to locate specific points on the aircraft. If you think of an aircraft with a grid system superimposed on it, you are close to understanding the three elements composing this system. They are the fuselage station (FS) that measures length; the buttock line (BL) that measures width; and the waterline (WL) that measures height. Using this system, you can readily find the location of components. This section also contains the aircraft zoning information.

Section X

Section X contains the references for aircraft safe-for-maintenance and hazardous areas with reference TO figure numbers.

General system manuals

General system (GS) manuals contain descriptions and theory of operations for different systems. They carry the MIDAS code on the lower outside corner of each page. Section I gives you the overall

picture of the F–16 structure, including the component location figures. Sections II and III go into detail with each subsystem, including operational theory of the subsystem and the components in each system. NDI GS manuals will contain all the inspections for the aircraft organized by subsystem.

Job guides

Job guides (JG) are TOs designed to lead you through a specific maintenance task. These TOs contain such information as general maintenance procedures, operational checkout procedures, and a step-by-step component removal and installation procedure. At the beginning of each task listed in the JG, you can find a complete listing of input conditions that tell you how many people are required, references to the applicable TOs, and what equipment you need. Make sure you read and understand these conditions before you start any job. By failing to read the input conditions, you could cause yourself or others a lot of unnecessary work or lost time. Because of the scope of JGs, numerous books are required to cover all the aircraft systems. For this reason, a JG index is provided for you. The index lists 115 JGs by system and subsystem; it also contains a cross-reference from the job name to the MIDAS code and from the MIDAS code to the JG that applies. So, as you can see, if you're not sure which job guide to use, the index is the place to start.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

001. Purpose and types of technical orders

1. What is a TO?

2. What technical order directs how all TOs are established, numbered, and issued?

3. What is the purpose of the TO system?

4. What one word best describes TO compliance?

5. How many basic types of TOs are there? List them.

6. What type of technical order is the 33B–1–1?

7. What are the three authorized categories of TCTOs?

8. How is an urgent action TCTO identified?

9. What type of TO is used to provide operating instructions, technical information for installing, servicing and repairing the equipment item and a parts list to assist in ordering replacement parts?

002. Location of the correct technical order

1. What is ETIMS?

2. What does the first two digits of a TO number designate?

3. What does the initial letter of an aircraft TO number designate?

4. What is the purpose of the dash number on a technical manual?

5. What is the last set of digits of an F–15 NDI procedures TO?

6. How would you find the TO number for a new x-ray unit, part number ZD400?

003. Maintenance Integrated Data Access System technical orders

1. Describe each part of the MIDAS code.

2. Where do you look first for a brief description of the F–16 systems?

3. In what section of the GV manual will you find the definition of a warning, caution or note?

4. What TO do you use for general maintenance procedures, operational checkout procedures, and a step-by-step component removal and installation procedure?

1–2. Using Technical Orders

By now, you should understand the purpose and scope of technical orders. In this section, you'll practice using some of the TOs that are most important to you in getting your job done. In essence, you will see how to locate technical information.

004. Locating technical information

As you would expect, technical information is found in technical manuals. The TMs for shop equipment usually fall into one of these three common dash numbered groups:

1. Operation and service manuals (–1).
2. Overhaul manuals (–3).
3. Illustrated parts breakdown (–4).

Remember, the dash 1 (–1) means the last digit of the TO number would be 1 (i.e., –1, –11, –21, or –31). As long as the last digit is a 1, the TO is normally an operation and service manual. This numbering system also applies to the other two shop equipment manuals; for example, –3, –13, –23, and so forth, are overhaul manuals. These manuals may be published separately, or combined into one or two complete TOs. Sometimes you won't need all three. It depends on the complexity of the equipment. Let's see what type of information is contained in each manual.

Operation and service manual

The operation and service manual contains information that may not be obvious from reading the title. For example, the manual may include an item's description, purpose, operating principles, preparation for use, storage or shipment, inspection instructions, and calibration requirements. By reading the table of contents, you can get an idea of the types of information contained in a particular manual.

Overhaul manual

The overhaul manual gives step-by-step procedures for disassembling a complete unit, inspecting and reworking each component, and reassembling the unit. Normally, you do not do major maintenance on your equipment, nor do you overhaul equipment. Therefore, you may never need this manual. In some cases, you may find overhaul manuals for some equipment in your TO file; however, they are there as a reference source of information only.

Illustrated parts breakdown

The IPB manual is an official catalog of replacement parts covered by the manual. It is the main source of information you will need to order replacements for worn out, broken, or missing components on your shop equipment. It can be produced as a separate TO or as part of an operation and service manual or overhaul manual.

Essentially, the IPB consists of these three sections:

1. Section I, Introduction.
2. Section II, Group Assembly Parts List.
3. Section III, Numerical Index.

Introduction

The introduction section explains how to use the TO. It can also contain such information as an explanation of source codes, repair codes, vendor's codes, and usable-on codes. The introduction is also where you would look to find the meaning of source codes. The introduction lists manufacturer codes in sequence, cross-referenced to the manufacturer's name and address.

Group assembly parts list

Refer to figure 1–6 as we discuss the group assembly parts list. As you can see, the figure shows an exploded view of the equipment. Also, refer to figure 1–7, which gives information on specific parts.

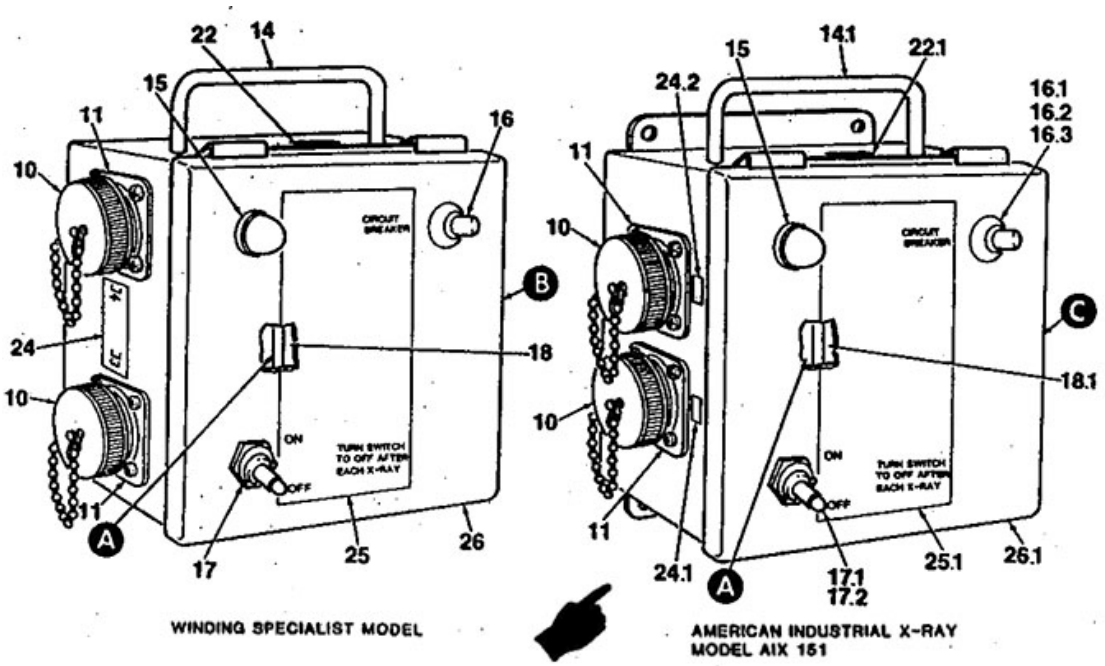


Figure 1–6. Illustrated parts breakdown.

As an example of using the IPB, let's say you're setting up for an x-ray. As you perform this task, you notice the lens cover for the indicator lamp on your *winding specialists* interlock is broken. You know you need to order a new one, but how. This is where the IPB works for you. Figures 1–6 and 1–7 are excerpts from TO 33B3–3–15–1, which covers this particular part on the interlock. Notice in figure 1–6 the IPB index number 15 points to the lamp assembly.

Now you need to look up the information for index 15 in the group assembly parts list on figure 1–7. This list contains five columns of information, figure & index reference: part number, description, units per assembly, and usable on codes. *Look at all five columns* to be sure you are gathering the correct information for the exact part you need.

Go down the **Fig & Index No.** column of the data section to the index number for your part (15). You can see index 15 includes information for all the sub-parts of the lamp assembly and four different part numbers. The last number in the **Part Number** column, 50F6205, matches up with the description – LENS, LAMP (0AAR4). This *could* be the part you need, but as we said before, you need to check ALL the columns to be sure.

The **Description** column will always contain the name of the item and may have the complete description of the item such as index 20, part number COML, Screw, 10–32×1/2 (AP), and so on.

NOTE: COML is used in IPBs to indicate a commonly procurable item like a screw, washer, nut, and so forth.

Many descriptions include the code number that identifies the name and address of the company that made the part. In the case of our lens cover 0AAR4, the manufacturer's information for this code will be contained elsewhere in the IPB.

FIG. AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
5	COML	. NUT, NYLOCK, 4-40 STAINLESS STEEL (AP)	16	B
14	971-0173	. HANDLE (01364) (INCLUDES ATTACHMENT SCREWS)	1	A
14.1	90F733	. HANDLE (0AAR4) (INCLUDES ATTACHMENT SCREWS)	1	B
	7330M	. WASHER, LOCK (72653) (AP)	2	A
	6515M	. WASHER, FIBER (72653) (AP)	2	A
15	NE51H	. LAMP, NEON (71744)	1	
	5201-233-303W PRED	. HOLDER, LAMP (33052)	1	A
	50F6198	. HOLDER, LAMP (0AAR4)	1	B
	50F6205	. LENS, LAMP (0AAR4)	1	B
16	SW1AN1211-1	. BOOT, CIRCUIT BREAKER (27193)	1	A
16.1	RVS3B27-16N/ N.1.480.16	. BOOT, CIRCUIT BREAKER (06402)	1	B
16.2	0071-PRESS TO RESET-PLT	. PLATE, CIRCUIT BREAKER (06402)	1	B
	MS25244-10	. CIRCUIT BREAKER (CB1)	1	A
16.3	140GILL-L2F1-SO1	. CIRCUIT BREAKER (CB1) (06402)	1	B
17	SW1AN1111-4	. BOOT, SWITCH (27193)	1	A
17.1	30F000	. BOOT, SWITCH (0AAR4)	1	B
	8390	. SWITCH, SPST (73559) (S1)	1	A
17.2	2GK50-73	. SWITCH, DPST (73559) (S1)	1	B
18	WS1213-100-1	. RETAINER, RELAY (30150)	AR	A
18.1	X600114	. RETAINER, FOAM (0UTE5)	1	B
19	WS1213-204	. HARNESS, WIRING (30150)	1	A
	WS1213-200	. BRACKET ASSY, RELAY (30150)	1	A
	X600115	. BRACKET ASSY, RELAY (0UTE5)	1	B
	COML	. SCREW, 10-32x1/2 (AP) (INCLUDED AS AS PART OF BOX)	4	A
	7330M	. WASHER, LOCK (72653) (AP	4	A
20	HP3SRR	. . BASE, RELAY (82050)	3	
	MS20426-5	. . RIVET (AP)	6	A
	COML	. . SCREW, MACHINE, 6-32 x 3/8 LG, ROUND HEAD, PHILLIPS, STAINLESS STEEL (AP)	6	B
	COML	. . NUT, NYLOCK, 6-32 STAINLESS STEEL (AP)	6	B
21	WS1213-201	. . BRACKET, RELAY (30150)	2	A
21.1	X600116	. . BRACKET, Z (0UTE5)	2	B
22	WS1213-205-4	. PLATE, IDENTIFICATION (30150)	1	A
22.1	X600120	. PLATE, IDENTIFICATION (0UTE5)	1	B

Figure 1–7. Group assembly parts list.

The **Units Per Assy** column lists the number of identical parts used on the major assembly. An AR in this column signifies “as required.” Another entry seen in this column is REF. This means the item is entered here only for reference and shouldn’t be ordered.

The **Usable On Code** column tells you which part number is correct for your equipment when the TO covers more than one piece of equipment (as TO 33B3–3–15–1 does). To interpret these codes, refer to the introduction section of the TO or, as in this case, the very beginning of the group assembly parts list.

Figure 1–8 shows you the first two entries of the listing. It tells you the first interlock with the manufacturer code 30150 (Winding Specialists Co. Inc. from elsewhere in the TO) is given the code “A.” The second interlock, which is the American Industrial unit, is given the code “B.” This tells you which interlock a part will fit on for each code in the **Usable On Code** column throughout the group assembly parts list.

FIG. AND INDEX NO.	PART NUMBER	DESCRIPTION 1 2 3 4 5 6 7	UNITS PER ASSY	USABLE ON CODE
5-1				
	WS1213	INTERLOCK ASSY (30150)	REF	A
	WS1213	INTERLOCK ASSY (OUTES PART NO. X600100)	REF	B
	WS1213-300	CABLE ASSY, MAGNAFLUX UNIT (CA1) (30150)	1	A

Figure 1–8. Usable on codes.

Now, let's go back and look at figure 1–7. Under index number 15, the LENS, LAMP we noted earlier has a "B" in the **Usable On Code** column. This is not your model of interlock. The only index number 15 with an "A" code is part number 5201–233–303W, HOLDER, LAMP (33052). This is the only part number available for your interlock for index number 15. The key here is the PRED entry immediately below the part number. This indicates part number 5201–223–303W is a pre-assembled component on the Winding Specialists model which includes both the lamp holder and lens cover. 5201–22–303W is the part number you need to order.

Numerical index

A numerical index lists all of the part numbers in the group assembly parts list in alphabetic-numeric order. These numbers are cross- referenced to the figure and index number that describe the part. Use this section to find the figure and index number of a part for which you have only the part number.

005. Using nondestructive inspection procedures technical orders

There are four other TMs you will use more often than the ones we already discussed:

1. TO 33B–1–1 *Nondestructive Inspection Methods, Basic Theory.*
2. TO 33B–1–2 *Nondestructive Inspection General procedures and process controls.*
3. The –6 aircraft TOs, *Aircraft Inspection Requirements.*
4. The –36 aircraft TOs, *Nondestructive Inspection.*

In all of these manuals, the first place to look for information is the table of contents. The table of contents normally tells you where to find instructions on how to use the rest of the TO. Do not take this seemingly obvious statement too lightly. You have probably seen someone more experienced than yourself leafing back and forth through the TO looking for something. Usually this is a waste of time.

Technical Order 33B–1–1

TO 33B–1–1 is used so often and so widely in the NDI career field that it is sometimes referred to as the NDI bible. It contains non-aircraft specific information of NDI methods and is broken down into these seven chapters:

1. NDI Methods, General Information.
2. Liquid Penetrate Inspection.
3. Magnetic Particle Inspection.
4. Eddy Current Inspection.
5. Ultrasonic Testing.
6. Radiographic Inspection.
7. Laser Sherography.

Chapter 1 of TO 33B–1–1 contains a wide range of general information. In it, you will find the following information:

- The minimum training requirements for personnel.
- Technique recording and reporting using an AFTO Form 24, Nondestructive Inspection Data.
- Reason for process control requirements.
- A typical NDI laboratory layout.

Of these subjects, you must become especially familiar with the AFTO Form 242. Every part you inspect requires a specific NDI technique. Anytime you develop or improve a technique, you must document it on the AFTO Form 242. You will also forward this information for inclusion in an applicable TO and maintain the documentation in the work center until the TO is updated.

Chapters 2 through 7 of TO 33B–1–1 give you detailed information on NDI methods. These chapters are your main source of information for developing inspection techniques. Each chapter includes the following information:

- Basic principles and theories.
- General safety precautions.
- Suggested techniques.
- Instructions for interpreting indications.

Technical Order 33B–1–2

This publication contains general procedures and process controls for all five NDI methods of inspection.

General procedures

The general inspection procedures contained in this TO will only be used when specific inspection procedures are not available in other TOs, manuals or approved AFTO 242s. The procedures in this manual can be used as a stand-alone inspection procedure when an aircraft TO specifies that an inspection be performed in accordance with (IAW) TO 33B–1–2, TO 33B–1–1 or a Military Standard (MIL STD). An example would be if hydraulic shop brought you a part they removed from a brake assembly and the overhaul TO instructs them to have a magnetic particle inspection performed IAW 33B–1–1 before putting the brake assembly back together.

NDI procedures contained in this manual are detailed step-by-step instructions with illustrations so a qualified NDI technician can perform the required inspection. In addition, this manual provides some general safety guidance for NDI inspectors. Other safety guidelines may apply and *shall be used as required*.

Process controls

The process control procedures are written so that an apprentice (3-level) technician can perform the checks with limited training and supervision. Each method’s requirements are conveniently located together in one section. Process control is an essential ingredient in achieving consistent and reliable results every time you perform an NDI inspection. A well regimented NDI process control program will give you confidence in the NDI method you are performing and eliminate false and missed calls.

- When NDI determines a part is defective, when in truth it is not, resulting in a *false call*. This is a waste of resources and an unnecessary reduction in mission capability.
- Even more dangerous is determining a part to be serviceable when in fact it is defective resulting in a *missed call*.

–6 aircraft technical orders

This manual contains all inspections and maintenance actions required on a specific aircraft model. This is the source document for all checklists and workcards. The inspections and maintenance

requirements are separated into three sections; scheduled, special and replacement. Each inspection or maintenance action lists how often it is to be accomplished. The following tables are examples of what inspections you may find in an aircraft –6 TO.

Scheduled Inspections	Special Inspections
• Combined preflight/postflight inspection. • End-of-runway inspection. • Thruflight inspection. • Launch and recovery inspection. • Quick turnaround inspection. • Basic postflight inspection. • Wall around before first flight of the day inspection. • Phased inspection requirements. • Engine phased inspection requirements.	• Special inspection after a specific occurrence. • Depot level inspection and maintenance. • Acceptance and functional check flight inspection. • Historical documents. • Aircraft structural integrity program inspections.

The *replacement section* lists parts of the aircraft that need to be removed and replaced at a pre-determined period of time. The period of time most likely will be a certain number of flying hours that part was in use.

–36 aircraft technical orders

These TOs detail specific NDI methods to be used on individual aircraft components. The way you locate information in these TOs may vary, depending on the aircraft they support. Remember that if you start with the table of contents and follow the instructions for using your particular TO, it is hard to go wrong.

There are three common ways to find specific inspection procedures in a –36:

1. Aircraft workcards.
2. Part number index.
3. Alphabetical index.

Aircraft workcards

NDI procedures called for in routine aircraft inspection workcards can appear in a number of different formats. The inspection can reference a part number, component name, figure, or paragraph number in the –36 TO. An example of how it may appear is shown here:

Perform radiographic inspection of emergency escape hatch.

Fus Sta 540 to 566 per TO 1C–130A–36, Figure 3–1.

In this case, simply turn to figure 3–1 in TO 1C–130A–36 and follow the radiographic inspection procedures pertaining to the figure.

When performing an NDI procedure that is not part of a scheduled inspection (i.e., verifying a possible defect) you may only know the name and possibly the part number of the item you will inspect. Most –36 TOs have these two indexes:

1. Part number index.
2. Alphabetical index.

Each will help you locate inspection procedures and the index you use will depend on whether you have the name or part number.

Part number index

If you know the part number, you can use the part number index, as seen in figure 1–9.

Table 1-1. Part Number Index – Continued

PART NUMBER	NOMENCLATURE	PARAGRAPH NUMBER
2006003	MLG Tension Strut Assembly	*(4-3/21) 4-4
2006004	MLG Tension Strut Attachment Pin Assembly	*(4-3/21)
2006017	MLG Retract Actuator Cylinder Assembly	*(4-3/3)
2006020	MLG Retract Actuator Piston	*(4-3/7)
2006025	MLG Retract Actuator Rod End Assembly	*(4-3/8)
2006035	MLG Axle	*(4-3/15) 4-16
2006101	MLG Shock Strut Inner Piston Assembly	*(4-3/10)
2006104	MLG Shock Strut Inner Cylinder	*(4-3/12)
2006106	MLG Shock Strut Outer Piston Assembly	*(4-3/13)
2006107	MLG Shock Strut Outer Cylinder	*(4-3/11) 4-10
2006302	MLG Drag Brace Upper Toggle Assembly	*(4-3/4)
2006303	MLG Drag Brace Center Link Assembly	*(4-3/5)
2006305	MLG Upper Drag Brace Assembly	*(4-3/2)
2006307	MLG Drag Brace Collar Assembly	*(4-3/16)
2006308	MLG Drag Brace Pin Assembly	*(4-3/1)
2006311	MLG Axle Link Assembly	*(4-3/16)
2006315	MLG Rotating Linkage Pivot Pin Assembly	*(4-3/17)
2006322	MLG Lower Drag Brace Assembly	*(4-3/19)
2006323	MLG Drag Brace Collar Assembly	*(4-3/18)
2006324	MLG Axle Link Assembly	*(4-316)
2006405	Linkage Attachment Pivot Pin	*(4-2/2) *(4-2/14) *(4-2/16) *(4-3/9)
2006407	Actuator Attachment Bolt Assembly	*(4-2/4) *(4-2/10)
2006409	MLG Drag Brace Pin	*(4-3/6)
2006601	NLG Shock Strut Housing Assembly	*(4-2/26)
2006602	NLG Shock Strut Steering Piston Assembly	*(4-2/22) 4-3.1
2006618	NLG Shock Strut Steering Collar Assembly	*(4-2/17)
2006625	NLG Shock Strut Trunnion Pin	*(4-2/12)
2006629	NLG Shock Strut Torque Arm Assembly	*(4-2/19)

See footnote at end of table.

Figure 1–9. Part number index.

Alphabetical index

If you know the name of a part, you can locate the applicable inspection procedure using alphabetical indexes in either of the following two ways:

1. Use the alphabetical index to locate the name of the part. This index will give you the figure number or paragraph number of the inspection procedure.
2. Use the master table of contents or major structural group illustration (fig. 1–10) to find the applicable section of the manual. Refer to the table of contents at the beginning of the applicable section to find the specific figure or paragraph number for the part.

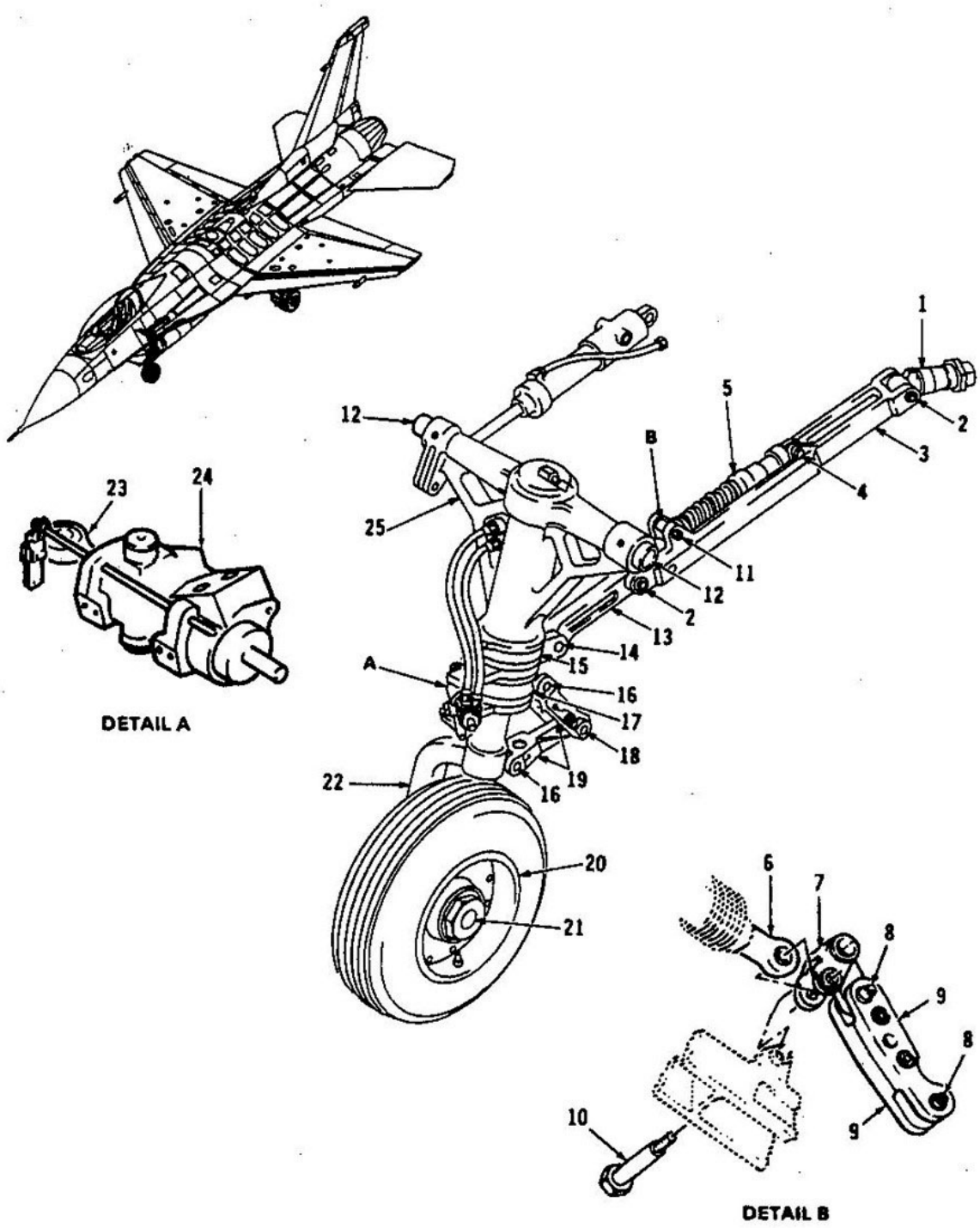


Figure 1–10. Structural group illustration.

Either way, you should find an illustration of the part to be inspected (fig. 1–11) and a detailed NDI technique for the inspection (fig. 1–12).

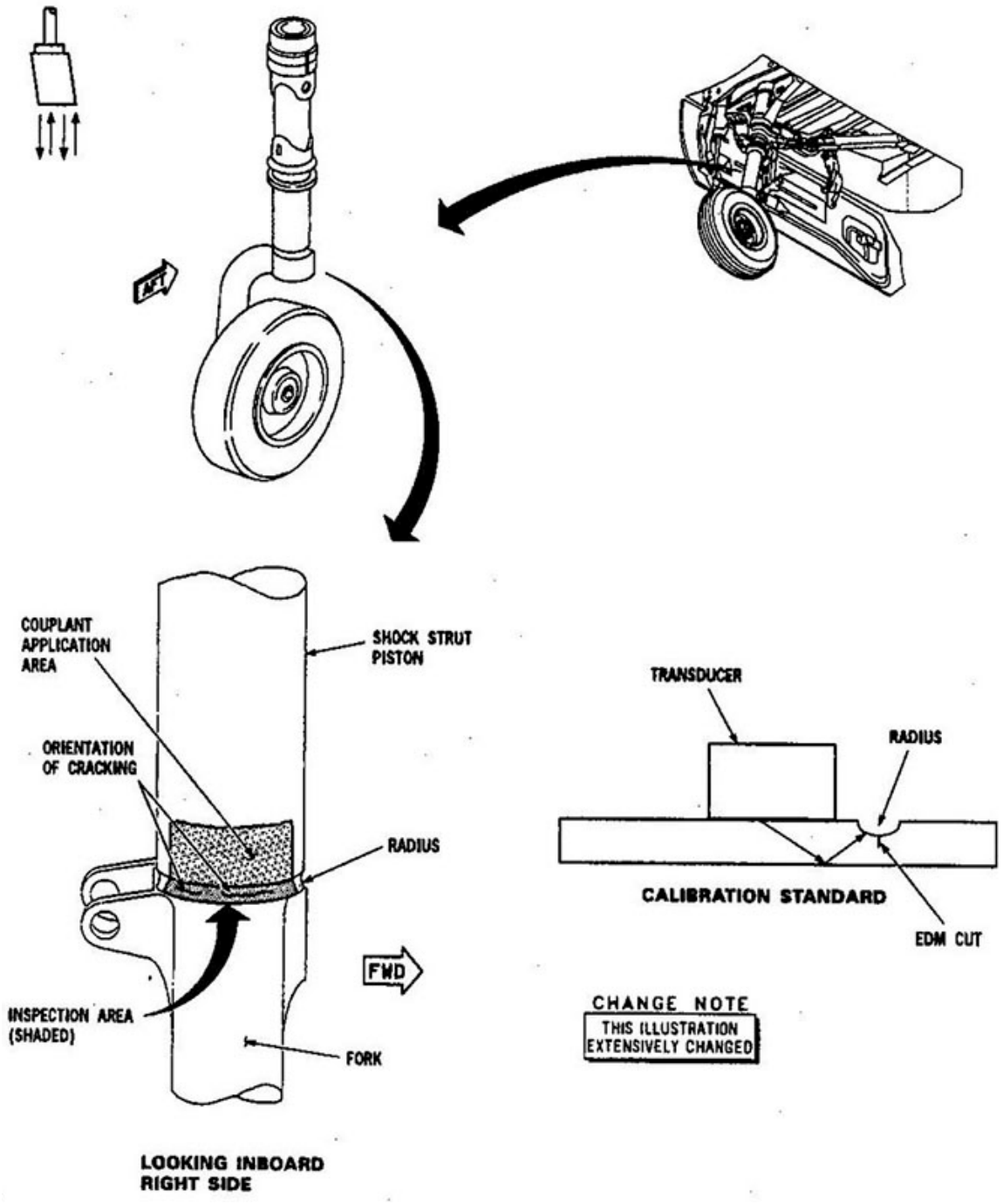


Figure 1–11. Figure from TO 1F–16A–36.

4-3.1. NOSE LANDING GEAR SHOCK STRUT PISTON ASSEMBLY, PART NUMBER 2006602.

4-3.2. PART DESCRIPTION. (See figure 4-2.1, sheet 1.) The nose landing gear shock strut piston assembly (shock strut piston) is manufactured from a 300M CVAR steel forging. Sliding/bearing surfaces are chrome plated, while remainder of shock strut piston is cadmium plated and finished with epoxy primer and a polyurethane coating.

4-3.3. DEFECT OR CONDITION DESCRIPTION. High tensile stress and environmental conditions may cause stress corrosion/cracking of shock strut piston. Inspection area is located in radius below chrome-plated shaft and directly above fork shown in figure 4-2.1, sheets 1 and 3.

4-3.4 PRIMARY NDI PROCEDURE (NLG SHOCK STRUT PISTON ASSEMBLY, SHOWN IN FIGURE 4-2.1 SHEETS 1 AND 2) – ULTRASONIC.

a. NDI Equipment:

(1). Ultrasonic flaw detector, Sonic Mark IV

(2). Inspection kit, F-16 nose piston, part number UK-NLGF16. (Contains: Transducer, part number SU-NLGF16, 5MHz calibration standard, part number RS-NLGF16, and 6 foot BNC to microdot coaxial cable)

(3). Couplant, lightweight oil

(4). Magnifier, 10X

b. Preparation of Aircraft: Prepare aircraft safe for maintenance (JG10-30-01).

c. Access: None required.

d. Preparation of Part:

(1). The area to be inspected is located on the right side of the shock strut piston in the radius below chrome-plated shaft and directly above the fork.

(2). If transducer placement surface is rough or has paint overspray on chrome-plated section, insure it is removed using No. 500-grit sandpaper to obtain a smooth surface.

(3). Insure any foreign material in area to be inspected is removed using clean, lint-free cloth dampened with MIL-C-38736 solvent compound. Wipe dry with clean, lint-free cloth.

WARNING

Insure all safety precautions for using electrical equipment near aircraft fuel cells, oxygen systems, and stores have been met. Failure to observe this warning may result in serious injury to personnel.

e. NDI Equipment Settings/Standardization/ Setup:

(1). Attach BNC connector of coaxial cable to T/R jack on ultrasonic flaw detector.

(2). Attach microdot connector of coaxial cable to transducer, part number SU-NLGF16.

(3). Connect ultrasonic flaw detector to 115-volt, 60 Hz power source and turn POWER on, allowing a 5 minute warmup period.

(4). Place VIDEO/RF in VID position and adjust frequency selection knob to 5 MHz.

(5). Set ultrasonic flaw detector sweep range for 1.5 inches.

(6). Apply couplant to surface of calibration standard part number RS-NLGF16.

(7). Adjust ultrasonic flaw detector sweep control so signal from EDM cut on calibration standard is at 8 on the horizontal axis.

NOTE

During calibration procedure make note of distance from forward edge of transducer in relation to radius of calibration standard. The same approximate distance for transducer and radius on shock strut piston is required when performing inspection procedure of shock strut piston.

(8). Adjust GAIN to obtain 90 percent of full screen height.

(9). Establish defect zone by adjusting gate to alarm between 7 and 9 on the horizontal axis and 30 percent vertical amplitude.

Figure 1–12. Excerpt from TO 1F–16A–36.

–9 aircraft engine technical orders

The –9 TOs serve the same purpose for the aircraft engine as the –36 manuals serve aircraft. Their arrangement and use is similar and they contain the same kind of information. If you need to know the inspection procedures for an aircraft engine part look in a –9 engine TO, such as 2J–J79–9.

006. Improving technical orders

Anytime a person finds a discrepancy in a TO inspection procedure, that person is responsible for submitting a *recommended change* (RC). They would follow instructions in TO 00–5–1 under the Submitting Recommended Changes section. All recommended changes will be submitted using a web-based system. An AFTO Form 22, Technical Manual Change Recommendation and Reply (fig. 1–13), will be filled out and routed as an attachment through the e-mail system if the web-based system is not available at your location. The web-based system is much more efficient because it automatically routes the form to where it needs to go.

TECHNICAL MANUAL (TM) CHANGE RECOMMENDATION AND REPLY

DATE SUBMITTED: 20160408 | DATE RECEIVED: | OMB NO. 0704-0188

Public reporting burden for this collection is estimated to average of 5 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302 and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.

PART I – ROUTING *(Use complete 3-4 line address, including 9 digit zip code and E-Mail address where applicable)*

1. FROM: *(Prod. Improve. Manager or equivalent)*	2. THRU: *(Parent MAJCOM CCP)*	3. THRU: *(Lead Command CCP)*	4. TO: *(Tech Manual Management Office)*
62 MXG PRODUCT IMPROVEMENT HNGR 4, CENTER SECTION MCCHORD FIELD, WA 98438 michael.bing.5@us.af.mil		HQ AMC/A4MP 402 SCOTT DRIVE UNIT 2A2 SCOTT AFB, IL 62225-5308 amc/lg-phoenix-start@scott.af.mil	BOEING COMPANY 5301 BOLSA AVE., M/C H010-C052 HUNTINGTON BEACH, CA 92647 C17-TECHPUBSPCRS@BOEING.COM
(Name/DSN) TSGT MICHAEL BING 382-2949 ■ APPROVED ☐ DISAPPROVED	*(Name/DSN)* ☐ APPROVED ☐ DISAPPROVED	*(Name/DSN)* ☐ APPROVED ☐ DISAPPROVED	

PART II – CONTROL INFORMATION

5. LOCAL CONTROL NUMBER: *(IAW TO 00-5-1)*	6. PRIORITY	7. TYPE OF CHANGE:
21L00062AWS106	☐ EMERGENCY ☐ URGENT ■ ROUTINE	■ CORRECTION ■ IMPROVEMENT

8. INITIATOR: *(Name, Rank, DSN, E-Mail)*	9. INITIATOR'S SUPERVISOR: *(Name, Rank, DSN, E-Mail)*
JERRY STEIN,SRA,982-2946 JERRY.STEIN@US.AF.MIL	MARIE COX, MSgt,3829922, marie.cox.1@US.AF.MIL

PART III – PUBLICATION (TM) INFORMATION

10. PUBLICATION No:	11. BASIC DATE:	12. CHANGE No:	13. CHANGE DATE:
1C-17A-36	20160408	0	N/A
14. WORK PACKAGE / WORK CARD ID:	**15. PAGE No:**	**16. PARAGRAPH No:**	**17. FIGURE / TABLE No:**
N/A	2-11	2-41 step-2	

18. SHORT DESCRIPTION OF DEFICIENCY:
Current probe listed in the 1c-17a-36 for the inspection of the Ram Air Inlet Forward Hinge does not always allow for edge clearance.

PART IV – DEFICIENCY:

19.
SEE PART VII – CONTINUATION BLOCK (DEFICIENCY)

PART V – RECOMMENDED TM CHANGE:

20.
SEE PART VII – CONTINUATION BLOCK (RECOMMENDED TM CHANGE)

21. SAVINGS / YR – DOLLARS:	22. SAVINGS / YR – MAN-HOURS:
0	

PART VI – EVALUATOR / DISPOSITION: | LCN: 21L00062AW4106R

23. DATE OF REPLY:	24. EVALUATOR: *(Name, Rank, DSN, E-Mail)*	25. EVALUATOR'S SUPERVISOR: *(Name, Rank, DSN, E-Mail)*

26. DISPOSITION:	27. DISPOSITION REMARKS:
☐ APPROVED ☐ DEFERRED ☐ ABEYANCE ☐ ADVISEMENT ☐ DUPLICATE ☐ DISAPPROVED ☐ OTHER	28. IDEA REPLY IS A/An: ■ INTANGIBLE ☐ TANGIBLE – AMOUNT:

PART VII – CONTINUATION (BLOCK No.): | LCN: 21L00062AWS106R

[BLOCK 19 PART IV – DEFICIENCY]:

SUBJECT: Ram Air Inlet Forward Hinge probes

DEFICIENCY: Current probe listed in the 1c-17a-36 for the inspection of the Ram Air Inlet Forward Hinge does not always allow for edge clearance.

REASON FOR CHANGE: The 1c-17a-36 Pg 2-11 Para 2-41 step-2 restricts us to only using part number VM202RAF 1/4 x 6, VM Products, Inc. In order to accomplish this inspection to the best of our abilities we need to be able to use equivalent probes of smaller size.

[BLOCK 20 PART V]:
RECOMMENDED TM CHANGE:

2. Probe - PN VM202RAF 1/4 x 6, VM Products, Inc., or equivalent

Figure 1–13. Sample AFTO Form 22.

You learned earlier that new inspection techniques are developed and recorded on an AFTO Form 242 in accordance with TO 33B–1–1. The AFTO Form 22 will also be filled out and sent along with the AFTO Form 242. The reason for this is to get your new inspection technique published in the applicable TO so that everyone benefits from it. (**NOTE:** We will cover use of the AFTO Form 242 in more detail in a later volume when you will be shown how to develop your own inspection techniques.)

Recommendation priorities

RCs are routed through the approval process depending on the priority assigned by the person requesting the change. The requester must select the appropriate *Emergency, Urgent,* or *Routine* priority when creating the RC on the web-based system or in block 6 of AFTO Form 22. The priority selected determines how the recommended change request is routed and creates a suspense time that certain actions must be completed by. Of course, changes concerning safety of personnel or preventing destruction of aircraft would be treated differently than changes dealing with spelling errors.

Emergency

Emergency reports are used to report conditions requiring immediate correction to the TO. They are used when you are concerned with safety or the unit mission. Failure to make the correction *WOULD* result in any of the following:

- Fatal or serious injury to personnel.
- Extensive damage or destruction of equipment or property.
- An inability to achieve or maintain operational postures (MISSION ESSENTIAL).

The activity responsible for the corrective action must approve the request and publish the change or disapprove/downgrade the request within 48 hours.

Urgent

These reports recommend changes to TOs to correct potential hazards, which if not corrected, *COULD* cause one or more of the following:

- Personal injury.
- Equipment or property damage.
- Reduce operational efficiency.
- Prevention of safe mission accomplishment.

The activity responsible for the corrective action must publish and distribute the update within 40 calendar days or disapprove/downgrade the request within 15 calendar days.

Routine

Routine recommendations require action on TO deficiencies that do not fall into emergency or urgent categories. These potential hazards *MAY* result from prolonged use and may have a negative effect on operation or maintenance efficiency. They *MAY* also reduce the life or general service of the equipment. The activity responsible for the corrective action must respond to the requester within 45 calendar days and then publish and distribute a TO update within 365 days.

Types of recommended changes

RCs are classified as either a recommended *correction* or a recommended *improvement*. The person suggesting the change must decide and mark the selection in the “deficiency” block of the web-based screen or in block 7 of the AFTO Form 22.

Correction

The following types of deficiencies will be classified as a correction:

- Merely calling attention to a word omission or typographical or printing error that does not cause misinterpretation.
- Illustration errors that do not detract from the performance of a procedure.
- Updates to correct or add new names/numbers of an Air Force Instruction (AFI), specification or standard, unless the change affects equipment.
- Identifying other nontechnical errors in a TO.
- Recommending minor word changes or corrections to a technical data that clarify or expand existing instructions, but are not essential for the adequate performance of the functions required for mission accomplishment.

Improvement

An “improvement” is an addition or significant change to a process or procedure in a TO which allows an inspection to be performed better, safer, faster, or cheaper.

Review/evaluation process

Let’s discuss in the following paragraphs the review and approval process.

Supervisor

Your supervisor and shop chief will ensure the recommendation is valid and warrants submittal before you submit the request through the web-based system.

Product improvement manager

The product improvement manager (PIM) is the Local Product Improvement Office or other office designated within the maintenance group or wing. *Emergency RCs are sent directly to the technical content manager (TCM) by the PIM.*

Using command control point

Use command control point (CCP) established by your major command (MAJCOM) to review AFTO Forms 22 submitted by subordinate units to eliminate duplicate entries and ensure adherence to command policies and procedures. The command headquarters may delegate the responsibility to someone else within the command by establishing different CCPs by functional area or aircraft affected.

Lead command control point

Lead CCP responsible for the aircraft or equipment affected has the option to omit this step in the coordination process. Lead CCPs check either “Approved” or “Disapproved” in block 3 of AFTO Form 22.

Technical content manager

The TCM is also known as the evaluator and is responsible for the content of a particular TO. The evaluator makes the final determination whether the recommended change is a correction or an improvement and if the submitted data is correct. Disapproved recommendations are returned to the submitting organizations with justification.

Let’s assume you submitted an RC to an ultrasonic inspection in the aircraft –36 TO. You requested an *improvement* to one of the steps in the inspection that would make the inspection go faster and less confusing. You submitted it as a *routine* priority. Thirty days have gone by and your shop chief informs you that your RC has been approved. Can you go out that same day and start performing the inspection using your improved step? No, you *cannot* use the improved procedure until your TO custodian receives and posts the official change or supplement into the TO.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

004. Locating technical information

1. What are the three common dash numbered manuals for shop equipment?

2. Which shop equipment manual contains step-by-step instructions for equipment disassembly?

3. What is the purpose of an IPB TO?

4. The group assembly parts list in an IPB provides what information?

5. Once you find the part in the picture and identify the index number associated with it, which column of the group assembly parts list do you go to find information about your part?

6. If you know a part number, what section of the IPB will tell you the figure and index?

005. Using nondestructive inspection procedures technical orders

1. Where is the *first* place to look for information in an NDI manual?

2. You are tasked to develop an NDI magnetic particle technique for a *new* part. Which TO and chapter will provide detailed information to assist you in this project?

3. Which TO and chapter provide instructions for recording an inspection technique you have just developed?

4. What form would you use to record new NDI techniques?

5. What three ways can you locate a specific inspection procedure for a particular aircraft part?

6. Describe two ways you can find the inspection procedures for a main landing gear shock strut.

Refer to figures 1–11 and 1–12 to answer questions 7, 8, 9, and 10.

7. What NDI method is required by the TO illustrated in figure 1-12?

8. The nose landing gear shock strut piston assembly is made from what type material?

9. What equipment and materials will be required?

10. For what defects are you looking?

006. Improving technical orders

1. Who is responsible for initiating an AFTO Form 22?

2. After you document a new NDI technique on an AFTO Form 242, why do you complete and submit an AFTO Form 22 along with it?

3. What are the three recommendation priorities?

4. What is the time limit for an emergency priority change request to be approved and published or disapproved/downgraded?

5. Which priority of recommended changes must publish and distribute the update within 40 calendar days or disapproved/downgraded within 15 calendar days?

1–3. Maintaining Technical Order Files

To improve maintenance efficiency and safety, TOs are changed and updated almost every day; however, the use of a noncurrent technical order has been the undoing of many a maintenance worker. If you are ever guilty of using an obsolete TO you have the potential of jeopardizing mission effectiveness by delaying task accomplishment, causing unnecessary damage to equipment, and possibly injuring or killing unsuspecting personnel. The Air Force TO system provides clear and concise instructions for the safe and effective operation and maintenance of centrally-acquired and managed Air Force military systems. This includes manuals for paper and electronic data delivery so you will be able to complete your NDI inspections in the field. Each TO is assigned a unique TO number in the Air Force Standard TO Management System for configuration so that users can identify and establish requirements for distribution.

In this section, we discuss the methods used to maintain paper and electronic TOs by understanding how to check to ensure TOs are current, explaining how to use them to perform inspections, and maintain equipment.

007. The operational technical order file

Complete instructions for maintaining TOs are contained in TO 00–5–1. A careful review of this TO reveals there are many types of TO files and just as many levels of responsibility for their maintenance. The TOs used on a daily basis in your shop are referred to as the operational file.

Operational file

Operational files are groups of TOs located in operations and maintenance organizations or remote logistic sites. They contain only the TOs required to accomplish the day-to-day operational and maintenance responsibilities of the activities they serve. They are located for convenient and immediate reference by all using personnel.

Electronic Tools

A digital technical order file is available for distribution and viewing for electronic means; technology is continuously updated through computers and computer programs. Electronic TOs (eTO) are files identified by a media distribution code suffix of "–WA-n" where "-1" indicates ETIMS distribution, and "-2" indicates distribution through other electronic means.

Electronic Tools (eTools) is a fixed and deployable multi-user device including storage cabinets and network switches, qualified to operate with AF network systems. ETools such as desktop/laptop computers, hand held devices, and portable maintenance aids (PMA) are common infrastructure which allows access to the following:

- eTO files.
- Logistics information systems.
- Update TOs.
- Automated change requests (similar to AFTO Form 22).
- Integrate with other maintenance information systems (MIS).

In order to acquire an eTool you must be able to access the ETIMS library.

Enhanced Technical Information Management System Technical Order Catalog

ETIMS (sometimes referred to as the AF TO Catalog) provides information about all active, rescinded, and superseded TOs. The catalog is a list of all TOs available for users' libraries and is updated and changed in real-time. The digital TOs are distributed in HTML (hypertext markup language) or PDF (portable document format) and are updated with the latest TO increment. Every time you need to use an eTO before starting your inspection, it is your responsibility to check and verify that the TO is current or has been updated.

008. Procuring technical orders

Someday, somewhere, you will probably have the opportunity to become a TO monitor. Unless you are assigned to a unit with no computer capability, you will find all TO file maintenance and procurement is accomplished using a military Internet website. Prior to assuming duties as a TO file monitor, you will be required to attend training or complete computer-based training on how to access and perform your duties using the website. In general, TOs are obtained by either of two methods:

1. Initial distribution (ID).
2. One-time requisition.

These two methods are different and each serves a specific purpose.

Initial distribution

When a new TO will be used regularly by assigned personnel, you should order it by ID. By establishing an ID requirement, you are telling the distribution system you will be maintaining and using the TO full time and are placing the publication in your operational file. This will ensure your office is identified to receive any changes, supplements, or revisions to the TO automatically. TODO personnel use ETIMS to order TOs for organization eTO libraries.

Multiple copies

In many NDI laboratories a single TO, such as 33B–1–2, will have an ID requirement of perhaps four copies. By maintaining multiple copies, personnel are able to perform multiple tasks in different locations at the same time. Additionally, multiple TOs are needed at bases that deploy aircraft to locations without TO or ETIMS libraries.

Paper TO listing

You can determine all of these in your shops operational TO file.

- Which TOs are in your operational file.
- Your TOs have the most recent changes.
- You have the ID requirement for each TO.

This listing is printed from the internet website that your TO monitor can access.

One-time requisition

There are several instances where you need to get one or more copies of a TO but do not need to establish an ID requirement. For example, you might requisition a TO for research purposes (one-time use) or need to replace lost or damaged copies in your file. In these cases, you order the TO by *one-time requisition*. This way the distribution system will not continue to send changes, supplements, or revisions in the future.

The requisition process

Now, let’s look at a typical TO request to see where it is routed. Your TO file will probably be a subaccount of an organizational file, such as the master file maintained in quality assurance (QA). You will identify requirements to the individual (monitor) responsible for maintaining the QA file. The monitor will certify your requests, consolidate them with requests from other shops within the maintenance organization, and forward the requests to the base TODO. The personnel in the base TODO will certify these requests and consolidate them with requests from other organizations on base. The requests are transmitted to the Oklahoma City Air Logistics Center (OC-ALC). Upon receipt of requirements from TODOs, the folks at OC-ALC establish the requirements in the TO computer system. These requirements are forwarded to the Air Logistics Center (ALC) responsible for each TO.

Each ALC or printer, upon receipt of requisitions or initial distribution instructions from OC-ALC personnel, ships the TOs to the various base TODOs. Your base TODO then forwards TOs to each organization, including a copy to the QA account. The QA account monitor then forwards your TOs to you.

009. Filing technical orders

The Air Force objective is to ensure TOs are compatible with the system they are used on at all times. The importance of correct and current filing of TOs cannot be overemphasized. Your TOs, with few exceptions, must be filed within a maximum of five workdays from the date you receive them. One exception is that interim TOs must be filed within 24 hours after receipt. Other exceptions are listed in TO 00–5–1.

Electronic technical orders

As technology continues to evolve, many TOs (once maintained by numerous organizations across a base) are now available electronically by accessing Internet websites. Normally, eTOs do not need to have an ID requirement established, be listed as part of your TO account, or be maintained in any way. As personnel require specific information, they look at the TO on the computer and only print individual pages as they need them. This system saves valuable resources including paper, manpower, and time.

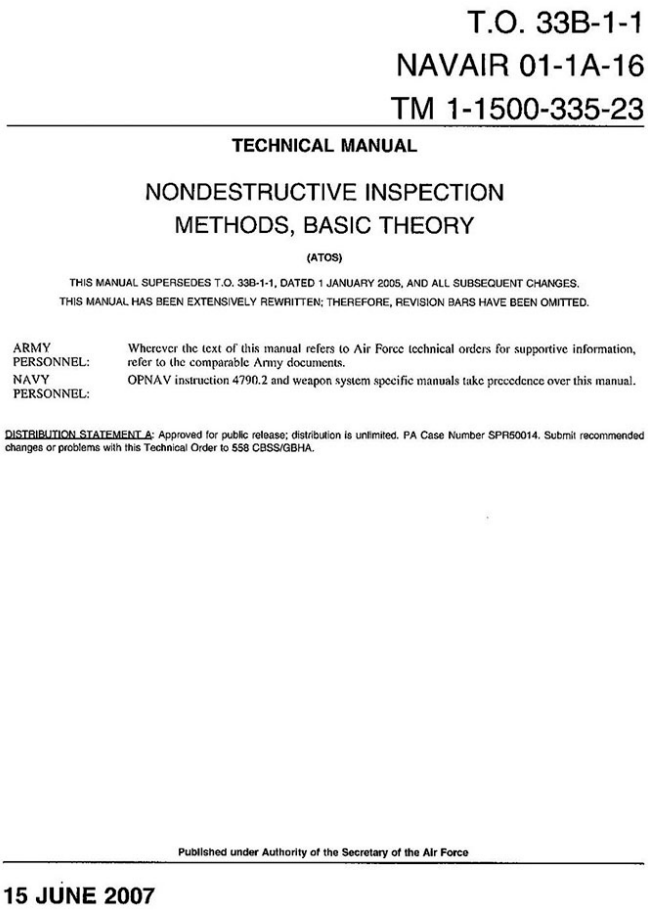
Technical order effective date

Some TOs are published with an effective date on the title page immediately above the authority note. This is normally the case when data in the TO is used in conjunction with a computer program. Procedures or data in the TO are implemented on the date the program or program change is implemented. The new or revised TO will normally be issued well in advance of the effective date so it is available when needed. The effective date will be later than the basic date of the TO which is printed in the bottom right corner of the title page.

Basic technical orders

New TOs received without an effective date are normally placed in the active file immediately, but no later than five working days after receipt when you have an operational paper TO file. There are several items you will need to check before you put the TO into your active file:

- Title page (fig. 1–14).
- List of effective pages (LOEP).
- TO page.



T.O. 33B-1-1
NAVAIR 01-1A-16
TM 1-1500-335-23

TECHNICAL MANUAL

NONDESTRUCTIVE INSPECTION
METHODS, BASIC THEORY

(ATOS)

THIS MANUAL SUPERSEDES T.O. 33B-1-1, DATED 1 JANUARY 2005, AND ALL SUBSEQUENT CHANGES.
THIS MANUAL HAS BEEN EXTENSIVELY REWRITTEN; THEREFORE, REVISION BARS HAVE BEEN OMITTED.

ARMY PERSONNEL: Wherever the text of this manual refers to Air Force technical orders for supportive information, refer to the comparable Army documents.
NAVY PERSONNEL: OPNAV instruction 4790.2 and weapon system specific manuals take precedence over this manual.

DISTRIBUTION STATEMENT A: Approved for public release; distribution is unlimited. PA Case Number SPR50014. Submit recommended changes or problems with this Technical Order to 558 CBSS/GBHA.

Published under Authority of the Secretary of the Air Force

15 JUNE 2007

Figure 1–14. Sample TO title page.

Title page

All TOs and TO changes come with a new title page. This page gives you the following information:

- TO number and name.
- Date of the revision or change.
- Change number.

In some cases a *supersede notice* will tell you whether any older supplements to the TO have been incorporated in the change and are no longer needed. All information is printed so personnel can rapidly determine if the TO is correct and current.

List of effective pages

The first page after the title page is the LOEP. This is often referred to as the "A" page because it is the first page after the title page and is designated page A. The A page is a type of index for the TO and contains a complete list of every page in the publication. In addition, the current change number that affects each page or group of pages is listed. Unchanged pages are listed with a zero under the change number column. The words *Deleted*, *Added*, or *Blank* will appear between the page number and the change number that caused the deletion, addition, or blank page. The LOEP is used to ensure accountability of every page in the TO during required periodic inventories.

TO pages

Every page in a TO is numbered in sequential order by chapter and page number. The first page in the first chapter is numbered 1–1; the second page is 1–2, and so on. Therefore, page 54 in chapter four is numbered 4–54. Additionally, on each page of the TO (next to the page number) the current change that affects the page is listed. An original page won't show any change number.

NOTE: Be aware the TO system is continuously undergoing change and this rule may not apply to every TO, particularly those undergoing new complete revisions or changes to digital media.

Updating and filing paper technical orders

TOs are updated by the following methods:

- Changes.
- Supplements.
- Revisions.

Changes

As with basic TOs, updates also must be posted within five working days of the date received. You'll receive a change to a basic TO when pages of the TO need to be changed, added, or deleted.

Before filing a change, check the basic date on the new change title page with the basic date on the title page it replaces. They should be the same. The basic date of this title page is 15 June 2007. Make sure the basic date of your change is dated the same.

Next, check each page in the change package against the new list of effective pages sent with it. Look at the bottom left-hand corner of the LOEP page. The page number is "A" and there should be a change number listed alongside. Now look up in the list of effective pages. The second entry under *Page No.* is "A." Follow the dots to the right. Under *Change No.* opposite page "A" should be the same change number that is at the bottom of the page A. You just compared page "A" to the list of effective pages and determined page "A" is current. Now continue down the list and ensure you have received all the pages that the new LOEP says have changed.

To file the change, remove each page that has changed and replace it with the new page. Destroy the replaced pages unless you have some special instructions for disposing of them. A change may also replace supplements to the previous change. This will be annotated on the title page of the latest change. If any supplements have been superseded, remove them after posting the change.

Supplements

A supplement is issued with a separate TO number to add or change data in a TO. Supplements are issued when the use of page changes is not suitable or practical. When you receive a TO supplement, you should read the first page and verify whether it affects the TO and change number you have on hand. Next, you need to make a notation on the title page indicating the TO has been supplemented. For example, write “SEE S–1” on the title page to show there is a supplement 1 to the basic technical order. Finally, check whether this supplement supersedes any previously received supplements. Whenever a supplement is replaced or superseded, remove it from the file and draw a line through or erase the corresponding notation on the title page. Once this is done, you can remove any superseded supplements and file the new one.

There are two main types of TO supplements:

1. Safety supplements (SS).
2. Operational supplements (OS).

Both types are filed in reverse numerical sequence in front of the basic TO title page. If one block of numbers is used to identify all TO supplements, they are filed together; that is, title page, OS–1, OS–2, SS–3, and OS–4 on the top. If separate blocks of numbers are used, SSs are filed in front of OSs; that is, title page, OS–1, OS–2, OS–3, SS–1, and SS–2 on top.

Technical order page supplement

Technical order page supplements (TOPS) are used to supplement individual pages in a TO. They *do not* replace the pages. File the TOPS title page in front of the existing TO title page and before any TO supplements. *Do not* remove the existing TO title page and LOEP. Retain only the latest TOPS title page and LOEP. File the individual TOPS data pages opposite (facing) the affected TO page. The affected page is not removed.

Revision

A revision is a complete, new edition of a TO and replaces the one you have on file. Before filing a revision, check the replacement note, TO number, and title page of the revision against the TO being replaced. If no discrepancy exists, remove the old TO from the file and replace it with the new one. If you find a discrepancy, try to determine the reason for it. If the reason can’t be determined, notify the appropriate TO distribution control agency. Complete the filing, if possible, and annotate the discrepancies on the LOEP.

Updating electronic technical orders

All eTools will be connected to the local area network (LAN) or ETIMS Master eTool to receive automatic updates. Organizations using digital TO files through ETIMS will be updated as long they are connected to the LAN no more than seven calendar days. ETIMS catalog is updated immediately by a TO manager so you can receive updates as they become available. If connectivity problems prevent ETIMS updates within seven calendar days, you may be able to update them manually.

While deployed less than 60 calendar days, updates are completed within five working days of return to home station. For deployments exceeding 60 calendar days, eTool updates will be forwarded and posted at least every 60 calendar days until they are returned to home station. It is important to check to ensure that the eTool you are using is updated *before* completing an inspection.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

007. The operational technical order file

1. Which TO contains the complete instructions for TOs?

2. What is contained in operational files?

3. What is an eTool?

4. What provides information about all active, rescinded, and superseded TOs and is sometimes referred to as the AF TO Catalog?

008. Procuring technical orders

1. What does the shop TO monitor use to maintain and order TOs?

2. When should your shop TO monitor establish an ID requirement for a new TO instead of a one-time requisition?

3. Why would you have an ID requirement for more than one copy of a TO?

4. How should you order a TO if you need it for short-term research only?

5. Place the following requisition steps into proper order:
   ____ (1) OC-ALC establishes a TO requirement in the computer.
   ____ (2) QA account monitor forwards TOs to you.
   ____ (3) QA consolidates all maintenance requests and forwards them to the base TODO.
   ____ (4) TOs are shipped to base TODO.
   ____ (5) The base TODO sends all TO requests from the base to OC-ALC.
   ____ (6) You send a request for TOs to the QA account monitor.
   ____ (7) TODO sends TOs to each account on base.

009. Filing technical orders

1. You receive a TO on 3 February with a basic date of 1 January. When should you place the TO in the file?

2. What's the purpose of a supersede notice on a TO title page?

3. What's an "A" page?

4. Name the three ways TOs are updated?

5. How are TO supplements filed?

6. What's a TO revision?

7. Organizations using digital TO files through ETIMS will be updated automatically no more than how many days?

Answers to Self-Test Questions

001

1. An official Air Force publication that provides technical information, instructions, and safety procedures pertaining to the inspection, operation, maintenance, and modification of Air Force equipment and material.
2. TO 00–5–1.
3. To provide concise but clear instructions for safe and effective operation and maintenance of Air Force military systems.
4. Mandatory.
5. Nine; (1) O&M, (2) General methods and procedures, (3) Index, (4) Abbreviated, (5) Brief manuals, (6) TCTO (7) Supplemental manuals, (8) Joint-use and (9) COTS manuals.
6. General methods and procedures.
7. Immediate action, urgent action, and routine action.
8. The words *URGENT ACTION* printed in red at the top and there's a border consisting of alternating red diagonals and red Xs.
9. A COTS manual.

002

1. An electronic system that is used to acquire, improve, publish, catalog, manage, store, distribute and display official TOs needed for a safe and effective operation of the Air Force weapon systems and equipment.
2. The major category under which the TO is grouped.
3. The type of aircraft.

4. Indicates the primary function of the manual.
5. –36.
6. Enter part number into search box.

003

1. The first two digits indicate the major system, the second two digits indicate subsystem and sub-subsystem, and the last two digits indicate the function number tied to the job guides.
2. GV manual.
3. The introduction.
4. JGs.

004

1. Operation and service manuals, overhaul manuals, and IPBs.
2. Overhaul manual.
3. It is the official catalog of replacement parts for equipment covered by the manual.
4. Part number, description, units per assembly and usable on code.
5. Figure & index number column.
6. The Numerical Index.

005

1. The table of contents.
2. TO 33B–1–1; Chapter 3, Magnetic Particle Inspection.
3. TO 33B–1–1, Chapter 1.
4. AFTO Form 242.
5. Workcards, part number indexes, and alphabetical indexes.
6. (1) Use the alphabetical index to find the figure and paragraph, or (2) use the master table of contents or major structural group illustration to find the applicable section and the section table of contents to find the figure and paragraph number.
7. Ultrasonic.
8. 300M CVAR steel forging.
9. Ultrasonic flaw detector, inspection kit number UK–NLGF16, couplant, and a 10X magnifier.
10. Stress corrosion/cracking.

006

1. The person who finds the discrepancy.
2. To get the new inspection technique published in the applicable TO for the benefit of everyone.
3. (1) Emergency, (2) urgent, and (3) routine.
4. 48 hours.
5. Urgent report.

007

1. TO 00–5–1.
2. Only the TOs required to accomplish the day-to-day operational and maintenance responsibilities of the activities they serve.
3. Is a fixed and deployable multi-user device including storage cabinets and network switches, qualified to operate with AF network systems.
4. ETIMS.

008

1. Military internet website.
2. When a TO will be used regularly by assigned personnel.
3. To allow personnel to perform multiple tasks in different locations at the same time.

4. Make a one-time requisition.
5. The proper order is 4, 7, 2, 5, 3, 1, and 6.

009

1. No later than five duty days after 3 February.
2. It tells whether any previous TO supplements have been incorporated into the change and are no longer needed.
3. An LOEP is often referred to as the A page because it is the first page after the title page and is designated page A. It also contains a complete list of every TO page.
4. Changes, supplements, and revisions.
5. In reverse numerical sequence in front of the basic TO title page.
6. A complete new edition of a technical order.
7. 7 calendar days.

Complete the unit review exercises before going to the next unit.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field Scoring Answer Sheet.

Do not return your answer sheet to Air Force Career Development Academy (AFCDA).

1. (001) Technical orders (TO) provide all of the following pertaining to the inspection operation, maintenance, and modification of Air Force (AF) equipment and material except
   a. instructions.
   b. policy directives.
   c. safety procedures.
   d. technical information.

2. (001) Simply stated, a technical order (TO) is considered to be
   a. a series of reference volumes.
   b. a listing of technical terms.
   c. guidance to follow.
   d. a military order.

3. (001) Technical orders (TO) are established, numbered, and issued in accordance with which TO?
   a. 0–1–01.
   b. 0–1–02.
   c. 00–5–1.
   d. 00–5–2.

4. (001) Which type of technical order (TO) covers installation, operation, troubleshooting, repairing, removing, calibration, and servicing or handling of Air Force military systems?
   a. Operations and maintenance TOs.
   b. Supplemental TOs.
   c. Abbreviated TOs.
   d. COTS manuals.

5. (002) Enhanced Technical Information Management System (ETIMS) provides a direct on-line connectivity from every base into the management system to allow all except
   a. on-line distribution to your base.
   b. most current publication date.
   c. submission of improvements.
   d. technical order account status.

6. (002) To find the most current publication date of a technical order (TO), check
   a. TO 00–5–18.
   b. the TO index.
   c. the TO title page.
   d. TO 0–4–6–2–CD–1.

7. (003) The Maintenance Integrated Data Access System (MIDAS) is
   a. a two-digit numbering system expressed as one element of two digits.
   b. a four-digit numbering system expressed as two elements of two digits each.
   c. a six-digit numbering system expressed as three elements of two digits each.
   d. an eight-digit numbering system expressed as four elements of two digits each.

8. (003) What information does the nondestructive inspection (NDI) general system (GS) manual provide?
   a. Inspections.
   b. Fault isolation.
   c. General vehicle.
   d. Schematic diagram.

9. (004) What type of equipment manual would contain equipment calibration requirements?
   a. Overhaul manual.
   b. Supplemental manual.
   c. Operation and service manual.
   d. IPB manual.

10. (004) A group assembly parts list has several part numbers listed for a part you need. To determine which part number is right for your aircraft, refer to the
    a. manufacturer's code.
    b. description section.
    c. item description.
    d. Usable on Code column.

11. (005) Where would you find information for recording and reporting a nondestructive inspection (NDI) technique to inspect an F–16C aircraft speed brake?
    a. TO 00–5–1.
    b. TO 33B–1–1.
    c. TO 1F–16C–36.
    d. TO 00–35D–54.

12. (005) You are tasked to do an inspection; however you only know the name of the part you are to inspect. To locate the applicable paragraph and figure number for the inspection, check the technical order's (TO)
    a. list of figures.
    b. numerical index.
    c. alphabetical index.
    d. group assembly parts list.

13. (006) While doing a job you find a mistake in a technical order (TO). Correcting this requires initiation of a Technical Manual Change Recommendation and Reply form. Who is responsible for this action?
    a. You.
    b. TO monitor.
    c. Your supervisor.
    d. Quality assurance.

14. (006) Which change recommendation priority must be answered within 40 calendar days?
    a. Urgent.
    b. Routine.
    c. Immediate.
    d. Emergency.

15. (006) Which type change recommendation priority is used to recommend improvements to correct potential hazards?
    a. Delayed.
    b. Routine.
    c. Immediate.
    d. Emergency.

16. (007) Which technical order (TO) contains complete instructions for maintaining TOs?
    a. 0–1–01.
    b. 0–1–02.
    c. 00–5–1.
    d. 00–5–2.

17. (007) Electronic technical orders (TO) are files identified by a media distribution code suffix of
    a. –WA-n.
    b. –WN-a.
    c. –1.
    d. –2.

18. (008) You need to order a new technical order (TO) for personnel use on a regular basis; how would you accomplish this action?
    a. Use an AFTO Form 22.
    b. Use your AFEMS software.
    c. Make a one-time requisition.
    d. Establish an ID requirement.

19. (008) The technical order (TO) listing for your shop's operational TO file will show you all of the following except
    a. who currently has one signed out.
    b. which TOs are in the operational file.
    c. if your TO has the most recent change.
    d. ID requirement for each TO on operation file.

20. (008) Responsibility for consolidating technical order (TO) requests on an installation rests with the
    a. NDI shop chief.
    b. personnel in QA.
    c. personnel in the ALC.
    d. personnel in the TODO.

21. (009) With few exceptions, you must file technical orders (TO) within a maximum of
    a. 24 hours of receipt.
    b. five workdays of receipt.
    c. seven workdays of receipt.
    d. seven calendar days of receipt.

22. (009) A technical order (TO) effective date is
    a. later than the basic date.
    b. earlier than the basic date.
    c. the same as the basic date.
    d. the same as the distribution date.

23. (009) In which technical order (TO) chapter would you find page 4–2?
    a. 1.
    b. 2.
    c. 3.
    d. 4.

24. (009) File technical order (TO) supplements in
    a. reverse numerical order in front of the basic TO.
    b. reverse numerical order behind the basic TO.
    c. numerical order in front of the basic TO.
    d. numerical order behind the basic TO.

25. (009) Enhanced Technical Information Management System (ETIMS) will be updated automatically in no more than how many days?
    a. 7 calendar days.
    b. 5 calendar days.
    c. 7 work days.
    d. 5 work days.

Please read the unit menu for unit 2 and continue ➔

Unit 2. Supply System

EACH YEAR THE AIR FORCE buys many millions of pieces of equipment, parts, and supplies, all at a cost of literally billions of dollars. You will do your part in using this material as you perform your job. For example, when you perform nondestructive inspections, you will need special tools, equipment, forms, replacement parts, and other materials. To perform your job successfully, it is very important that you know how to use the Air Force supply system to obtain and protect the supplies you need. Without the supply system, your laboratory could not operate.

You will find that management of Air Force materiel is a major operation and will become a greater part of your job as your responsibilities increase. In this unit we examine how the supply system fulfills your needs. We also look at your role as a supply customer. This unit includes information on the Federal Supply Classification System, how to justify equipment, and the forms used to get the supplies you need.

2–1. Supply Management and Documentation

As you know, the Air Force is involved in worldwide operations. This far-flung mission requires a constant flow of supplies. This worldwide flow of Air Force supplies is controlled by a complex supply system. In this section we discuss the purpose, scope, and use of supply items. We also address your responsibilities for property accountability.

As you go about your job, you will use many forms to complete your assigned tasks. Some forms will be used to request and receive supplies and equipment and others will be used to account for, control, and document condition.

010. The purpose and scope of Air Force supply

The Air Force does not own property. In fact, the supplies and equipment in the NDI laboratory (as well as the items you inspect) are not owned by the Air Force. Instead, they are public property owned by the American taxpayers and controlled by the Air Force. The taxes we citizens pay are budgeted to the Department of Defense (DOD) by Congress and spent in the defense of our nation.

DOD allocates a certain portion of the defense budget to the Air Force. The Air Force, in turn, determines items needed to complete its mission. These items are placed on order in the supply system. Also, the Air Force buys equipment or supplies to fill requirements and distributes them where they will do the most good. For this reason, you may be required to formally justify certain items you order before they will be issued to you.

Purpose

The purpose of the Air Force supply system is to provide a standard means of purchasing, distributing, and controlling all equipment and supplies required for the successful completion of the Air Force mission. The goal of the supply system is to provide the most efficient and economical ways for personnel to acquire, use, and dispose of these supplies and equipment.

Scope

The amount of materiel controlled by the Air Force is vast and providing that material to Air Force units around the world is an impressive achievement. For you, the supply system starts in the NDI laboratory. Someone in your section identifies the supplies and equipment you need to do your job. At the other end of the system, a company somewhere in the world makes the supplies and equipment

you need. In between, the Air Force supply system establishes the policies and procedures that enable you to get the items you need from the manufacturer.

For you to have the materials, tools, and equipment available when you need them, these assets must be properly managed. This management responsibility starts locally with the supply squadron, but includes many people throughout the Air Force. To give you an idea of the scope of the supply endeavor we'll look at some of the ways Air Force supplies are managed.

National stock number

Everyone in the Air Force needs to understand how supplies are identified. This is necessary so that each person and the personnel in supply can communicate using common, specific information about the supplies.

In the unit on technical orders, you learned how to locate the TO, figure, index, and part numbers for items you may need to repair your equipment. Although you can use this information to order parts, it would be cumbersome for the supply system to organize all supplies this way. To streamline the operation, the Air Force (as well as all other DOD agencies) uses the Federal Supply Classification system. The key to this system is the national stock number (NSN).

An NSN is a unique, 13-digit number used to group, classify, and identify each item in the federal supply system. No two items in supply ever have the same NSN (unless they're identical). Specific digits of the NSN indicate the following information:

- Group.
- Class.
- Country of origin.
- Exact description of the item.

The first four digits of the NSN are known as the Federal Supply Classification (FSC) code. The FSC is comprised of these two parts:

1. The first two digits indicate the supply group of the item.
2. The last two digits break the item into a specific class within the group.

Look at figure 2–1 as we explore NSN 9535–00–167–2280. The first two digits (95) identify the supply group (sheet metal). The next two digits (35) indicate a specific class within the group (aluminum). From this you can conclude that all aluminum sheet metal in the supply system will be identified by an NSN that starts with the FSC of 9535. What about the rest of the number?

The remaining nine digits of the NSN, called the national item identification number (NIIN), consist of two parts:

1. The first two digits (00 in fig. 2–1) show the National Codification Bureau (NCB) code and identifies the country that assigned the NIIN. For example, stock numbers assigned by the United States are assigned NCB code 00 (before 1974) and 01 (after 1974). Code 11 identifies a North Atlantic Treaty Organization (NATO)-assigned NSN.
2. The last seven digits of the NIIN concisely identify a specific item in the Federal Stock List. Again, refer to figure 2–1 and note that the number 167–2280 completes identification of the item. As you can see, NSN 9535–00–167–2280 describes an aluminum sheet, 0.040 inches thick, 36 inches wide, and 144 inches long with a temper condition of T3. It has a tensile strength of 59,000 pounds per square inch (psi) and weighs 20.73 pounds per sheet. You know from the NCB code that the number was assigned by the United States. If you were to change any of the description above, for example make the sheet only 0.030 inches thick, it would need to have a new, unique NSN assigned.

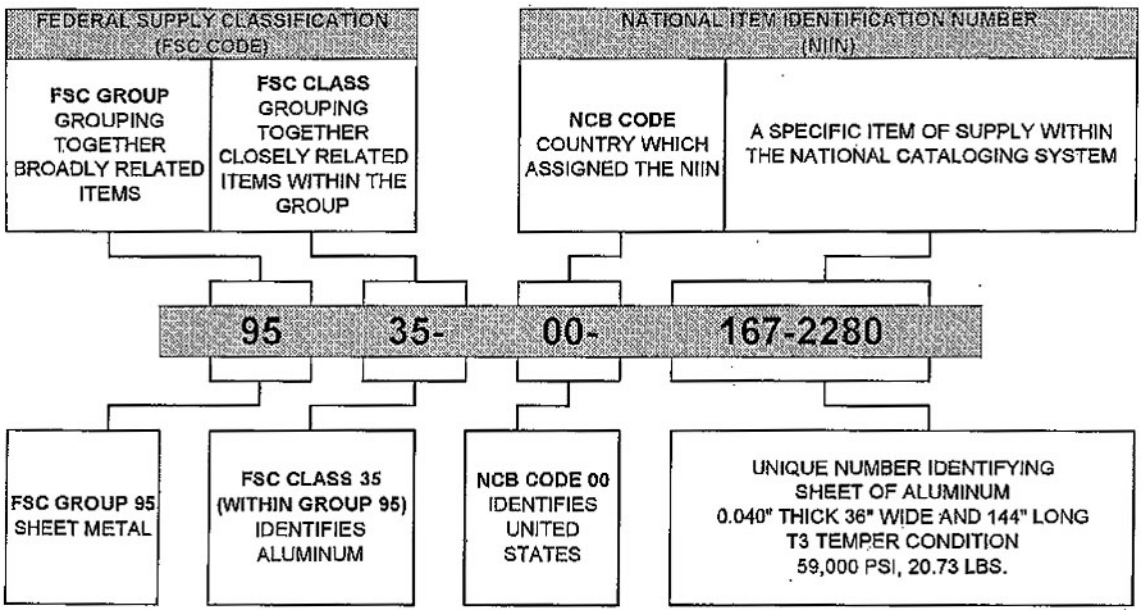


Figure 2–1. National stock number breakdown.

There are many ways to obtain the NSN or other information for an item. One is the method we just used. In other cases, you can use the stock number and federal supply catalogs, other supply publications, or manufacturer's catalogs. You can also use several computer-based search engines.

Federal Logistics Information System

One of the most complete sources of information on items in the supply system is the Federal Logistics Information System (FEDLOG), which uses a computer equipped with a DVD drive and a set of DVDs. The DVDs contain a complete listing of items in the Federal Supply System by NSN, supplier, and manufacturer. All information can be cross-referenced. For example, you can enter a supplier's part number and retrieve a list of all manufacturers for that item.

NOTE: FEDLOG contains so much data your biggest problem may be limiting your search to the item you want.

FEDLOG will give you all the information you need to make nearly any supply transaction. Here is just some of the information you can obtain:

- Item name or nomenclature – what you call it.
- NSN – the assigned national stock number.
- Unit of issue – how the item is issued.
- Price per unit of issue – how much the item costs.
- Manufacturer – including addresses and telephone numbers.
- Supplier – including addresses and telephone numbers.
- Description of the item – including size, color, weight, power requirements.

Supplies and equipment

Although every item with an NSN is listed in the supply system, not all items can be simply ordered and received. Some items are classified as equipment items. These are items controlled more closely by the Air Force due to high cost, large size, or special value. The supply system will require more information than just an NSN before an equipment item can be issued to you.

As an example, let's say you have gathered all information about an ultrasonic flaw detector you want and it fills a need in your NDI laboratory. Before you complete the paperwork to order it, you will need to determine if you are authorized to have it.

Equipment authorization and justification

The Air Force Equipment Management System (AFEMS) is a computer-based program maintained at Wright-Patterson Air Force Base. This program establishes and maintains all equipment information for every Air Force activity. AFEMS allows Air Force units from around the world to contact the central computer and research specific authorizations, view current equipment accounts, or establish new equipment requirements or requests. Each organization requesting equipment items must have an authorization for those items in AFEMS or the equipment request will be denied.

Allowance standards

Personnel in every Air Force activity have a specific allowance standard (AS) they may use to justify equipment requests. Each AS is the source document showing all equipment authorizations for an activity. Allowance standards are assigned a three-digit code to identify the type of AS and allow users to retrieve the data they need. All NDI laboratories use AS 455 to justify the majority of equipment they use. This AS lists all of the authorized equipment NDI laboratories need in order to perform their mission. Laboratory authorizations will vary depending on the size, number and type of aircraft assigned, and primary mission of the organization.

Each AS is organized to allow users to view all authorized equipment, search for a specific NSN, or determine how many items they are allowed to have. For example, let's say you look up the NSN for the ultrasonic unit you researched earlier in AS 455. You find your lab is authorized one of these units. In this case, you can then use AS 455 as your justification to order the ultrasonic unit. However, let's say the AS 455 does not list your ultrasonic unit. In this situation, you have two options:

1. Search AS 455 for an authorized ultrasonic unit meeting your needs and order that one instead.
2. Submit additional documentation with your order requesting that AFEMS add the ultrasonic unit you want to AS 455. If your request is approved, AFEMS will update the database to show you're authorized one of the new units and allow you to order the item.

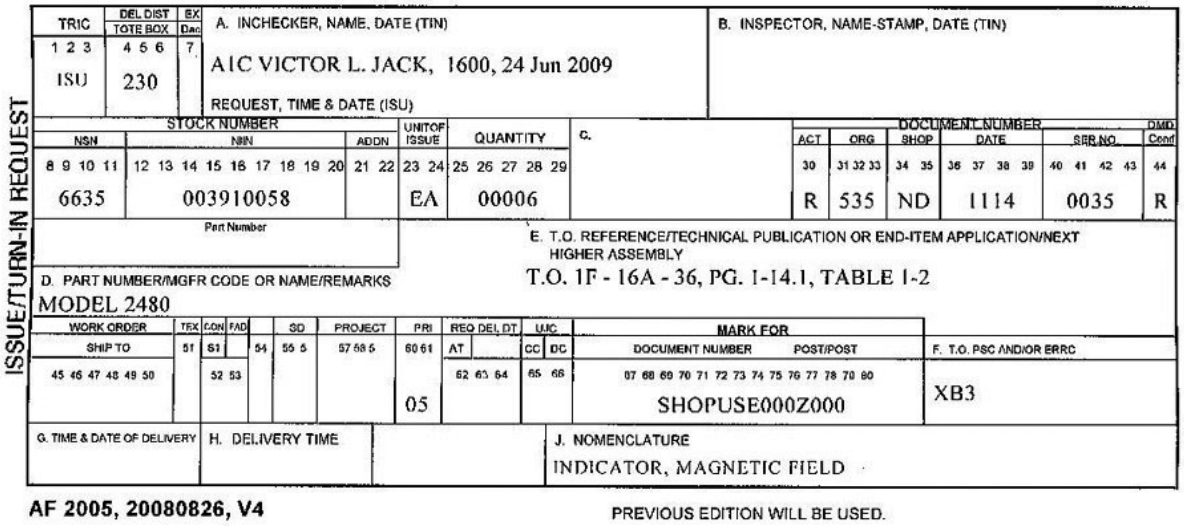
011. Supply forms and tags

In this lesson, we will look at the most common forms used to receive, turn-in, order, and temporarily transfer possession of accountable supplies and equipment. Now that you are in your shop you will begin to realize how important supplies and equipment are to you and your mission. To ensure that you get what you need, the supply system depends on you to follow strict procedures and to use the proper forms.

AF Form 2005, Issue/Turn-In Request

The AF Form 2005 (fig. 2–2) is used to request or turn-in supply system property. When you need a supply item, you request it on this form. Then submit the form to the section of base supply that is responsible for the item you are ordering or turning in. The methods of filling out an AF Form 2005 will vary, but as with most supply forms, the following minimum information is required:

- Name of the item.
- NSN.
- Unit of issue.
- How many you want.
- Your laboratory supply account code.
- Where you need the part delivered.
- Priority.


ISSUE/TURN-IN REQUEST

TRIC	DEL DIST / TOTE BOX	EX / Dac	A. INCHECKER, NAME, DATE (TIN)	B. INSPECTOR, NAME-STAMP, DATE (TIN)
1 2 3	4 5 6	7	A1C VICTOR L. JACK, 1600, 24 Jun 2009	
ISU	230		REQUEST, TIME & DATE (ISU)	

STOCK NUMBER NSN	NIN	ADDN	UNIT OF ISSUE	QUANTITY	C.	DOCUMENT NUMBER ACT	ORG	SHOP	DATE	SER NO.	DMD Cond
8 9 10 11	12 13 14 15 16 17 18 19 20	21 22	23 24	25 26 27 28 29		30	31 32 33	34 35	36 37 38 39	40 41 42 43	44
6635	003910058		EA	00006		R	535	ND	1114	0035	R

Part Number

D. PART NUMBER/MFGR CODE OR NAME/REMARKS
MODEL 2480

E. T.O. REFERENCE/TECHNICAL PUBLICATION OR END-ITEM APPLICATION/NEXT HIGHER ASSEMBLY
T.O. 1F - 16A - 36, PG. 1-14.1, TABLE 1-2

WORK ORDER	TEX	CON	FAD		SD	PROJECT	PRI	REQ DEL DT	UJC		MARK FOR	
SHIP TO	51	S1		54	55 5	57 58 5	60 61	AT	CC	DC	DOCUMENT NUMBER POST/POST	F. T.O. PSC AND/OR ERRC
45 46 47 48 49 50		52 53					05	62 63 64	65 66		67 68 69 70 71 72 73 74 75 76 77 78 79 80 SHOPUSE000Z000	XB3

G. TIME & DATE OF DELIVERY	H. DELIVERY TIME	J. NOMENCLATURE
		INDICATOR, MAGNETIC FIELD

AF 2005, 20080826, V4

PREVIOUS EDITION WILL BE USED.

Figure 2–2. AF Form 2005.

You have already seen that FEDLOG can give you most of this information. Your supply account code and delivery code are assigned locally by supply. The priority you assign to the order depends on how urgently you need the item. Supply personnel can assist you with any questions regarding how to fill out supply forms. Figure 2–2 shows an example of an AF Form 2005, requesting issue of six magnetic field detectors.

DD Form 1348–6, DOD Single Line Item Requisition System Document

The purpose of Department of Defense (DD) Form 1348-6 is to request an item or part that is not listed in the Federal Supply System by an NSN (e.g., some replacement parts on old equipment or new pieces of equipment that are not carried in the supply system). In these cases, manufacturers may still make the replacement parts and newer equipment can be procured through the supply system with justification. DD Form 1348–6 enables you to provide the best possible information to help supply or base contracting personnel identify exactly what you want.

Completing a DD Form 1348–6 may require extensive research on your part. At times, you may have to search through numerous TOs, manufacturer's catalogs, flyers, or even the Internet to find all the information you need. Many times, you will find there may even be a supply source for your item in the local community. If you do your homework, and provide complete information on the 1348–6, the supply folks can normally fill your request. Figure 2–3 shows a DD Form 1348–6, requesting a nonstock listed replacement part.

Equipment action request

An equipment action request is submitted through the web-based equipment management internet site. Your designated shop equipment custodian has the authority and access to request and justify equipment items not currently authorized on your allowance standards to be added.

AF Form 1297, Temporary Issue Receipt

This form (fig. 2–4) is used to issue an item of equipment for short specified periods. It also is used for the temporary issue of controlled supplies. This form becomes the receipt for anything that is removed from one activity to another. The AF Form 1297 is commonly referred to as a *hand receipt*. Two uses of the form are as follows:

1. You loan an x-ray unit to another NDI laboratory. Because the equipment is accountable, it must be signed for before being taken. The signed AF Form 1297 (fig. 2–4) transfers responsibility to the other shop.

2. You may fill out an AF Form 1297 when you are issued special clothing, such as a parka, from your squadron. The squadron is accountable for the parka, but *you are* responsible for it. The completed AF Form 1297 is the receipt document.

Remember this cardinal rule*: Whenever accountable supplies or an item of equipment leaves your shop, you must have a signed receipt or one issued and tracked by the tool control system (TAS or TC-Max).* One copy of every completed AF Form 1297 is kept on file somewhere in your shop's records. This file is the official record of all issued accountable assets and shows who signed for them.

DOCUMENT IDENTIFIER	ROUTING IDENTIFIER	M & S	ITEM IDENTIFICATION* (NSN, FSCM/Part No., Other)																	UNIT OF ISSUE	QUANTITY				DOCUMENT NUMBER	
			FSCM					PART NUMBER																	SERVICE	REQUISITIONER
1 2 3	4 5 6	7	8 9 10 11 12					13 14 15 16 17 18 19 20 21 22												23 24	25 26 27 28 29				30	31 32 33 34 35
I S U	2 3 0		6 6 3 5 L					0 0 0 2 3 X - 4 5 0												E A	0 0 0 0 1					5 3 5 N D

DOCUMENT NO. (Cont.)																																
DATE			SERIAL					DEMAND	SERV	SUPPLEMENTARY ADDRESS			SIGNAL	FUND CODE		DISTRIBUTION CODE		PROJECT CODE		PRIORITY		REQUIRED DELIVERY DAY OF YEAR			ADVICE CODE		BLANK					
36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69
2	2	6	3	0	0	0	4	R													0	5							C	Z			

REJECT CODE (FOR USE BY SUPPLY SOURCE ONLY)		IDENTIFICATION DATA
65	66	*1. MANUFACTURER'S CODE AND PART NO. (When they exceed card columns 8 thru 22) (00756) P/N: 23X-450
		2. MANUFACTURER'S NAME AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA INC.

3. MANUFACTURER'S CATALOG IDENTIFICATION	4. DATE (YYMMDD)	5. TECHNICAL ORDER NUMBER
		1F-15C-36
6. TECHNICAL MANUAL NUMBER	7. NAME OF ITEM REQUESTED	
	ALUMINUM REFERENCE STANDARD	

8. DESCRIPTION OF ITEM REQUESTED	8a. COLOR
ALUMINUM REFERENCE STANDARD, 4 INCHES LONG, 3 INCHES WIDE, 2 INCHES DEEP, WITH ONE 1/32 INCH AND ONE 1/16 INCH HOLE DRILLED THROUGH (SEE ATTACHED DRAWING) FOR USE CALIBRATING ULTRASONIC INSTRUMENTS FOR INSPECTION OF F-15C L/R HORZ. STABILIZER ATTACH BRACKET, P/N: 15B3456.	8b. SIZE

9. END ITEM APPLICATION	9a. SOURCE OF SUPPLY
F-15C	00756

9b. MAKE	9c. MODEL NUMBER	9d. SERIES	9e. SERIAL NUMBER

10. REQUISITIONER (Clear text name and address)	11. REMARKS
SRA SHONA DAVIS 16 FMS/NDI 724-5561	THIS IS A REPEAT REQUISISTION FROM THE MANUFACTURER WHO HAS DETAILED SPECIFICATIONS ON FILE. XB3, $135.97

DD Form 1348-6, FEB 85 (EG) *Edition of Apr 77 may be used until exhausted.* DOD SINGLE LINE ITEM REQUISITION SYSTEM DOCUMENT *(MANUAL - LONG FORM)*

Designed using Perform Pro, WHS/DIOR, Feb 96

Figure 2–3. DD Form 1348–6.

I acknowledge receipt of and responsibility IAW AFI 23-111 for the items described below and will return them by the return date indicated.

ISSUED TO: SIGNATURE	DUTY PHONE	ISSUED BY
	496-4669	MSgt Heather Cox
ISSUED TO: NAME, GRADE, ORGN (Type or print)	ORGN ACCT NO.	DATE OF ISSUE / RETURN DATE
Lindsey Coffelt, MSgt, 446 MXS		20161022

STOCK NUMBER	DESCRIPTION OF ITEM	U/I	QNTY
MXMNA0001	Eddy Current unit		1
MXMNA0002	Eddy Current probe kit		1
MXMNB0001	ETool		1
**********	**********Last Item**********	******	

AF IMT 1297, 19870701, V4 PREVIOUS EDITION WILL BE USED. TEMPORARY ISSUE RECEIPT

Figure 2–4. AF Form 1297.

012. Condition tags

As the name implies, condition tags are used to identify the condition of supply property. They are light cardboard tags or gummed labels that easily attach to equipment or cartons. The tags are produced in three different colors for easy, at a glance, recognition.

DD Form 1574, Serviceable Tag-Material

This yellow condition tag (fig. 2–5) is used on all new property, serviceable used property, and property that was repaired and returned to the supply system.

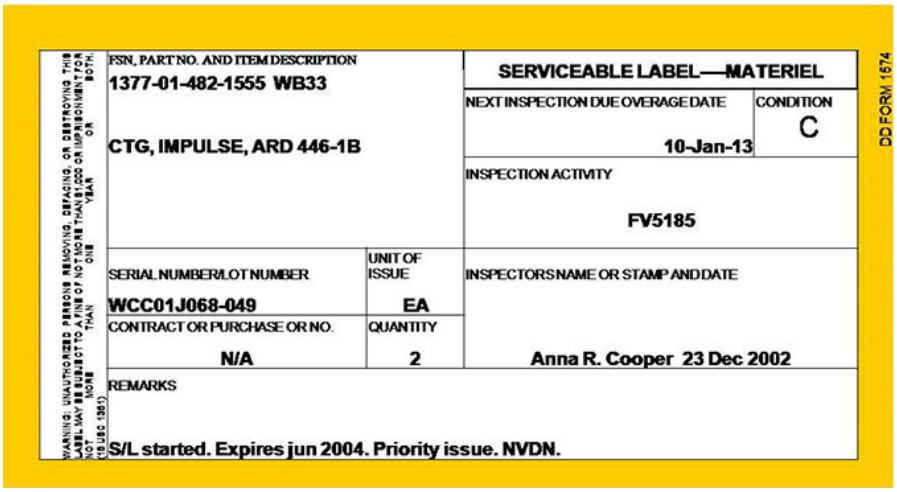


Figure 2–5. DD Form 1574 (Yellow).

DD Form 1577, Unserviceable (Condemned) Tag-Material

This red, or condemned, tag (fig. 2–6) is used to identify property that is worn or damaged beyond economical repair. If this tag is placed on an item, the item *must not be used for any reason*.

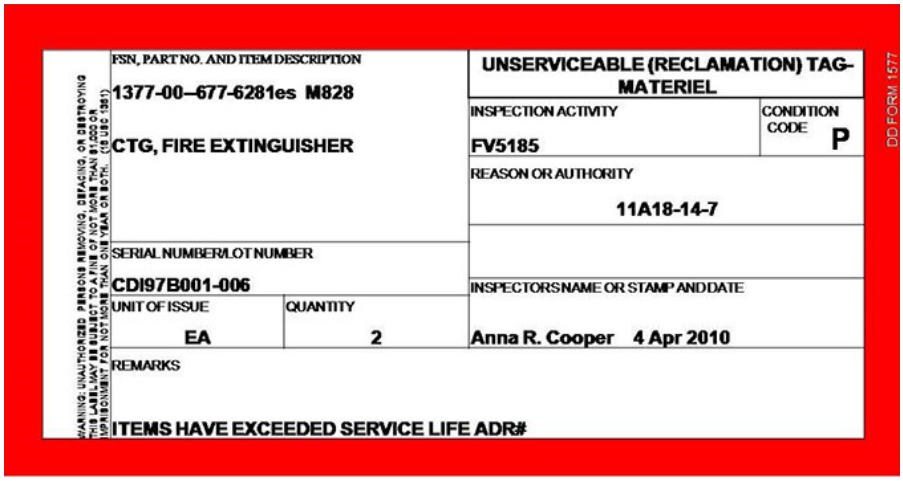


Figure 2–6. DD Form 1577 (red).

DD Form 1577–2, Unserviceable (Repairable) Tag-Material

This green repairable tag (fig. 2–7) is used to identify property that is not currently serviceable but is more economical to repair than to replace.

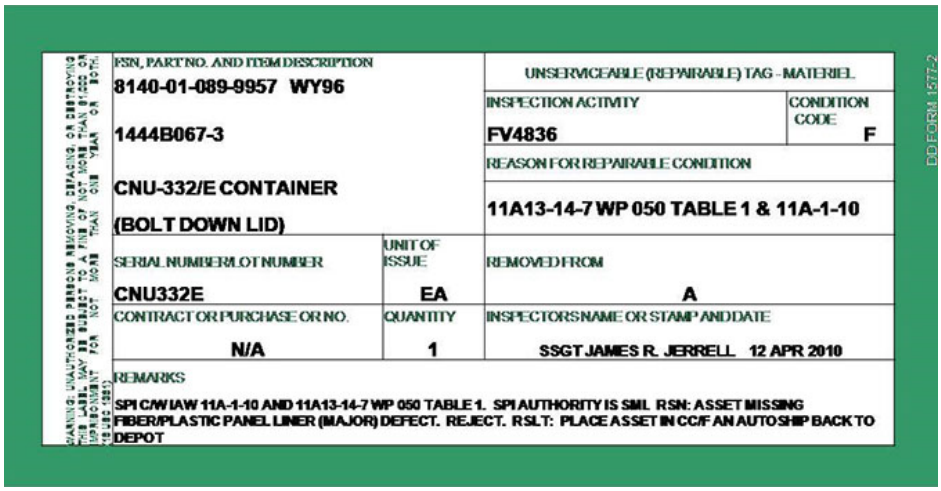


Figure 2–7. DD Form 1577–2 (green)

Entries on condition tags

All three condition tags are filled out in similar ways. Refer to figures 2–5, 2–6, and 2–7 as we discuss the entries made on condition tags.

NSN and description

This block is the same on all three tags and must be filled out accurately. If any questions arise about the stock number or nomenclature, call your supply research section.

Serial number/lot number

Here, you must enter the serial or lot number from your equipment. This is done to avoid any mix-up if the tags accidentally fall off separate items with the same stock number.

Unit of issue

This entry is self-explanatory.

Quantity

The quantity is not always “1”. Small identical parts, such as ultrasonic transducers or eddy current probes, can be tied together or put in a box with only one tag. In these cases, annotate the total number of parts.

NOTE: Multiple parts identified with one condition tag must ALL be in the same condition. If some are repairable and others aren’t, they must be tagged separately.

Condition code

The condition code is one of four letters: A, B, F, or H.

- A and B are used only on the DD Form 1574. An A means the property is new or used; B means the property was repaired and is serviceable.
- The F is used only on DD Form 1577–2, and means the item is repairable.
- H is used only on the DD Form 1577 and means the item cannot be repaired and is condemned.

Reason

The reason block is used only on the green and red tags and explains why the item is in a repairable or condemned condition.

Inspector's name

In most cases, the supply or equipment custodian can sign both the serviceable and repairable tags on all property. A condemned tag can be signed only by an authorized inspector for condemned equipment. Items repaired on base can normally be condemned by a designated individual assigned to the responsible repair facility.

Back of tag

If an item is serviceable but requires correction of minor discrepancies, the discrepancy and supply document numbers (if parts are on order) will be listed on the back of the DD Form 1574, Serviceable Tag.

If the item is unserviceable, but you are going to keep it and repair it yourself, the discrepancy, backordered parts, and supply document numbers may be listed on the back of the DD Form 1577–2, green tag.

Back-of-tag entries normally apply to shop equipment. Complete instructions for use of condition tags are contained in TO 34–1–3, *Inspection and Maintenance-Machinery and Shop Equipment*.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

010. The purpose and scope of Air Force supply

1. Who actually owns the equipment you use in the NDI shop?

2. What is the purpose of the Air Force supply system?

3. Where can you locate information on parts listed in the federal supply system?

4. What are the terms for the acronym AFEMS?

5. What information does AS 455 provide?

011. Supply forms and tags

1. Which form is used to request or turn in a supply item?

2. Which form do you use when there is not an established NSN for the item?

3. What is the purpose of the equipment action request?

4. What is an AF Form 1297 commonly called?

5. What is the cardinal rule for equipment that leaves your lab?

012. Condition tags

1. Match the form listed in column B with the condition listed in column A. Each tag may be used more than once.

Column A	*Column B*
____ (1) An unserviceable item that can be economically repaired.	a. DD Form 1574.
____ (2) An unserviceable item that's uneconomical to repair.	b. DD Form 1577.
____ (3) Identifies an item and indicates a serviceable condition.	c. DD Form 1577–2.
____ (4) Indicates serviceable material or property.	
____ (5) Unserviceable item that can be restored for reuse.	

Answers to Self-Test Questions

010

1. The American taxpayer.
2. To purchase, distribute, and control equipment and supplies used by the Air Force.
3. FEDLOG.
4. Air Force Equipment Management System.
5. Lists equipment authorizations for NDI laboratories.

011

1. AF Form 2005.
2. DD Form 1348–6.
3. To request that a piece of equipment be added to your AS.
4. Hand receipt.
5. Make sure to get a signed hand receipt or one issued by the shop TAS or TC-Max.

012

1. (1) c, (2) b, (3) a, (4) a, (5) c.

Complete the unit review exercises before going to the next unit.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter.

Do not return your answer sheet to AFCDA.

26. (010) Who has ownership of Air Force supplies and equipment?
    a. Air Force.
    b. American taxpayer.
    c. Department of Defense.
    d. Individuals to whom the supplies and equipment are assigned.

27. (010) The purpose of the Air Force supply system is to
    a. purchase equipment and supplies and store them until someone in the Air Force needs them.
    b. provide a means by which you can order and store equipment/supplies that are needed to do your job.
    c. provide a means of purchasing, distributing, and controlling equipment/supplies used by the Air Force.
    d. store equipment and supplies purchased by the Department of Defense until they are needed by someone in the Air Force.

28. (010) Which system is used to determine whether your nondestructive inspection (NDI) laboratory is authorized a piece of equipment?
    a. FEDLOG.
    b. AFEMS.
    c. ETIMS.
    d. SBSS.

29. (011) Which form is used to request an item not listed in the Federal Supply System?
    a. AF Form 601.
    b. AF Form 1297.
    c. AF Form 2005.
    d. DD Form 1348–6.

30. (012) Which condition tag would be placed on an eddy current unit being sent back to depot for repair?
    a. DD Form 1348–6.
    b. Red DD Form 1577.
    c. Yellow DD Form 1574.
    d. Green DD Form 1577–2.

Please read the unit menu for unit 3 and continue ➔

Student Notes

Unit 3. Maintenance Management

EVERYTHING NEEDS MAINTENANCE to function properly and slow the aging process. For example, your body requires maintenance to ensure good health. You provide this maintenance through proper diet and exercise. Our homes are another example. If you do not paint or seal a wooden house periodically, it will rot away in a fraction of its normal life span. Here's another example: would you try to drive a new car for 100,000 miles without changing the oil?

The point is that Air Force equipment is no different from anything else. If it is not properly maintained, this equipment will rapidly fall apart. In the case of aircraft and missiles, the result could be catastrophic in terms of our nation's defense. After all, systems that are not able to perform their missions are useless.

An important part of your duties is to ensure all equipment under your control is maintained properly. This applies to equipment you may use for only one day or every day for several years. In this unit we will outline your responsibilities with regard to Air Force maintenance, inspections, and documentation.

3–1. Air Force Maintenance

To keep aircraft safe and functioning properly, the Air Force has developed a system of maintenance and inspection generally considered the finest in the world. This maintenance system revolves around these two basic principles: prevention and documentation.

Prevention attempts to limit component failures. In contrast, documentation provides component failure data. The documented data is analyzed and prevention measures improved; thus reducing failures. It is a constantly evolving system and you're key to its success.

013. Nondestructive inspection career field

Let's first look at your role as an NDI technician and then take a broader view of how NDI fits into the larger maintenance community. Like all career fields within the Air Force, NDI is designated by an Air Force specialty code, or AFSC. AFSCs use a specific numbering system that group similar jobs together based on their functions, training, and other criteria. It also helps to clarify where NDI falls into the overall maintenance hierarchy.

Air Force Specialty Code 2A7X2

NDI AFSC 2A7X2 is broken down in the following table:

NDI AFSC 2A7X2		
2	Career Grouping	Logistics
A	Career Field	Maintenance

NDI AFSC 2A7X2		
7	Career Field Subdivision	Fabrication
X	Skill Level	1 – Helper 3 – Apprentice 5 – Journeyman 7 – Craftsman 9 – Superintendent
2	Specific Job	NDI
	NOTE: Other numbers will relate to other specific jobs in Fabrication Flight, such as: 2A7X1 — Aircraft Metals Technology 2A7X3 — Aircraft Structural Maintenance 2A7X5 — Low-observable Aircraft Structural Maintenance	

The 'X' in the Skill Level position will change throughout your career. When you gain more training and experience as an NDI technician, you will advance in skill level. As you move upward through the career field, your duties and responsibilities will continue to increase.

Apprentice skill level

While you were in technical training, you were considered a 1-level trainee, which is defined as a helper. Once you successfully graduated technical school, you became an NDI apprentice, or 3-level. There are two specific requirements for becoming an apprentice. You must be in the grade of E–1 through E–3, and you must complete formal training (technical school). In addition, every apprentice is expected to take on specific responsibilities, with an appropriate level of supervision. These responsibilities are as follows:

- Determine test methods and prepare parts for inspection.
- Perform inspections; interpret and evaluate test indications; record findings.
- Operate and maintain NDI and oil analysis test equipment.

Journeyman skill level

Each skill level has additional requirements and responsibilities. As an apprentice, you will gain experience as you continue your training until you meet the qualifications of a 5-level journeyman. You may have noticed the front cover of these CDCs is labeled 2A752 Nondestructive Inspection Journeyman. That is because this course is one of the primary requirements for becoming a 5-level. The following table lists the requirement and responsibilities of this level of proficiency.

Journeyman – 5-Skill Level	
Requirements	**Responsibilities**
• E–1 through E–4. • Complete NDI CDC 2A752. • 12 months of on-the-job training (OJT); 9 months of OJT for re-trainees. • Complete all 5-level core tasks. • Recommended by supervisor for upgrade.	• Same as apprentice, but may do tasks unsupervised. • Conducts OJT.

Craftsman skill level

Once you become an NDI journeyman, your training and progression does not stop. Throughout your career, there will be more knowledge to gain and additional responsibilities

to take on. After 5-level, your next skill level goal will be the 7-level craftsman. As you might expect, higher proficiency levels include more requirements and greater expectations. The following table lists these expanded 7-level duties and responsibilities.

Craftsman—7-Skill Level	
Requirements	**Responsibilities**
• Minimum rank of SSgt. • 12 months of OJT; 6 months of OJT for retrainees. • Complete all 4- and 7-level core tasks. • Complete craftsman CDC 2AX7X.	• Plans and schedules NDI activities. • Interprets TO and inspection results. • Provides training, feedback, and task qualification for personnel. • Establishes performance standards. • Enforces maintenance safety.

Additional duties

As you gain experience within the shop, you may be placed in leadership roles, such as a shift leader. You will also be tasked with programs, like TOs, tools, or vehicles. These programs are known as additional duties because you will perform them in addition to learning the NDI trade. Each program gives you a chance to expand your knowledge and learn more about your work center. Over time, you will have a better perspective on how each program impacts aircraft maintenance.

In addition to progression within the career field, you will have opportunities for training and growth outside of NDI. For example, you may be tasked to fill in as a Security Forces augmentee or be selected as part of a base beautification detail. As a SrA you will attend Airman Leadership School (ALS), where you will gain formal training to prepare you for greater responsibilities as a non-commissioned officer (NCO).

Once you become an NCO, you may be tasked to fill a flight or squadron position. NCOs can also be selected for the job of QA inspector. Members in senior NCO (SNCO) positions take on significantly greater roles of leadership and management. These roles include shop chief, flight chief, and production superintendent, just to name a few. Many of the details regarding career progression are outlined in the 2A7X2 Career Field Education and Training Plan (CFETP). Review this document to become familiar with the opportunities and expectations at every level throughout your Air Force career.

National Aerospace Standard (NAS) 410

National Aerospace Standard (NAS) 410 is a “written practice” that establishes requirements and procedures for qualification and certification of USAF field-level civil service personnel performing NDI in aerospace service, maintenance, and overhaul operations.

The USAF is responsible for the implementation of and compliance with this written practice, and for certifying qualified personnel. The USAF is solely responsible for the certification of its own employees and cannot certify for another employer. Individuals cannot qualify themselves.

014. Maintenance levels

Aircraft preventative maintenance involves regular upkeep and repair to ensure downtime is minimized. Each aircraft, missile, vehicle, or equipment item has a preventative maintenance program specifically designed to best keep it operational. However, it is not practical for every Air Force base to be 100 percent capable to perform maintenance on everything. Staffing and budget constraints make this impossible. Therefore, the Air Force requires increasing levels of support capability based on the following considerations:

- Mission requirements.
- Economy of repair.

- Transportation limitations.
- Component reliability.
- Workload agreements.
- Facility requirements.
- Frequency of tasks.
- Special training requirements.

Three levels of maintenance

The three levels of maintenance capability from lowest to highest are organizational, intermediate, and depot.

Generally, Air Force units must have full capability to perform on-equipment tasks and a moderate capability to perform off-equipment tasks. Let's look at the capabilities required for each level and learn how Air Force units use them.

Organizational maintenance

Organizational maintenance includes routine inspections, replacement of some components, minor structural repairs, and servicing with fuel or oil. Personnel assigned to organizational maintenance may also perform TCTO modifications if facilities are available at this level. Organizational maintenance is typically accomplished by the organization possessing the equipment being worked on. For example, maintenance on aircraft is normally performed by the owning fighter squadron, airlift squadron, or helicopter squadron.

It is very important technicians at organizational levels perform preventative maintenance and identify potential problems before major component failures occur. Major failures lead to lost mission capability in the organization and increased workloads at other levels of maintenance. Additionally, in-flight failures can result in loss of life or equipment.

Intermediate maintenance

Intermediate maintenance closely supports the organizational level and usually has the highest concentration of skilled specialists in the maintenance organization.Intermediate maintenance includes the primary back shops such as fuel shop, propulsion, pneudraulics, and NDI laboratory, just to name a few. The actual number depends on the size of the mission of the organization.

Intermediate maintenance support consists primarily of furnishing specialist assistance to verify a suspected defect, performing bench checks of equipment, and maintenance repair that's beyond the capacity of the organizational unit.

Depot maintenance

Depot maintenance is the highest level and requires extensive equipment to perform major repair and overhaul. The chief function of a depot is to perform major maintenance on aircraft and aircraft components. During a depot overhaul, all aircraft systems are inspected and repaired as necessary. Depot also supplies spare parts, aerospace ground equipment, and TCTO kits to the organizational and intermediate maintenance levels through normal supply channels.

Two level maintenance

At the intermediate level, the Air Force has implemented a two level maintenance (2LM) concept for most avionics and engine workcenters. The 2LM concept was implemented to reduce manpower, facilities, equipment, and accumulation of spare parts. In addition, 2LM transfers some intermediate level capability to the organizational level and establishes a direct link between depot and the organization. 2LM is possible because of modern communications, computers, and transportation methods which allow rapid movement of unserviceable parts through the repair process.

Lean logistics

Logistics is the science of procuring, maintaining, and transporting military material, facilities, and personnel. Lean logistics is an Air Force initiative to use "best business practices" to reduce inventories and costs. The focus of lean logistics is rapid depot repair; high velocity, two-way movement of parts using express carriers; and improved base processing of repairable parts and quick response repair contracts.

015. Maintenance inspection policy

Air Force policy for preventative maintenance uses a planned inspection and maintenance concept. This concept provides a method of performing required inspections and repairs on a scheduled and planned basis. There are five authorized inspection concepts used on aerospace vehicles:

1. Periodic.
2. Phased.
3. Isochronal.
4. Programmed depot maintenance.
5. Airline manufacturer maintenance program inspections.

Each inspection concept uses a similar set of specific inspections designed to provide the best preventative maintenance for a particular aircraft. The inspection concepts and types of inspections used are shown in this table:

Inspection Concept	Types of Inspections Used
Periodic	Pre-flight, end-of-runway, thru-flight, basic post-flight, combined pre-flight/basic post-flight or pre-flight/thru-flight, hourly post-flight, and periodic.
Phased	Pre-flight, end-of-runway, thru-flight, basic post-flight, combined pre-flight/basic post-flight or pre-flight/thru flight, hourly post-flight, and phase.
Isochronal	Pre-flight, end-of-runway, thru-flight, basic post-flight, combined pre-flight/basic post-flight or pre-flight/thru-flight, home station check, minor, and major.
Programmed depot maintenance	Requires aircraft to fly to a depot for inspections, repairs, or modifications using advanced skills, equipment, and facilities.
Airline manufacturer maintenance	A check, B check, C check, and D check

At first glance, these inspections look like a great deal of work (and they are), but you will not be involved in most of these inspections. Each weapon systems –6 inspection TO will outline all inspection requirements including those requiring NDI support. In this lesson we will only cover those inspections normally involving you, the NDI technician. These inspections are as follows:

1. Hourly post-flight (HPO).
2. Periodic (PE).
3. Phased (PH).
4. Isochronal (ISO). (**NOTE:** The ISO includes home station checks (HSC) and minor or major inspections.)

Since our discussions will be general in nature, consult TO 00–20–1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures* for a complete description of these inspections.

Hourly post-flight inspection

HPO inspections are accomplished after a specified number of accumulated flying hours. Inspection intervals, such as *every 25 hours*, and those components requiring HPO inspections are specified in

the applicable –6 TO. HPOs are limited to those components requiring inspection more frequently than a periodic inspection provides.

Periodic inspection

PE inspections are thorough and searching inspections of the entire weapon system. They are far more extensive than the basic or hourly postflight. PE inspections are due after a specified number of flying hours, operating hours, or upon expiration of a calendar period specified in the applicable –6 TO.

Phased inspection

PH inspections are a combination of the HPO and PE inspections. The objective of PH inspections is to minimize the length of time an aircraft is out of commission for a scheduled inspection. All HPO and PE requirements for a given period are broken down into packages containing inspections requiring approximately equal time to accomplish. Each package becomes a PH inspection—saving time over a PE while inspecting more than an HPO. When inspection requirements cannot be reasonably divided into equal packages, aircraft are unable to use this system. The applicable –6 TO will specify PH requirements for your weapon system.

Isochronal inspection

Isochronal is a term meaning of equal terms, or recurring at regular intervals. ISO inspections are designed to convert flying hours into *calendar periods* usually expressed in days. The number of days in each inspection interval is based on average flying hours during the period. HSCs and minor or major inspections will usually involve NDI in some way.

Home station check

The HSC consists of inspections scheduled for accomplishment when the aircraft returns from a long-range mission or when a specific calendar interval is met. The weapon system –6 TO will specify HSC calendar intervals. Because these inspections must be completed at the home station, HSC inspections may be done in conjunction with minor or major inspections.

Minor inspection

Minor inspections are designed to fill the gap between an HSC and the next major inspection. It is more detailed than the home station check and consists of checking certain components, areas, or systems requiring more frequent checks than the calendar interval for major inspections.

Major inspection

Major inspections are similar to PE inspections because they are also a thorough and searching inspection of the entire weapon system. Inspection calendar intervals are established in the applicable –6 TO and determine when the inspection is due. Major inspections are the most extensive inspection in the isochronal concept.

016. Maintenance symbols and their use

The purpose of maintenance symbols, or special characters, is to make important information instantly apparent. As you would expect, the proper use of symbols is critical to safety for personnel and equipment. The symbols we use indicate the following information instantly:

- Condition.
- Fitness for flight or operation.
- Servicing.
- Inspection.
- Maintenance status of weapon systems or equipment.

With the exception of black initials, all maintenance symbols covered in this unit will be entered on forms in red (pencil or pen). Once entered into maintenance forms, symbols can only be changed under certain specific conditions. These are outlined in TO 00–20–1.

NOTE: Under no circumstances will maintenance symbols ever be erased even if entered in error.

We will cover four commonly used maintenance symbols in their order of importance: red X, red dash, red diagonal, and black last name initial. Our discussion will be general in nature. For a detailed description, consult TO 00–20–1.

Red X

The red X symbol is the most serious of all the symbols and indicates an aircraft or a piece of equipment is unsafe and can't be used. An aircraft is grounded or a piece of equipment is restricted from use until the unsafe condition is cleared. A red X symbol is entered on forms for the following conditions:

1. Major discrepancies.
2. Safety-of-flight conditions (work being done on a critical part of the aircraft).
3. Equipment is unsafe or unfit for use.

No one will authorize or direct an aircraft be flown, a missile be launched, or equipment be used until a red X has been properly cleared in accordance with applicable technical data. All repairs made or work accomplished to remedy a red X condition will be inspected by only highly qualified personnel authorized to clear red X conditions.

Red dash

The red dash is entered on maintenance forms to indicate equipment condition is unknown. You will notice that most NDI inspections will be written on a red dash. A red dash is used to show the following conditions:

1. A required special inspection.
2. Accessory replacement, operational checkout, or functional check flight is due.
3. A scheduled inspection, such as PE or HPO, is overdue.

Red dash conditions are corrected by qualified maintenance personnel who perform required inspections, replace parts, operationally check, functionally check, or accomplish any other necessary maintenance as soon as possible.

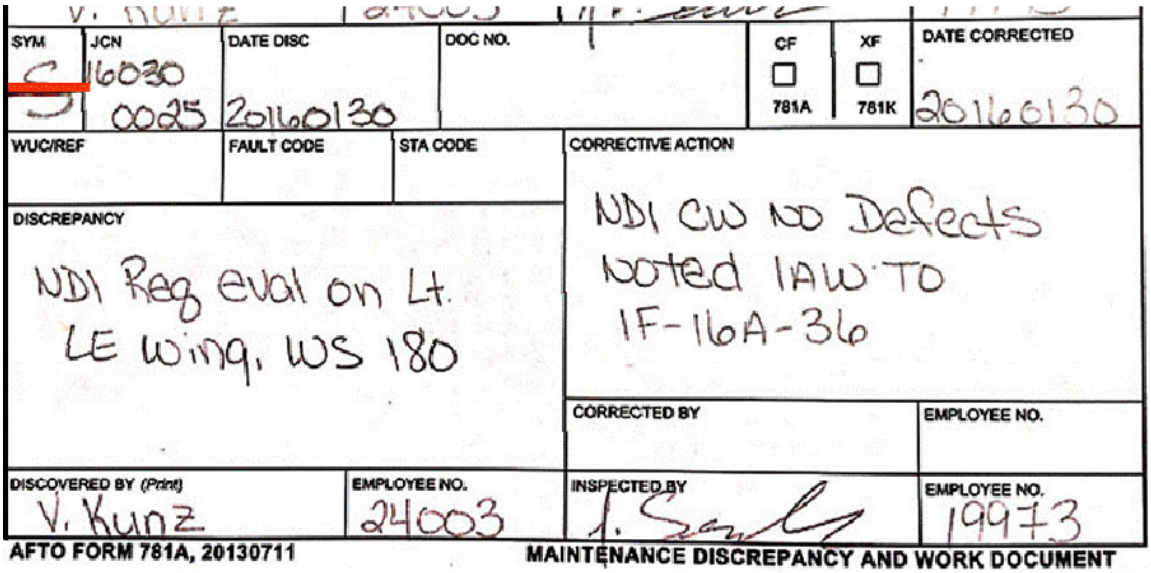


Figure 3–1. AFTO Form 781A, red dash example.

Red diagonal

The red diagonal symbol is the least serious of the red symbols. It indicates that an unsatisfactory condition exists, but is not sufficiently urgent or dangerous to prevent use of the aircraft or equipment. A red diagonal symbol is entered on maintenance forms, from upper right to lower left, to indicate minor discrepancies.

Black last name initial

The last symbol is the black last name initial. A black last name initial is placed over a red symbol and indicates the individual whose name appears in the signature block has accomplished required maintenance or inspected on a component and found its condition satisfactory. When this symbol is entered in the aircraft maintenance forms, the discrepancy is cleared.

017. Air Force deficiency reporting system

Sometimes a failure occurs on a system or component regardless of how effective your inspection program seems. When this happens, the Air Force deficiency reporting system comes into play and the failure must be reported. Examples of reportable deficiencies are as follows:

- Failures due to faulty design.
- Workmanship during manufacture.
- Improper repair or modification.
- Substandard maintenance.

As you would expect, deficiencies must be reported quickly for prompt corrective action to be taken on the substandard condition. To make this possible, all personnel need to be familiar with deficiency reporting procedures contained in TO 00–35D–54, *USAF Deficiency Reporting, Investigation, and Resolution System*. Each Air Force unit, command, and ALC has a point of contact for matters pertaining to deficiency reports (DR). The point of contact on Air Force bases is the QA office of the organization that initiates the DRs.

Categories of deficiency reports

DRs are divided into two distinct subdivisions: category I and category II.

Category I

Category I DRs are submitted to correct conditions that may cause death, severe injury, severe occupational illness, or major system damage or loss. Also included are conditions, which if uncorrected, could unacceptably restrict combat or operational readiness.

Category II

Category II DRs cover deficiencies that do not meet the criteria of category I. Reportable category II deficiencies include errors in workmanship, nonconformance to specifications, drawing standards, or other technical requirement. Additionally, categories II DRs are submitted to identify a specific problem for potential improvement or a potential enhancement.

Deficiency reporting procedures

There are four places, or levels, where DR actions take place: originator, originating point, screening/action point, and support point. Let’s discuss them in detail.

Originator

You or the person in your shop that discovers and identifies the deficiency becomes the originator. Your responsibility as the originator of a DR is very important. You lay the foundation for all actions taken later concerning the DR. You discover and identify the deficiency, determine if the condition meets DR criteria, prepare the draft DR, then secure and identify the DR exhibit. The exhibit can be a single part, piece of equipment, item of clothing, blueprint, or any other item causing the DR. As the originator, you forward your DR to the originating point and assist them as requested.

Originating point

The originating point is your unit or the base DR monitor who communicates with the next level. In either case, the originating point receives your DR and certifies it is valid, complete, and accurate. The originating point assigns a report control number, submits the DR to the screening point/action point, and ensures proper marking and handling of exhibits. The originating point will also follow up DRs as required.

Screening point/action point

These are the ALC point-of-contact for all DR submissions. In most cases, these two points are both located at the ALC. At times, they may be at two separate locations. Personnel in the screening point/action point receive DRs from the originating point. The screening point folks review each DR for proper categorization, validity, correctness, accuracy, and completeness. They also obtain correct or missing information from the originating point. The DR will then be processed to the proper action point either within or outside the organization. Personnel in the action point determine whether the DR requires an investigation or should be closed. If an investigation is required, the action point folks forward the DR to the support point, receive the investigation report, and take corrective action as required.

Support point

Essentially, the personnel in the support point assist the action point (as requested) folks in processing, investigating, and resolving deficiencies. We will now look at the specific actions accomplished by each level during a DR submission. The following table shows this information; the information is excerpted from TO 00–35D–54.

Action Points	Actions
Originating Point	1. Discovers and identifies deficiency. 2. Prepares draft report. 3. Secures DR exhibit and identifies it with DD Form 1575, Suspended Tag–Material, and DD Form 2332, Product Quality Deficiency Report Exhibit. 4. Forwards draft report to screening point.
Screening Point	1. Certifies validity, completeness, and accuracy of draft report. 2. Assigns a control number, finalizes report, and processes exhibit documentation. 3. Submits reports to action point within: CAT I DR–72 hours, CAT II DR–13 workdays. 4. Ensures exhibit is secured in designated holding area. 5. Monitors the DR record in Information Central Web Interface (INFOCEN) for exhibit disposition instructions. 6. Coordinates and assures exhibit shipment or disposition.
Action Point (ALC-SPO)	1. Checks INFOCEN daily for new DRs. 2. Assigns material improvement project (MIP) number (if applicable). 3. Contacts warranty manager (if applicable). 4. Updates INFOCEN with acknowledgement and initial and final disposition instructions within 1-workday for CAT I DRs and 10-workdays for CAT II DRs. 5. If no investigation is required, closes DR in INFOCEN with narrative and closing code explaining reason for closure. 6. Conducts the investigation. 7. Requests support point assistance. 8. Monitors support point investigations and updates the DR record in INFOCEN as applicable. 9. Receives final investigative report from support point and updates INFOCEN with narrative and closing code accordingly. 10. Takes corrective action.

Action Points	Actions
Support Point	1. Performs investigation if requested. 2. Provides exhibit disposition instructions to action point or directly to holding activity (with prior action point authorization). 3. Provides status to action point as significant events occur. 4. Accomplishes the analysis and investigation (if applicable) and provides results to action point. 5. Upon completion of analysis, processes exhibit according to instructions on DD Form 2332, i.e., repair, return, or condemn.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

013. Nondestructive inspection career field

1. What uses a specific numbering system that groups similar jobs together based on their functions, training and other criteria?

2. List the 5-skill levels.

3. How many months of OJT are required for an *initial* journeyman skill level?

4. What is your next skill level goal after achieving your 5-level?

5. What is a written practice that establishes requirements and procedures for qualification and certification of USAF field-level civil service personnel performing NDI in aerospace service, maintenance and overhaul operations?

014. Maintenance levels

1. Name the three levels of maintenance in order from the lowest to the highest.

2. What level of maintenance is generally performed in an NDI laboratory?

3. Match a maintenance level from column B to each type of maintenance in column A. Items in column B may be used more than once.

Column A	*Column B*
____ (1) Performs major overhaul of aircraft.	a. Organizational maintenance.
____ (2) Services aircraft with fuel and oil.	b. Intermediate maintenance.
____ (3) Performs TCTO modifications when facilities are available.	c. Depot maintenance.
____ (4) Supplies spare parts to organizational level.	
____ (5) Performs routine inspections of aircraft.	
____ (6) Supplies NDI technician to verify a suspected defect.	
____ (7) Maintains fuel for aircraft.	

4. What workcenters are affected by 2LM?

015. Maintenance inspection policy

1. What are the five authorized scheduled inspection concepts used by the Air Force?

2. What publication outlines all inspection requirements for a weapon system?

3. When are HPO inspections accomplished?

4. What is a PE inspection?

5. What are combined HPO and PE inspections called?

6. What is the main objective of the PH inspection concept?

7. What periods are used for isochronal inspections?

8. What isochronal inspections will normally involve NDI?

9. Which isochronal inspection is similar to a PE?

016. Maintenance symbols and their use

1. What is the purpose of maintenance symbols?

2. When can you erase maintenance symbols?

3. Match a maintenance level from column B to each type of maintenance in column A. Items in column B may be used more than once.

Column A	*Column B*
____ (1) The condition of the aircraft is unknown.	a. Red dash.
____ (2) An unsatisfactory condition exists, but not serious enough to prevent aircraft use.	b. Red diagonal.
____ (3) A piece of equipment is unsafe or unfit for use.	c. Red X.
____ (4) A critical flight control linkage is disconnected.	d. Black initial.
____ (5) A scheduled PE is overdue.	
____ (6) A discrepancy is cleared and the condition is now satisfactory.	

017. Air Force deficiency reporting system

1. What TO contain DR procedures?

2. What category DR is submitted for poor workmanship which won’t harm anyone?

3. What are the four levels of the DR reporting process?

4. Personnel in what point act to correct DR deficiencies (if appropriate)?

3–2. Maintenance Management Documentation

Management of aerospace system maintenance relies first and foremost on *complete and accurate documentation*. Documentation starts with you, the technician performing maintenance. If you fail to properly document your maintenance actions, the entire system fails.

The key to good documentation is good data. Knowing this, the Air Force has developed a system for maintenance data documentation (MDD) that standardizes how data is gathered, stored, and retrieved. MDD also standardizes common elements of data applying to all weapon systems and equipment. This standardization ensures all personnel have a common reference when documenting maintenance or researching maintenance trends. The benefit may not be apparent to you right away, but this system provides extensive savings to the Air Force through better management decisions made with sound, factual data.

018. Maintenance data documentation process

The importance and usefulness of data makes it essential MDD is as accurate as possible. To simplify data recording and improve the accuracy of input data, the MDD process uses coded information. The use of data codes also facilitates data retrieval for reports or summaries used in maintenance management.

In this lesson we will look at the objectives, scope, key codes, and concept of the MDD process that you will need to document maintenance.

Objectives

The objectives of the MDD process are to provide a means of collecting, storing, and retrieving base, depot, and contractor maintenance data. The MDD process also establishes the specific uses of data.

NOTE: At one time, MDD was used to determine manpower requirements. Although still a consideration, it is no longer the primary source for decisions. Work centers inflating maintenance repair or inspection times to justify additional manpower won’t accomplish their goals and will corrupt data used for other management decisions.

Scope

The MDD process begins during the first operational tests of an equipment item and continues through the entire life of the item. MDD applies to the following:

- All maintenance functions.
- All units maintaining MDD reportable training equipment.
- Contractors (when specified in contracts).
- Depots (when accomplishing maintenance on MDD reportable equipment).
- Historical documentation.

Concept

The MDD process includes all aspects of collection, storage, and retrieval of data. Data serves an important function in MDD beyond showing what maintenance was performed, who did it, when it was completed, where it was accomplished, and how it was done. Data is used both at the site where it’s collected and by the Air Force management and engineering agency, MAJCOMs, and the DOD.

Locally, data provides supervisors with feedback on maintenance operations, manpower, equipment status, workcenter taskings, and weapon system configuration information. Off base, data assists in managing Air Force and MAJCOM programs established in instructions or manuals. It’s also used to identify reliability, maintainability, and availability of Air Force equipment, establish priorities for improvements, and identify safety deficiencies.

As you can see, data has an unlimited number of beneficial uses. However, without being accurate, collected data is useless.

Documentation categories

All MDD can be grouped into two categories: on-equipment and off-equipment.

On-equipment MDD

Any data documented to describe maintenance performed on an end item piece of equipment is called on-equipment MDD. An end item is any complete, operational piece of equipment. An example of an on-equipment item is an inspection on an aircraft or an engine component.

Off-equipment MDD

Generally, data documented to describe maintenance on assemblies, subassemblies, or components removed from an end item of equipment is called off-equipment MDD. An example of an off-equipment item is a wheel assembly, torque tubes, or any part of an aircraft component that has been removed.

Data is usually required to be entered into a database in one of four cases.

1. A discrepancy is discovered during scheduled maintenance.
2. Unscheduled events are discovered and entered as discrepancies as they occur.
3. A discrepancy may be discovered as a result of a specific aircraft flight during debriefing.
4. Discrepancies may be discovered by on-board recording devices.

Documentation rules

Support of the MDD process requires rules to ensure documentation is accomplished consistently.The rules are in place to specify data formats and when to use which data codes. Specific rules are found in the following sources:

- 00–20 series TOs.
- Aircraft maintenance manuals.
- Air Force, MAJCOM, or local instructions.

Now we look at the key data elements and codes you need to know to provide accurate and standardized data to the MDD process.

Maintenance information systems

To this point, we have not specifically covered the automated systems used by the Air Force to manage data. Although computer advancements have made data storage and retrieval far more efficient than only a few years ago, one basic premise is that the basic process of MDD does not change, regardless of the system you are using to store data. New systems are being evaluated by the Air Force while those systems currently in use are continuously upgraded. Your installation is responsible for providing detailed training on the particular systems you will use.

Maintenance information systems (MIS) refers to automated maintenance information systems that support and enable maintenance business processes. MIS is used to document maintenance actions and track fleet health. The information entered into the MIS is accomplished IAW TO 00–20–2, *Maintenance Data Documentation* and matches the content of the aircraft forms. MIS data entries do not have to be accomplished by the same individual who documented the aircraft forms, but employee numbers/man numbers/USERIDs of individuals accomplishing the actual work are entered into the MIS.

The two most prominent automated management systems used by the Air Force are the Integrated Maintenance Data System (IMDS) and GO81 (on which you will receive more extensive training at your unit). GO81 is an automated system developed by Air Mobility Command (AMC) and is only used by AMC bases.

Three key data elements are used to authorize and control maintenance:

1. Job control number (JCN).
2. Workcenter code.
3. Identification (ID) number.

When used in conjunction with other data elements in MDD, the JCN, workcenter code, or ID number plays a vital role in identifying, controlling, and analyzing maintenance actions.

Job control number

The JCN is used to report, control, and identify every maintenance action. All authorized maintenance jobs are assigned a JCN. No maintenance is authorized without a JCN unless you have specific knowledge a JCN will be assigned. Each individual job requires a JCN and every workcenter performing tasks related to the job uses the same JCN. This enables retrieval of all tasks related to the single job for analysis.

A base-level JCN consists of nine characters. The first five characters represent the complete Julian date such as 16041 for 10 February 2010 or 16363 for 29 December 2016. The last four characters are used to identify jobs and usually consist of daily or monthly sequence numbers such as 0001 for the first job of the day or month. Using these examples, the JCN 163630024 would identify the 24th job on 29 December 2016 or the 24th job for December 2016.

As outlined in TO 00–20–2, *Maintenance Data Documentation,* hourly and calendar phased inspections are assigned an alpha or numeric character to the sixth position.Additionally, hourly and calendar phased inspections normally have blocks of sequence numbers reserved for the seventh, eighth, and ninth positions to assign to discrepancies discovered during the scheduled inspection. Therefore, a JCN of 16245C124 indicates the 124th job assigned during the hourly or calendar phase started on 2 September 2016.

Workcenter code

The workcenter code is used to identify organizational elements to which maintenance personnel are assigned. Standard workcenter codes are used by all organizations engaged in maintenance functions. There are four types of workcenters referred to in the MDD process: (1) owning, (2) performing, (3) reporting, and (4) nonreporting.

Owning workcenter

The owning workcenter is the workcenter having the basic custodial and maintenance responsibility for an item of equipment

Performing workcenter

The performing workcenter is a workcenter that performs maintenance or contributes labor towards a maintenance requirement. When maintenance is performed by owning workcenter personnel on their own equipment, they represent both the owning and performing workcenters.

Reporting workcenter

A reporting workcenter is any workcenter to which maintenance personnel are assigned.

Nonreporting workcenter

A nonreporting workcenter can be anywhere maintenance personnel may expend man-hours, but no maintenance personnel are actually assigned. Examples of nonreporting workcenters are those for maintenance contractors who provide maintenance data, or for training equipment which isn’t assigned to maintenance, but requires maintenance support.

Workcenter code characters

Workcenter codes consist of five characters with the format varying across MAJCOMs and individual Air Force units. You will find that the local workcenter code for the NDI laboratory can be, and is often, different at each Air Force installation. The first position of the workcenter code can be either

an alpha or a numeric character and identifies divisions, wings, separate squadrons, or commands located on a base. The second through fifth positions are all either alpha or numeric and identify progressive sub-functions under the first position on the base. This results in every workcenter having a unique five-position code for reporting its maintenance activities.

A sample NDI laboratory code could be *AEMFN*. This is broken down as follows:

A	might indicate the wing
E	indicates the equipment maintenance squadron (EMS)
M	indicates the maintenance sub-function of EMS
F	indicates the fabrication flight
N	indicates the NDI laboratory within the flight

NOTE: As stated before, this is only an example and your particular workcenter code may vary.

Identification number

Like the workcenter code, an ID number also has five characters. The ID number is used to identify a specific piece of equipment. The first position of the ID number is normally the type of equipment. For example:

	Used to indicate:
A	Aircraft
M	Missiles
E	Engines

The last four positions are normally the same as the last four characters of the equipment serial number. However, to avoid ID number duplication, local methods of modifying the last four positions can be developed. There are three basic categories of ID numbers:

1. ID numbers assigned to specific end items of equipment (i.e. aircraft, missiles, engines, guns, pods, and ground equipment).
2. ID numbers assigned to certain calibratable equipment.
3. ID numbers assigned to select items of support equipment, such as dollies, stands, or other equipment, on which maintenance is performed, but detailed identification for failure analysis isn't required.

Some equipment does not lend itself to ID numbering. Examples include the following:

- Equipment frequently transferred between workcenters.
- Items on which maintenance is infrequently performed.
- Items not assigned to maintenance organizations.
- Items subject to only off-equipment maintenance actions.

Maintenance data documentation codes

Information repeatedly input into MDD system (by numerous maintenance activities) is coded for standardization. Specific MDD codes are established and listed in the 00–20 series TOs and –06 aircraft manuals. The following are just some of the more common MDD codes you can expect to see and use regularly.

Type maintenance code

The type maintenance (TM) code consists of one character identifying the type of work accomplished. All –06 aircraft manuals list TM codes used for the applicable aircraft and many include specific codes to identify NDI or oil analysis maintenance actions.

Work unit code

You will often hear –06 aircraft manuals referred to as work unit code (WUC) manuals because the work unit code section often accounts for more than 90 percent of the manual. A WUC consists of five characters and is designed as a quick reference to identify primary systems, subsystems, and components on an end-item. WUCs are used as the primary method for accomplishing the following:

- Sorting the information used to track maintenance performance.
- Determining maintenance requirements.
- Identifying trends in component failures.

Action taken code

An action taken code (ATC) is a single character used to identify the maintenance action taken to clear a discrepancy or show a portion of maintenance performed. A complete list of authorized ATCs is listed in the appendix to TO 00–20–2.

When discovered code

The when discovered code (WDC) is a one-character code and indicates when a defect, discrepancy, or maintenance action was discovered. Just as the same JCN is used when multiple maintenance actions are required, the WDC assigned when the discrepancy was first discovered will be used for all maintenance actions. A list of WDCs is contained in the appendix to TO 00–20–2 and in –06 manuals.

How malfunctioned code

Consisting of three characters, the how malfunctioned code is used to identify the nature of a defect and *not* the cause of the discrepancy. The Air Force maintains a limited number of how malfunctioned codes to simplify reporting. This means there may not be a code specifically describing a defect you encounter. In such a case, use the code most nearly identifying the nature of the defect. If multiple defects exist on the same WUC item, use the code that indicates the most predominant failure or malfunction. How malfunctioned codes are listed in –06 manuals and the appendix to TO 00–20–2.

Employee number

Employee numbers serve to identify every technician assigned to the local maintenance community. The employee numbers provide a rapid means of determining who performed a specific maintenance action. When two or more technicians act as a team to correct a maintenance discrepancy, the senior member or team leader uses his or her employee number to record the action. The format for employee numbers can vary depending on computer systems and local means of assignment.

019. Maintenance forms

There are literally thousands of forms in the maintenance community. Some forms you need to become familiar with because of their importance and the time you will spend filling them out. First let’s look at the repair cycle and how maintenance is tracked.

Repair cycle system

A basic Air Force concept is to perform repairs at the lowest level of maintenance, to the greatest extent possible, consistent with good management practices. In addition, troubleshooting and repairs are extended to the lowest possible component or part. Repairs are not limited to the procedures found in equipment TOs. Unless specifically prohibited, the procedures in general maintenance TOs and common sense maintenance actions should be used to aggressively pursue local repair options. Defective Air Force components are replaced with a like item, repaired in place, or removed, repaired, and reinstalled.

Due to their critical nature, repair cycle assets are those items requiring a one-for-one swap before they can be issued from supply. Some examples of repair cycle assets might include the following:

1. Aircraft flight controls, skin panels, or other components.
2. Missile components.
3. Munitions handling, storage, or transportation equipment.
4. Any assets with supply shortages, high value, or sensitive nature that are designated.

When repair cycle assets are removed for maintenance work, they enter the repair cycle system. The particular layout of the repair cycle system on each base will vary depending on the MAJCOM, organizational layout, and weapon systems supported. Centralized repair processing or control centers should be physically located near the center of the maintenance complex surrounded by the supporting shops performing the various repair and inspection actions.

Tracking and processing repair cycle assets

Whenever you receive a component in the NDI laboratory, whether it is a repair cycle asset or a generic part, you track it using an AFTO Form 350, Repairable Property Processing Tag (fig. 3–2). This two-part form is used to identify an item, tell you where the item originated from, and provide data needed to properly document shop actions into MDD systems. Part I of the form is the repair cycle processing tag. Part II serves as a production-scheduling document to track maintenance actions. Some base organizations may bring you parts to be inspected without an AFTO Form 350. Normally, this will only apply to organizations not part of the maintenance complex such as civil engineering, the base fire department, base services facilities, or contractors. Local procedures should be developed to track and document maintenance on these components.

AFTO FORM 350
20121109

PREVIOUS EDITIONS MAY BE USED

REPARABLE ITEM PROCESSING TAG

Public reporting burden for this collection of information is estimated to average 10 minutes per response, including the time for reviewing instructions, completing and reviewing the collection of information. Send comments regarding this burden estimate to any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 120, Arlington, VA, 22202-4302, and the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington DC 20503. Please DO NOT RETURN your form/questionnaire to either of these addresses. Send your completed form/questionnaire to: Prime Weapon

1. JOB CONTROL NO.	2. I.D. NO./SERIAL NO	3. TM	3A. SRD	4. WHEN DISC
16245471				F

5. HOW MAL	6. MDS	7. WORK UNIT CODE OR LOGISTICS CONTROL NO	8. ITEM OPER TIME	9. QTY
		27DØØ		19

10. FSC	11. PART/LOT NUMBER
3270	E432-741-Ø1

12. SERIAL NUMBER	13. SUPPLY DOCUMENT NUMBER
103-Ø2	

14. DISCREPANCY
Force Adapter Fittings Req NDI (Magnetic Particle Inspection) IAW TO 33C-2-76-1 SupE

15. SHOP USE ONLY

15A. DMC/ACT ID	15B. SHOP ACTION TAKEN

16. SUPPLY DOCUMENT NUMBER

17. NOMENCLATURE
Force Adapter Fittings

18. PART NUMBER	18A. WORK UNIT CODE OR LOGISTICS CONTROL NO.
E432-741-Ø1	27DØØ

19. NSK

20. ACTION TAKEN	21. QTY	22. RPC USE ONLY
	19	

Figure 3–2. AFTO Form 350, front.

Depending on the organizational structure at your base, personnel in a designated central office continuously monitor the location of repair cycle assets, their status, and when they may be returned to serviceable condition. Your job, as an NDI technician, is to inspect the asset as quickly as possible and properly document your actions in the applicable MDD system. Once you've done that, the item can be returned to the owning workcenter, repair cycle center, or next shop in the maintenance chain.

All personnel routinely dealing with a repair cycle system should be familiar with detailed requirements outlined in TO 00–20–3, *Maintenance Processing of Reparable Property and the Repair Cycle Asset Control System*, as well as MAJCOM and local guidance.

Inspection of repair cycle assets

As part of the Air Force QA program, maintenance and supply functions designate certain representatives to serve as inspectors. Maintenance inspectors include QA inspectors, production inspectors, and designated maintenance supervisors. These folks verify the quality of all asset maintenance including repair, overhaul, modification, local manufacture, or restoration to serviceable condition for all materials and equipment at USAF facilities. Designated maintenance inspectors will also determine the final

condition of property. This includes items repaired, reclaimed, manufactured by the maintenance community, or removed from service.

Aircraft forms

There are literally thousands of forms in the maintenance community. You are not expected to know all of these forms; however, there are some forms you need to be very familiar with because of their importance and the time you will spend filling them out. Among the most important to you are the AFTO Form 781 series of aircraft maintenance forms. As an NDI technician you will spend quite a bit of time either finding data or documenting maintenance on these forms. For this reason, we look at these forms in some detail. For any additional information concerning these forms, refer to TO 00–20–1.

AFTO Form 781 series

As the name implies, the AFTO Form 781 is actually a series of forms. The AFTO Form 781 series of aircraft records consist of the following forms:

1. AFTO Form 781, Aviation Resource Management System (ARMS) Aircrew/Mission Flight Data Document.
2. AFTO Form 781A, Maintenance Discrepancy and Work Document.
3. AFTO Form 781B, Communications Security (COMSEC) Equipment Record.
4. AFTO Form 781C, Avionics Configuration and Load Status Document.
5. AFTO Form 781D, Calendar and Hourly Item Inspection Document.
6. AFTO Form 781E, Accessory Replacement Document.
7. AFTO Form 781F, Aerospace Vehicle Flight Report and Maintenance Document.
8. AFTO Form 781G, General Mission Classification – Mission Symbols.
9. AFTO Form 781H, Aerospace Vehicle Flight Status and Maintenance Document.
10. AFTO Form 781J, Aerospace Vehicle—Engine Flight Document.
11. AFTO Form 781K, Aerospace Vehicle Inspection, Engine Data, Calendar Inspection and Delayed Discrepancy Document.
12. AFTO Form 781L, Record of Removal/Installation of Controlled Cryptographic Items (CCI).
13. AFTO Form 781M, Status Symbols and Functional System Codes.
14. AFTO Form 781N, J–79 Engine Run-up Record.
15. AFTO Form 781P, Support General Documentation Record.

Use of the series collectively provides maintenance, inspection, service, configuration, status, and flight records for a specific aircraft. A set of AFTO Form 781 series is maintained for each aircraft in the Air Force inventory. The forms are normally maintained in a single loose-leaf binder on or near the aircraft.

Entries on these forms can be made by personnel in varying capacities. For example, the flight crew, crew chief, mechanics, and specialists are all authorized to make entries on one or more of these forms. The handwritten entries on maintenance documents will be made in black (pencil or ball point pen), unless otherwise specified.

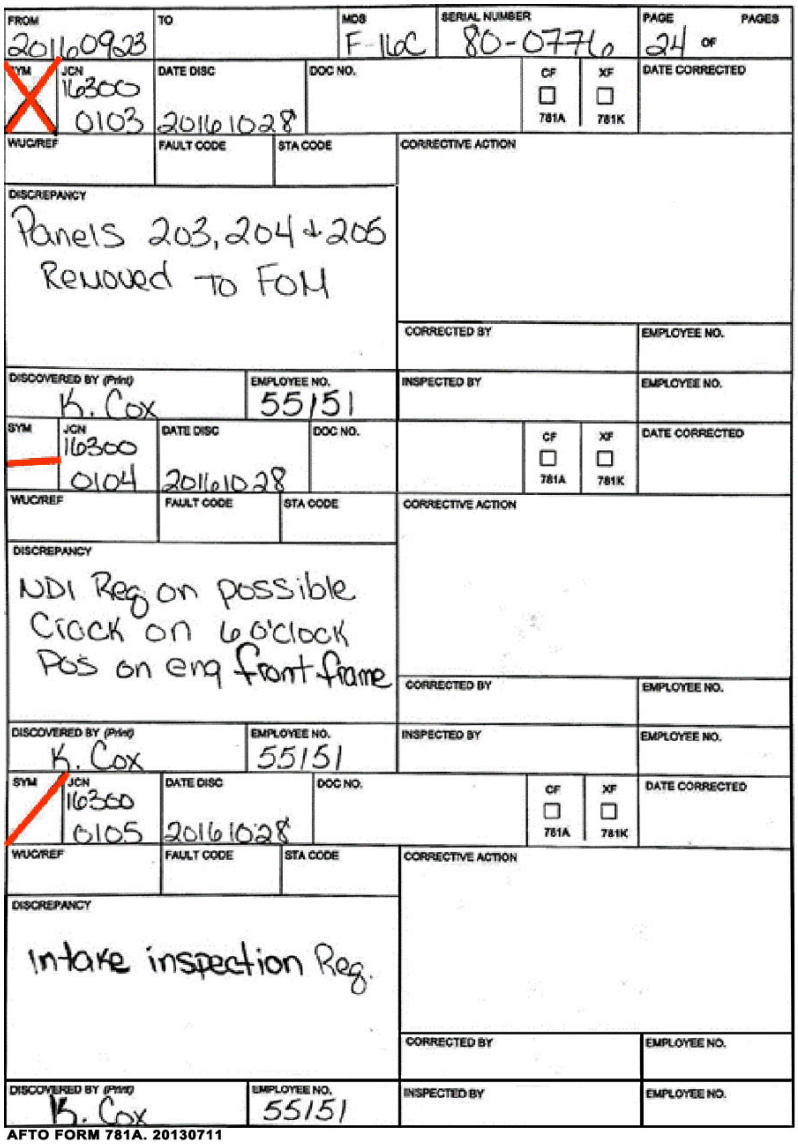
The aircraft commander ensures the forms properly reflect pertinent flight data and the flying time after each fight. The aircraft crew chief or alternate ensures that enough copies of these forms are aboard the aircraft. Also, the crew chief removes forms from the binder, transcribes open write-ups to a new AFTO Form 781A, and forwards the removed forms to the maintenance officer. After reviewing the forms, the maintenance supervisor sends the AFTO Form 781A to the documentation activity for filing.

Typical aircraft forms

Not all 15 of the forms previously listed are mandatory. Instead, only the AFTO Form 781, 781A, 781F, 781G, 781H, 781J, 781K, and 781M are required on each aircraft. Let's look at a typical binder arrangement and what data you can find on the forms. The AFTO Form 781F serves as the front cover of the binder and provides the basic information for identification of the aircraft. The AFTO Form 781G and 781M contain basic information to assist in filling out other 781 series forms and are filed in the rear of the binder. The remaining forms are normally placed in the order AFTO Form 781A, 781H, 781J, and 781K; however, this order is not required and MAJCOMs or units can place these forms in any standardized order.

AFTO Form 781A entries

The AFTO Form 781A (fig. 3–3) is the aircraft form you will see and use most often. It is used to document each discrepancy found and document corrective action taken to clear each discrepancy. Proper completion of aircraft forms is stressed by all levels of supervision. Documentation errors can lead to unsafe conditions jeopardizing the aircraft, flight crewmembers, or other maintenance technicians. Refer to figure 3–3 as we discuss some of the required entries on the AFTO Form 781A.



AFTO FORM 781A, 20130711

Figure 3–3. Sample, AFTO Form 781A.

PAGE___OF___PAGE block

If you ever are in the position to place a new page of 781As into the aircraft binder, you will need to fill out this block. These forms are numbered sequentially: 1 through the last page, with the front and back of the form being two separate pages. For example, if there are only two AFTO Form 781As in the binder, there would be four pages; the first form front is page 1, back is page 2, second form front is page 3, and back is page 4.

Fill in the PAGE___ half of the block with the appropriate consecutive page number and leave the OF___PAGES side of the block blank. Until all discrepancies have been documented, additional pages will be added throughout the day.

DATE FROM and TO blocks

The only time you would be concerned with these blocks is when you happen to be the person placing an additional page of 781As in the binder. Dates on AFTO Form 781 series forms are all entered in the format – YYYYMMDD. For example, 20100617 would indicate 17 June 2010. Enter the current date in the DATE FROM block when you fill in the first discrepancy on the form. Leave the TO block blank.

CREW CHIEF, ORGN, LOCATION, MDS, and SERIAL NUMBER blocks

Leave these blocks blank. They will be filled in by the crew chief or other authorized individual.

SYMBOL block

Enter the proper symbol (red X, red diagonal, or red dash) for each discrepancy documented. Nearly every NDI discrepancy that is documented on an AFTO Form 781A will be on a red dash indicating an unknown condition. *Remember, once entered, symbols will never be erased!*

When a discrepancy is corrected (cleared), the last name initial is placed over the symbol. Red dash and red diagonal symbols are initialed over by the individual who performs the corrective action. Red X symbols are initialed over by only those personnel designated and authorized to clear red X symbols.Specific instructions for clearing red X symbols are contained in TO 00–20–1.

If a symbol is entered in error, do not panic. Annotate one of the following statements in the CORRECTIVE ACTION block:

> “Symbol entered in error; discrepancy and correct symbol entered below,”
> or “Symbol entered in error no discrepancy exists.”

Then, sign the CORRECTED BY block and initial over the erroneous symbol. If the erroneous symbol is a red X and you aren’t authorized to clear the symbol, the erroneous entry must be cleared by a designated individual.

DATE DISC block

In this block use the format YYYYMMDD and enter the date the discrepancy was documented.

JCN block

In the JCN block use the phased inspection JCN, isochronal inspection JCN, and so forth, when available. If you are performing an NDI task not associated with other maintenance, use the JCN you were given or obtain a new JCN.

DOC NO. block

The crew chief or other personnel complete this block with a supply document number if something has been placed on order to fix this discrepancy.

WUC/REF block

Local policy will determine if you need to enter the WUC or reference designator into this block.

FAULT CODE block

Use of this block applies to those aerospace vehicles that use fault codes to aid in troubleshooting. The code is often computer generated and describes a system malfunction which references a narrative or troubleshooting procedure in a technical order.

STA CODE block

Use this block when any corrective action is accomplished away from home station and when maintenance or inspections are performed by someone other than home station personnel. Enter the four digit geographic location (GEO-LOC) identifier for the location where the maintenance or inspection was accomplished. The GEO-LOC code will be entered when the discrepancy or inspection is corrected or accomplished and signed off. Do not enter GEO-LOC codes when the aircraft is on a classified mission.

DISCREPANCY block

The person entering the defect in the AFTO Form 781A prints a complete description of the discrepancy in this block. Only one discrepancy is entered in each block, but if space is needed, use as many blocks as necessary to enter a single discrepancy. Any part or panel of an aircraft removed to facilitate other maintenance (FOM) or inspection, which would prevent the aircraft from flying or creates an unsafe condition if not reinstalled, is written up as a separate discrepancy in its own block on the 781A. This is required even if the part or panel is to be immediately reinstalled. This requirement also applies to anything maintainers attach to the aircraft that would prevent the aircraft from flying or cause an unsafe condition if not removed. As an NDI troop, your activities most likely will fall under the exception to this policy.

EXCEPTION: Procedures that require removal of a component as a step of the task and contain all of the steps for component removal/installation within the same procedure do not need to be documented separately. However, local policy at your base may impose additional requirements which require you to document certain tasks separately.

Any time one entry in the 781A is directly related to another entry, a reference will be made to the original discrepancy by using the “see page__4__, item (block) __3__ format.”

DISCOVERED BY and EMPLOYEE NO. blocks

Maintenance personnel print their first name initial and last name in the DISCOVERED BY block and print their employee number in EMPLOYEE NUMBER block.

CF TO 781 and XF (TRANSCRIBED) TO 781K blocks

The crew chief or designated personnel complete these blocks when discrepancies are carried forward to a new set of AFTO Form 781As or transferred to the AFTO Form 781K.

DATE CORRECTED block

When clearing a discrepancy, enter the date in the proper format in the DATE CORRECTED block.

CORRECTIVE ACTION block

When a defect is corrected, a brief description of the corrective action is documented in the CORRECTIVE ACTION block. For red X and red dash discrepancies, include TO reference (including page and paragraph/figure number) or equivalent, in the corrective action block. Local policies may specify additional minimum TO reference.

CORRECTED BY and EMPLOYEE NO. blocks

These blocks are used by NDI personnel who are clearing a discrepancy on a red diagonal. If you are clearing a red diagonal discrepancy, write your minimum signature (first name initial and last name), and employee number in the corrected by blocks. Then, place your last name initial over the red diagonal in the symbol block. If the symbol is a red X and you are not authorized to sign off (clear) a red X, but perform the inspection or other requirement to clear the discrepancy, enter your minimum

signature and employee number in the corrected by blocks. The authorized red X inspector completes the inspected by blocks and initials over the red X symbol.

INSPECTED BY and EMPLOYEE NO. blocks

These blocks are used by NDI personnel to clear all red dash discrepancies and inspect red X work completed by other NDI personnel. Technicians write their minimum signature in the INSPECTED BY block and employee number in its block, and place their last name initial over the red dash symbol. Authorized individuals clearing red X conditions complete these blocks in the same way.

AFTO Form 781H

The AFTO Form 781H, block 9, provides NDI technicians with the current airframe time on the aircraft. This is often used to determine whether inspections are due and to calculate the airframe time when future inspections will be due.

AFTO Form 781J

The AFTO Form 781J provides NDI personnel with all engine data for the aircraft including serial numbers, operating times, and oil added data. This form is often copied or faxed to NDI during 14-day record checks under the oil analysis program. If the aircraft assigned to your base have reoccurring NDI engine inspections, you will use the current engine operating hours on this form to establish the next time the inspection is due.

AFTO Form 781K entries

The AFTO Form 781K (fig. 3–4) could be the aircraft form with which you have the second highest contact. Aircraft hourly and calendar inspection requirements are tracked and updated using block G of this form. Many aircraft NDI inspections are included on this form. As an NDI technician, the only information on the AFTO Form 781K you routinely use is in Section G., Calendar and Hourly Inspection Schedule. Refer to figure 3–4 while we discuss this form.

INSPECTION ITEM block

The INSPECTION ITEM block will contain a short description of the hourly or calendar inspection requirement. Examples might include: NDI UT Insp Stage 2 Fan Blades, NDI Bulkhead 479.55, or 1200-Hour Insp of MLG Axles.

FREQUENCY block

This block will contain the frequency of the various inspection items. The frequency will be hourly or will cover a calendar period, such as the following:

1. 100-hour.
2. 50-hour.
3. 30-day.
4. 180-day.

Sometimes, the frequency of an inspection becomes the common term used by both NDI and non-NDI maintainers to when referring to an inspection. For example, if an NDI ultrasonic inspection on a strut is the only 100-hour inspection performed by NDI on a particular aircraft, it may simply be referred to as the “100-hour NDI inspection” for the aircraft.

NEXT DUE blocks

The NEXT DUE blocks contain the next airframe time, engine time, or calendar date an inspection is due. Once an inspection item is completed, line through the current time or date due and enter the next time or date due in the next block to the right on AFTO Form 781K. A corresponding AFTO Form 781A entry is required to document the discrepancy, the corrective action taken, and who completed the inspection for every inspection item updated.

FROM	TO	MDS	SERIAL NUMBER
20161010		F-16C	80-0015

A. AEROSPACE INSPECTION STATUS						B. ENGINE DATA					
NEXT PERIODIC, MAJOR, OR PHASED INSPECTION DUE NO.							ENG SER NO	ENG CHANGE DUE TIME		ENG SER NO	ENG CHANGE DUE TIME
TYPE	COMPL	NEXT DUE	COMPL	NEXT DUE		1	500347		5		
Phase	200 hr	2346.8	2546.8			2			6		
						3			7		
						4			8		

C. CALENDAR AND HOURLY INSPECTION SCHEDULE

INSPECTION ITEM	FREQUENCY	NEXT DUE	NEXT DUE	NEXT DUE	NEXT DUE
1200 hr MLG Insp	1200 hr	2600.0			
800 hr Flight Control Check	800 hr	~~2400.0~~	3200.0		
400 hr Battery Check	400 hr	~~2508.6~~	2908.6		
100 hr NDI FS 223.8 Insp	100 hr	~~2425.1~~	2525.1		
50 hr NDI EC NLG Strut Insp	50 hr	~~2409.9~~	~~2459.9~~	2509.9	
180 Day Egress Check	180 Day	16300			
60 Day A1C Wash	60 Day	16315			

AFTO FORM 781K, 20160325 PREVIOUS EDITION IS OBSOLETE AEROSPACE VEHICLE INSPECTION, ENGINE DATA, CALENDAR INSPECTION AND DELAYED DISCREPANCY DOCUMENT

Figure 3–4. Sample, AFTO Form 781K.

An aircraft forms scenario

To give you some practical experience in filling out 781 series forms we will use a scenario. Let’s say it has been a long week, its two o’clock on a Friday afternoon and you’re looking forward to the weekend. Unexpectedly, your shop gets a call for an unscheduled inspection from the flightline. The individual calling your shop does not know the exact job, but assures you they have been told it is an eddy current inspection somewhere on the airframe of F–16C aircraft 0776. You obtain the JCN for

the job, gather your technical data and equipment and dispatch to the aircraft. Once there, you need to determine if the aircraft is “safe for maintenance.” You learn the procedures for determining how to tell if an aircraft is safe for you to work on from your assigned OJT trainer. You must first locate the aircraft forms then open them to the AFTO Form 781A section. You try to locate an open discrepancy for NDI. Finding none, you turn to the AFTO Form 781K. Listed on the 781K form are three NDI requirements on airframe items that are possibly due. You flip to the AFTO Form 781H, look at block H, and note the current airframe time is 2461.1 hours. Turning back to the 781K, you see one inspection item, a “50Hr E/C NLG Strut Insp”, is next due at 2460.6 hours. Success at last!

It is now time to start the documentation process. You turn to the 781As and in the next open DISCREPANCY block you write, “NLG due 50hr NDI eddy current inspection.” You fill in the SYMBOL block with a red dash using your red pencil or pen and fill in the DATE DISC, DISCOVERED By and EMPLOYEE NO. blocks. You put the JCN you obtained earlier in the JCN block.

You complete your inspection using the –36 TO for the aircraft and find no defects. In the CORRECTIVE ACTION block you enter “50hr NLG NDI insp. C/W IAW TO 1F–16C–36. Page 4–59, para 4–109, No defects noted.” (C/W stands for complied with and IAW means in accordance with). You then sign off the INSPECTED BY and EMPLOYEE NO. blocks. You enter today’s date in the DATE CORRECTED block and place your last name initial over the red dash you entered earlier. Are you done? No, not yet.

You turn to the AFTO Form 781K; find the inspection you just did. You line through the next due time 2460.6, and enter “2511.1” in the NEXT DUE block to the right (2461.1 + 50 = 2511.1). This is the airframe time when this inspection is next due. Now you are finished.

This has been a basic overview of aircraft forms. In our discussion, we did not cover how you obtain a JCN (which varies from base to base). Additionally, some bases may have local procedures in place to modify some of the steps outlined. However, the material in this lesson should give you a good understanding of how all the items you have learned to this point tie together into one simple task.

020. Equipment forms

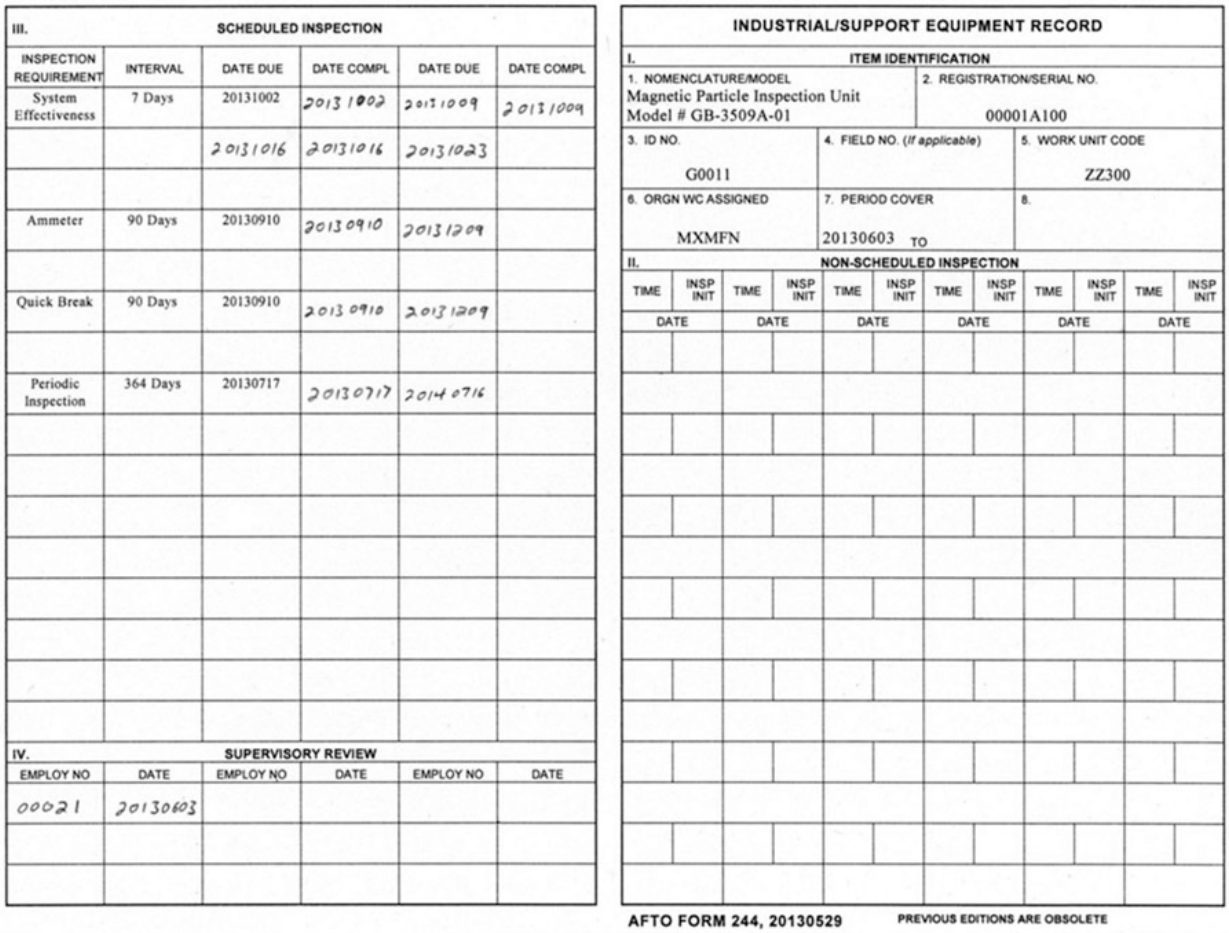
In addition to aircraft forms, you will also use equipment forms in your day-to-day operation. The form you should become most familiar with is the AFTO Form 244, *Industrial/Support Equipment Record* (fig. 3–5). In some circumstances, you may be asked to sign off an NDI inspection on an AFTO 244. However, you most likely will see the form in your own shop where it is used to document and schedule inspections on NDI equipment.

AFTO Form 244

AFTO 244s are used on support equipment (SE). SE includes all powered and nonpowered aerospace ground equipment (AGE); industrial plant equipment; test, measurement and diagnostic equipment (TMDE); test equipment; and special tools which require scheduled inspections. The AFTO 244 documents equipment discrepancies and corrective actions. It is also used to record service, periodic, and special inspections, and the current status of the equipment. Not only is this important to ensure Air Force equipment is properly maintained, but it allows the operator and mechanic to ensure equipment is safe to operate.

Air Force Technical Order 244	
Part	**Purpose**
I	Identify the SE for which the form is maintained.
II	Document servicing inspections.
III	Document scheduled inspections.

Air Force Technical Order 244	
Part	**Purpose**
IV	Document a supervisory review of the form.
V	Document equipment discrepancies and corrective actions.



III. SCHEDULED INSPECTION

INSPECTION REQUIREMENT	INTERVAL	DATE DUE	DATE COMPL	DATE DUE	DATE COMPL
System Effectiveness	7 Days	20131002	20131002	20131009	20131009
		20131016	20131016	20131023	
Ammeter	90 Days	20130910	20130910	20131209	
Quick Break	90 Days	20130910	20130910	20131209	
Periodic Inspection	364 Days	20130717	20130717	20140716	

IV. SUPERVISORY REVIEW

EMPLOY NO	DATE	EMPLOY NO	DATE	EMPLOY NO	DATE
00021	20130603				

INDUSTRIAL/SUPPORT EQUIPMENT RECORD

I. ITEM IDENTIFICATION

1. NOMENCLATURE/MODEL	2. REGISTRATION/SERIAL NO.	
Magnetic Particle Inspection Unit Model # GB-3509A-01	00001A100	
3. ID NO. G0011	4. FIELD NO. (*If applicable*)	5. WORK UNIT CODE ZZ300
6. ORGN WC ASSIGNED MXMFN	7. PERIOD COVER 20130603 TO	8.

II. NON-SCHEDULED INSPECTION

TIME	INSP INIT	TIME	INSP INIT	TIME	INSP INIT	TIME	INSP INIT	TIME	INSP INIT	TIME	INSP INIT
DATE		DATE		DATE		DATE		DATE		DATE	

AFTO FORM 244, 20130529 PREVIOUS EDITIONS ARE OBSOLETE

V. MAINTENANCE/DELAYED DISCREPANCY

9. T.O. 33B2-65-1-WA-1	10. NSN 6635-00-361-4631	11.	12.

DATE DISCOVERED	DISCOVERED BY / SUP DOC NO.	SYM-BOL	DISCREPANCY	JOB CON/ W.O. NO.	CORRECTIVE ACTION	DATE CORRECTED	CORRECTED BY / INSPECTED BY
20130603	M. TEUSCH	V	364 DAY PERIODIC INSPECTION	13198 0155	C/W 364 DAY PERIODIC INSPECTION IAW 33B2-65-1-WA-1	20130717	S. VITALE

Figure 3–5. AFTO Form 244.

Equipment discrepancies

The types of discrepancies recorded in Part V of the AFTO 244 include: required TO maintenance actions; overdue inspections; overdue time changes; and discrepancies discovered during operation. Whenever discrepancies are noted, promptly document them in Part V, using the appropriate symbol. These symbols are identical to the aircraft maintenance symbols you learned about earlier in this unit. A *red X* indicates the equipment is unsafe or unfit for use, and the equipment must not be used until the unsatisfactory condition is corrected. The *red dash* (–) indicates a required special inspection or operational check is due, or a scheduled inspection is overdue, and the equipment is in an unknown condition. This condition must be corrected as soon as possible by complying with the required action. The *red diagonal (/)* indicates an unsatisfactory condition exists, but is not sufficiently urgent or dangerous to warrant not using the equipment.

The last name initial entered in black over the symbol in the symbol block of the AFTO Form 244 indicates the individual has accomplished the required maintenance or has inspected the affected equipment. Upon initialing (clearing) the symbol, the individual closes out the discrepancy. Refer to TO 00–20–1 for complete information on using and documenting AFTO 244s.

Process Control Automated Management System

The Process Control Automated Management System (PCAMS) is a database developed for the NDI career field in an effort to reduce paper and improve the management of process controls and equipment maintenance. PCAMS is authorized to track equipment inspections and discrepancies as a form of computerized 244s. When PCAMS is used to manage 244s, there are a few minimal steps to follow:

- Print a daily inspection report at the beginning of each duty day. Each shift supervisor SHALL review PCAMS at the beginning of each shift to verify any equipment problems.
- Provide the employee number and initials of the person performing each inspection on the printed report as each inspection is completed. Remember to include the inspection results, as well. Transfer this information to the computer and file the printed report.
- Back-up PCAMS to a separate location once each week. The printed reports MAY be disposed of once all data is safely backed up.
- In case of deployments, inspections due prior to use (when required to document), or identified discrepancies, print out the AFTO Form 244 and maintain it with the item requiring the inspection.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

018. Maintenance data documentation process

1. What is the objective of MDD?

2. Who uses collected MDD process data?

3. What are the two categories of MDD?

4. What category of MDD is used for NDI of aircraft wheel bolts that are brought into the shop for inspection?

5. Why are there MDD rules?

6. What does MIS document and track?

7. What are the two most prominent automated management systems used by the Air Force?

8. What are the three key data elements used in MDD?

9. Write the JCN for the 134th job on 4 January 2014.

10. What does a letter in the sixth position of a JCN indicate?

11. What four types of workcenters use MDD?

12. How many characters make up a workcenter code?

13. In what publications are MDD codes normally listed?

14. WUCs are primarily used for accomplishing what?

019. Maintenance forms

1. What is a basic Air Force concept concerning repair?

2. What is a repair cycle asset?

3. What form is used to track and identify repair cycle assets?

4. What is your primary job, as an NDI technician, regarding repair cycle assets?

5. Who determines the final condition of repaired assets?

6. What is the series number of aircraft maintenance forms?

7. Who removes forms from an aircraft's binder?

8. What is the AFTO Form 781A aircraft form most often use for?

9. Who are red X symbols cleared by?

10. When a symbol is entered in error, what's entered in the AFTO Form 781A CORRECTIVE ACTION block?

11. What is the format for entering a date on an aircraft form?

12. When signing off a routine inspection on a red dash, in which AFTO Form 781A block would you sign your minimum signature?

13. Which AFTO Form 781 will show an NDI technician the current airframe time?

14. How do you update the next due time on the AFTO Form 781K?

020. Equipment forms

1. What form is used on support equipment?

2. What is the purpose of part V of an AFTO Form 244?

3. What does a red dash indicate when using an equipment discrepancy?

4. What is PCAMS authorized to track?

Answers to Self-Test Questions

013

1. AFSCs.
2. 1 – Helper, 3 – Apprentice, 5 – Journeyman, 7 – Craftsman, 9 – Superintendent.
3. 12 months.
4. 7-level craftsman proficiency.
5. NAS 410.

014

1. Organizational level, intermediate level, and depot level.
2. Intermediate level.
3. (1) c, (2) a, (3) a, (4) c, (5) a, (6) b, (7) b.
4. Avionics and engine workcenters.

015

1. (1) Periodic, (2) phased, (3) isochronal, (4) programmed depot maintenance, and (5) airline manufacturer maintenance.
2. –6 inspection TO.
3. After a specified number of accumulated flying hours.
4. A thorough and searching inspection of the entire weapon system.
5. Phased inspections.
6. Minimize the length of time an aircraft is out of commission.
7. Calendar periods.
8. HSCs, minor and major inspections.
9. Major.

016

1. Make important information instantly apparent.
2. Never.
3. (1) a, (2) b, (3) c, (4) c, (5) a, (6) d.

017

1. TO 00–35D–54.
2. Category II.
3. (1) Originator, (2) originating point, (3) screening/action point, (4) support point.
4. Action point.

018

1. Provide a means of collecting, storing, and retrieving base, depot, and contractor maintenance data.
2. Personnel at the site where the data is collected as well as the Air Force management and engineering agency, MAJCOMs, and DOD.
3. On-equipment and off-equipment.
4. Off-equipment.
5. To ensure documentation is accomplished consistently.
6. Document maintenance actions and track fleet health.
7. The integrated maintenance data system (IMDS) and GO81.
8. (1) JCNs, (2) workcenter codes, and (3) IDs.
9. 140040134.
10. The JCN is for an hourly or calendar phased inspection.
11. (1) Owning, (2) performing, (3) reporting, and (4) nonreporting.
12. Five.
13. 00–20 series TOs and –06 aircraft manuals.
14. Serves as a quick reference to identify a primary system, subsystem, and component on an end-item.

019

1. Perform repairs at the lowest level of maintenance, to the greatest extent possible, consistent with good management practices.
2. An item requiring a one-for-one swap before being issued from supply due to their critical nature.
3. AFTO Form 350.
4. Inspect the asset as quickly as possible and properly document your actions in the applicable MDD system.
5. Designated maintenance inspectors.
6. 781.
7. Aircraft crew chief.
8. To document each discrepancy found and document corrective action taken to clear each discrepancy.
9. Only those personnel designated and authorized to clear red X symbols.
10. “Symbol entered in error; discrepancy and correct symbol entered below” or “Symbol entered in error no discrepancy exists.”
11. YYYYMMDD.
12. INSPECTED BY block.
13. 781H.
14. Line through the current due time (hours or date) and enter the new due time in the adjacent NEXT DUE block.

020

1. AFTO 244s.
2. Document equipment discrepancies and corrective actions.
3. Indicates a required special inspection or operational check is due, or a scheduled inspection is overdue, and the equipment is in an unknown condition.
4. Equipment inspections and discrepancies as a form of computerized 244s.

Complete the unit review exercises before going to the next unit.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter.

Do not return your answer sheet to AFCDA.

31. (013) All of these are requirements for an initial journeyman skill level *except* you must
    a. be an E–1 through E–4.
    b. complete NDI 5 level CDCs.
    c. complete all 5 level core tasks.
    d. complete 9 months of on-the-job training.

32. (014) From the lowest to the highest, what are the three levels of maintenance capability?
    a. Organizational, intermediate, depot.
    b. Depot, intermediate, organizational.
    c. Intermediate, organizational, depot.
    d. Organizational, depot, intermediate.

33. (014) Which level of maintenance involves major repairs and overhaul?
    a. Field.
    b. Depot.
    c. Intermediate.
    d. Organizational.

34. (015) Which inspection involves a thorough and searching review of an entire weapon system?
    a. Minor.
    b. Phase (PH).
    c. Periodic (PE).
    d. Isochronal (ISO).

35. (015) Which inspection attempts to *minimize* the length of time an aircraft is down for inspection?
    a. Minor.
    b. Phase (PH).
    c. Periodic (PE).
    d. Home station check (HSC).

36. (015) Which inspection is based on calendar days?
    a. Phase (PH).
    b. Periodic (PE).
    c. Isochronal (ISO).
    d. Hourly post flight (HPO).

37. (016) Which maintenance symbol would be used to indicate a scheduled periodic (PE) inspection is overdue?
    a. Red X.
    b. Red dash.
    c. Black initial.
    d. Red diagonal.

38. (016) Which symbol signifies that an unsatisfactory condition exists?
    a. Red X.
    b. Red dash.
    c. Black initial.
    d. Red diagonal.

39. (017) Category I deficiency reports (DR) are *not used* to report conditions
    a. that may cause death.
    b. that may cause a major system loss.
    c. resulting from nonconformance to specifications.
    d. which, if uncorrected, could unacceptably restrict combat readiness.

40. (018) Maintenance data documentation (MDD) is grouped into what categories?
    a. On- and off-equipment.
    b. End item and off-equipment.
    c. End item and support equipment.
    d. On-equipment and support equipment.

41. (018) You would not find maintenance data documentation (MDD) rules in
    a. aircraft maintenance manuals.
    b. TO 00–20 series TOs.
    c. local instructions.
    d. TO 00–35D–54.

42. (018) Maintenance information system (MIS) refers to an automated maintenance information system that supports and enables what?
    a. Classified data.
    b. Inspections due prior to use.
    c. Maintenance business processes.
    d. Indicates individuals has accomplished the required maintenance.

43. (018) Which maintenance data documentation (MDD) code is used as the primary method of sorting information?
    a. Work unit.
    b. When discovered.
    c. Type maintenance.
    d. How malfunctioned.

44. (018) The Air Force maintains a limited number of these maintenance data documentation (MDD) codes to simplify reporting?
    a. Work unit.
    b. Action taken.
    c. When discovered.
    d. How malfunctioned.

45. (019) Which is *not* a maintenance inspector function?
    a. Determine the final condition of a locally manufactured part.
    b. Certify a part is restored to serviceable condition.
    c. Verify the quantity of modified parts is correct.
    d. Inspect the quality of a repair.

46. (019) All engine flight data can be found on Air Force Technical Order (AFTO) Form
    a. 781A.
    b. 781H.
    c. 781J.
    d. 781K.

47. (019) What is the correct format for entering a date in the 781 series forms?
    a. MMDDYY.
    b. YYMMDD.
    c. YYYYMMDD.
    d. YYYYDDMM.

48. (019) Which blocks are used by nondestructive inspection (NDI) personnel to clear all red dash discrepancies?
    a. Inspected by and employee no. blocks.
    b. Corrected by and employee no. blocks.
    c. Discovered by and employee no. blocks.
    d. Corrective action and date corrected blocks.

49. (020) What is used to record service, periodic, and special inspections, and the current status of equipment?
    a. 781A.
    b. TMDE.
    c. AFTO 242.
    d. AFTO 244.

50. (020) What indicates a special inspection or operational check is due, a scheduled inspection is overdue, and the equipment is in an unknown condition?
    a. A red X.
    b. A red dash.
    c. A diagonal.
    d. A last name initial.

51. (020) What is a database developed for the nondestructive Inspection (NDI) career field in an effort to reduce paper and improve the management of process controls and equipment maintenance?
    a. MDD.
    b. TMDE.
    c. PCAMS.
    d. AFTO 244.

Please read the unit menu for unit 4 and continue ➔

Unit 4. Safety

DO YOU EVER ASK yourself, “Am I doing this task safely?” You probably do not consciously ask this question every time you do something—no one does—but you should! Only through a continuing conscious effort toward safety can you ever hope to be an accident-free worker. Perhaps, you think your instincts will prevent you from committing an unsafe act. Are you willing to bet your wellbeing, and perhaps your life, on your instincts? If so, you are probably an accident waiting to happen. From these statements you can determine the purpose of this unit is to focus your attention towards making safety a conscious habit.

Everyone in the Air Force should have an understanding of how to act safely in all situations. You have probably heard the statement, “Accidents don’t just happen, they’re caused.” In fact, unsafe acts by well-meaning people cause about 90 percent of all accidents. In this unit, we discuss the fundamentals of safety and accident prevention in your workcenter and on the flightline.

4–1. Laboratory and Flightline Safety

The Air Force recognizes the role safety plays in mission accomplishment and states its position as follows: “The Air Force will conduct a comprehensive and aggressive program to protect all Air Force personnel from work-related deaths, injuries, and occupational illnesses.” The program includes all safety, fire prevention, and health activities affecting the safety and health of Air Force personnel at their workplace.

Each individual is responsible for understanding safety standards established to prevent personal injury and damage to equipment and property. If every individual successfully discharged this responsibility, we would live and work in an environment virtually free of accidents.

AFOSH standards and local base directives govern normal flightline operations and maintenance. These policies prescribe your behavior while performing maintenance on the flightline and gives directions for the safe use of motor vehicles in support of flightline operations.

021. Accidents

Identifying and eliminating accident causes are the foundation for any effective accident prevention program. Mishaps result from a chain of events usually including one or more unsafe acts or conditions. In theory, mishaps can be prevented by eliminating just one unsafe act to break the chain of events. In practice, this is not very realistic because we cannot always predict the result of a series of events. The objective is to prevent mishaps by eliminating all unsafe acts and conditions possible.

Unsafe acts or conditions are the result of one or more basic, or root, causes. If a basic cause can be identified and eliminated, the associated unsafe act or condition is removed from the accident sequence, and the accident cannot happen. Examples of some basic causes are deficiencies in training, supervision, attitude, and design. In addition to basic causes, all accidents have an immediate cause. Sometimes the immediate cause and the root cause are the same, but this is not usually the case. Immediate causes are those deficiencies immediately preceding the accident. Examples would include water or oil on a floor, ice on the road, a loose rug, a poorly tied knot, or any of a thousand other things directly resulting in an accident.

Let’s look at accidents within NDI operations. Personnel performing NDI operations on aircraft shall be familiar with general aircraft safety procedures as well as inspection safety associated with NDI.

The major sources of aircraft maintenance accidents are falls, strains from lifting, fire or explosion, electrical shock, crushing of body or limbs in moving components and walking into protruding objects. Removal of basic and immediate causes for accidents is normally accomplished through one of three methods: safety engineering, education and training, and enforcing safety standards.

Safety engineering

Safety engineering encompasses any physical protection measure designed to reduce or eliminate accidents. These protection measures can affect either the environment or equipment. Mechanical revisions or modifications may eliminate existing unsafe conditions. Special devices or accessories may correct specific unsafe conditions or prevent these acts. Properly designed machine guards, working platforms, personal protective equipment, and handrails are examples of safety engineering at work. In general, safety engineering involves controlling the work situation to minimize the physical hazards associated with accidents.

Education and training

Safety engineering only eliminates the physical unsafe conditions. Education and training are primary ways emotional or mental hazards associated with unsafe actions by individuals are eliminated. Through adequate instruction, personnel gain useful or necessary knowledge and develop safe attitudes. Safety consciousness developed through education is supplemented and broadened by training in specific practices and skills. Training protects all personnel by developing safe habits and practices.

Enforcing safety standards

Accidents can be prevented through adequate safety engineering, education, and training. However, no organized accident prevention effort is successful without effective enforcement, because many accidents are the direct result of violating safety principles. This is particularly true of vehicle accidents, many of which are caused by a conscious disregard for traffic laws. Each commander, staff officer, and supervisor is responsible for enforcing safety standards and regulations. They issue accident prevention directives to serve as guidance for their personnel. When these directives are not enforced, responsible personnel are condoning conduct that leads to accidents.

022. Good housekeeping and fire prevention

Good housekeeping plays an important role in the prevention of accidents in every workcenter including the nondestructive inspection laboratory. Poor housekeeping results in obstacles in walk areas, liquid spills, sawdust accumulations and the use of slippery surface cleaners. That is why it is important to practice good housekeeping, because it is everyone’s responsibility.

It is the job of the supervisor, technician, and apprentice to keep the shop clean and safe by not allowing tools, materials and debris to accumulate around the workcenter. Do not allow materials that could cause personnel to slip or stumble to accumulate on floors. Immediately after spillage, wipe up cleaning solvents, grease, oils, penetrant, emulsifier, or other substances that could cause someone to slip and fall. Ensure coolant hoses, power cables, and so forth are routed so workers do not trip on them. Unless they are permanently installed, return such items to proper storage places as soon as you finish using them.

Fire prevention

Fire is nothing more than the production of light and heat from the rapid oxidation of a combustible material. To produce fire, these three things must be present at the same time: fuel, heat, and oxygen. If any one of the three is missing, a fire cannot be started. With the removal of any one of them, the fire is extinguished.

Fuel

Fuel for a fire comes in one of these three forms: solid, liquid, and gas. Most substances burn only after the solid or liquid is partially vaporized or decomposed by heat to produce a gas.

Heat

The temperature at which a substance gives off vapors in a sufficient quantity to ignite is called the *flashpoint* of the substance. *Ignition temperature* is the minimum temperature required for a substance to initiate self-sustained combustion. Once the ignition temperature is reached, the fire itself produces all the heat necessary for combustion to continue.

Oxygen

Most fires draw oxygen from the air, which is composed of roughly 21 percent oxygen. A fire usually goes out when the oxygen content of the air drops below 16 percent.

Substance categories

Substances are normally grouped into one of these three categories: flammable, combustible, and nonflammable.

Substance Category	Required to Ignite	Examples
Flammable	No heating required	Gasoline
Combustible	Some degree of heating required	Wood Clothing
Nonflammable	Cannot ignite	Water Most metals

Flammable and combustible liquids and vapors

Generally, the term *flammable liquid* applies to a liquid having flashpoint below 100 degrees Fahrenheit (°F). However, any combustible liquid will produce flammable vapors if heated to, or above, its flashpoint. Combustible liquids that produce flammable vapors include kerosene, paint, and most cleaning solvents. Dangerous concentrations of flammable vapors can collect in an enclosed area at temperatures below the flashpoint of the liquid solvent, especially if the solvent is agitated vigorously. Two preventive measures you should always follow when using solvents are to remove all sources of ignition and provide adequate ventilation.

Storage of flammable or combustible liquids

Normally, no more than 10 gallons of flammable or combustible liquid is stored per cabinet in a closed container. Storage shall be limited to a 5-day supply of flammables and are limited to one cabinet. Storage cabinets are labeled FLAMMABLE—KEEP FIRE AWAY.

Oily waste

Dispose of oily rags and other oily combustible waste in a metal container with a self-closing lid. Empty these containers daily or move them to a safe location outside the building for scheduled pickup. Oily waste can spontaneously decompose, producing its own heat. Once the heat reaches a critical point, simply opening the lid can provide a sufficient quantity of oxygen for the waste to erupt into a ball of flame. Clearly mark metal storage containers OILY WASTE ONLY.

Sources of ignition

In order for a fire to start when you are working with a flammable or combustible material, there must be a source of ignition. An ignition source is any item capable of generating sufficient heat to cause a fire. The key to safely working around hazardous materials is to remove all potential ignition sources from the area. Obvious examples would include matches, lighters, and cigarettes. Where a complete prohibition of smoking is impractical, provide designated areas, approved in writing by the base fire marshal. Clearly mark and separate these areas from hazardous areas to preclude the possibility of fire or explosion.

Less obvious ignition sources include space heaters, not explosion-proof electrical equipment, any improperly fused electrical equipment, tools producing mechanical sparks, and static electricity.

Static electricity results from friction between small particles or from the contact and separation of two substances, one or both of which are nonconductive. The hazard from static is more severe in dry, cold weather than in humid, warm weather when most surfaces are coated with a film of moisture drawing off the charge. Many clothing materials such as rayon, nylon, silk, wool, and certain plastics generate static sparks.

To minimize fire potential, personnel should follow these simple rules:

1. Do not light or carry smoking materials into an environment with flammables or explosives.
2. Wear only approved clothing.
3. Bleed off any static charge on the body by momentarily touching a grounded metal object prior to entry into a flammable or explosive atmosphere. (**NOTE:** This is in addition to, not instead of, wearing the proper clothing).

Fire extinguishers

Hand-operated, portable fire extinguishers are provided for emergency use to extinguish or confine fires in their initial stages. Place them where they can be easily reached in an emergency. Identify the location of each extinguisher by signs or color markings. You should always call the base fire department immediately to the scene of a fire, regardless of how effective an extinguisher appears to be in combating a particular blaze. Costly destruction has resulted from unnecessary delay in reporting fires by waiting to see if the fire could be extinguished with equipment at hand.

023. General nondestructive inspection safety procedures

AFOSH standards are published by the Air Force to give all personnel information needed to provide the best possible shop and flightline safety. AFOSH standards provide occupational safety, fire protection, and occupational health guidance. These standards are of a general nature and general safety practices are discussed in this lesson.

General aircraft safety and specific NDI safety measures relating to each individual inspection method are found in, AFI 91-203 *Air Force Consolidated Occupational Safety Instruction* and TO 33B–1–1, *Nondestructive Inspection Methods, Basic Theory*. The safety measures found in them are included throughout this CDC under the individual inspection methods.

In addition to specific safety instructions for particular actions, there are general safety practices you must observe daily to protect yourself and others during the course of your work as outlined in your lab safety and bioenvironmental program. The few minutes you spend complying with these rules will pay off in the end.

Smoking

Smoking is not allowed inside Air Force buildings and should have a designated smoking area for each building. It is also prohibited in aircraft maintenance facilities, flightline areas and weapon storage and maintenance areas and NO SMOKING signs will be posed in areas where it would be dangerous to do so.

Horseplay

Not only is horseplay dangerous to people but it can and it has resulted in serious personnel injuries and extensive damage to aircraft. Horseplay shall not be tolerated even though harm is not intended when workers “fool around,” severe injuries and even fatalities may result from horseplay.

Jewelry

Wearing jewelry while performing maintenance or inspections is dangerous. Metal watches or rings conduct electricity and heat very rapidly. Even momentary contact with an electrical conductor can cause severe burns. Additionally, fingers have been ripped completely off because of snagging a ring while slipping, grabbing for support, or jumping from equipment. The following activities identified below have the potential for serious injury; therefore, jewelry shall not be worn while doing the following activities:

- Climbing, ascending or descending activities where personnel could fall or jump from elevated surfaces; major injuries may occur from a finger ring catching an object.
- Handling materials (e.g., warehousing, parts handling, operating equipment, packing and crating, and attaching and detaching equipment to tow vehicles).
- Operating machines or equipment; any type of work where individuals are exposed to moving machinery, rotating or revolving parts, or activities could result in their hands being caught by a moving part.
- Performing maintenance or inspections; this includes on aircraft or ground support equipment and civil engineering-type or transportation-type maintenance.

SAFETY NOTE: Protect yourself by removing all jewelry before starting any job.

Using technical data

The importance of following technical data cannot be overemphasized. Besides being the safe and authorized way of doing a job, technical data normally describes the most efficient way to get the job done. Pay particular attention to the TO sections marked with CAUTION, WARNING, or NOTE signs (fig. 4–1). These areas of the TO will let you know about specific safety considerations associated with a task. Your failure to heed these warnings could result in serious injury, equipment damage, or even death.

Figure 4–1. Caution markings.

Electrical equipment

Electrical equipment possesses a potential danger no matter how safely you operate it. Let’s look at several ways that you can minimize and eliminate some of the dangers. All stationary or portable electrical equipment must have three-prong plugs and be connected only to grounded three-wire outlets, or grounded in accordance with standard procedures. Extension cords used with portable electrical equipment must be three-wire type and with three-prong plugs and receptacles. All wiring must be of sufficient size to handle the load without overheating. Loose wires, frayed insulation, disconnected leads, and exposed power terminals are potential fire hazards and sources of personnel injury. You should never use electrical equipment until these conditions have been corrected. Supervisors are required to constantly check the operation of electrical equipment to detect and eliminate any faulty wiring condition that could cause worker injury or property damage.

Standard practice requires power to be turned off, and where practical, power cord disconnected, prior to adjusting electrical circuits inside equipment. In all cases, adjustments to equipment are only accomplished by qualified, authorized personnel. Adjustments to energized circuits will only be made when a power-on condition is essential.

High-voltage equipment, such as X-ray generating equipment, oil analysis equipment, or equipment using cathode-ray tubes and capacitors, must be discharged to ground prior to internal cleaning, adjustment, or maintenance.

Protective equipment

Personnel are the most valuable resource the Air Force has to protect. Millions of dollars are spent each year procuring safety equipment and training personnel in its use. However, the investment is useless if you fail to use the safety equipment provided for you. The following are some of the personal protective equipment items most often found in NDI labs:

- Face shields.
- Goggles or safety glasses.
- Rubber gloves.
- Rubber aprons.
- Safety-toe boots.
- Ear protection.

Face shields

Protection to the eyes and face is normally provided by wearing the proper face shield. A face shield usually consists of a headband with a transparent visor of nonflammable material attached in such a way that it can be pushed up and out of the way when not in use. Face shields are available in various sizes, strengths, and light-filtering capacity. Use your face shield when mixing chemicals or completing a job in which small flying particles or splashed liquids could hit you in the face or eyes. If a heavy aircraft wheel were accidentally dropped into the penetrant tank, a face shield would be a welcome piece of protective equipment.

Goggles

Industrial goggles are designed specifically to protect your eyes. Although they do not protect your face, they completely seal your eyes from harmful liquids or solids. When handling some extremely hazardous materials, both goggles and a face shield are required.

Rubber gloves

Wearing rubber gloves protects your hands from the solvents and chemicals normally used in NDI. The gloves considerably reduce the incidence of dermatitis, which at one time was highly prevalent in NDI operations. Protective gloves come in several different types including nitrite, surgical, and industrial rubber. The substances you’re protecting yourself from will determine which type of glove you need to wear.

Rubber apron

A rubber apron serves the same function as rubber gloves except for your body. It also provides an advantageous secondary benefit of protecting your clothes.

Safety-toe boots

It’s mandatory for all personnel working in industrial areas where heavy items are handled to wear safety-toe boots or shoes. If heavy objects accidentally fall or are dropped on your feet, this footwear will protect your toes from severe injuries.

Ear protection

Often, people seem to either forget or ignore safety equipment for their ears. Working on an Air Force base subjects you to numerous situations where hearing protection is essential for your safety. Aircraft engines, flightline ground equipment, and even in-shop equipment or tools will all produce noise at levels capable of permanently damaging your hearing. You are provided with earplugs and earmuffs. These are normally located in the NDI laboratory. Follow all safety directives concerning their use and you'll be able to hear things long after you've left the service.

Hazardous materials and waste handling

Solvents and other NDI materials may contain toxic or flammable vapors. It is very important to know how to handle, store, and dispose of the chemicals properly. Consult the safety data sheets (SDS) for specific information on hazards, effects, and protective equipment requirements. Each chemical SDS will be reviewed by the shop supervisor before the material is first put into use. If there is not a SDS for the material involved, contact your supervisor, the base Safety or Bioenvironmental Engineering Offices.

Storage and handling

Safety data sheet instructions for proper handling, storage, and disposal will be followed for each chemical stored in the NDI lab. Use cleaners and chemicals only in authorized areas and use as directed by the SDS and local Bioenvironmental Office directives.

Proper disposal

Waste material disposal shall be disposed of properly by the local Bioenvironmental Engineer Office directives. Each NDI lab may be different so make sure you know where to find the information for your lab.

Safe for maintenance Ensure the aircraft you are about to work on is safe for maintenance in accordance with the applicable weapons specific TO, any local operating instructions or checklist. This is to prevent injury to NDI personnel so it is pertinent that you review the steps required for each aircraft system before working on or near an aircraft. The following are general precautions and safety conditions:

- All safety pins will remain installed at all times, except when directed by procedures.
- Care should be taken when working around open doors with unprotected blade seals.
- Review all AFTO 781 forms prior to aircraft maintenance to identify hazards.
- To prevent death or serious injury, personnel shall not approach aircraft for 30 minutes after flight to allow static discharge to dissipate. Make sure the aircraft is statically grounded.
- Ensure aircraft has wheel chocks and are positioned correctly.

024. Driving on the flightline

Motor vehicles operating on the flightline are necessary to normal operations and maintenance. However, the placement of motor vehicles, ground equipment, aircraft, and personnel in close proximity to each other presents a significant potential for danger. Carelessness, haste, and disregard of existing standards by flightline vehicle operators are the primary causes of aircraft-vehicle collisions and personal injuries. The following are general safety standards you should follow as a vehicle operator to avoid accidents on the flightline. LOCAL POLICIES may be stricter and shall be followed. You will have to complete training and pass a test at your base before you are authorized to drive on the flightline.

Operator's inspection

Operators do not normally make major repairs to their vehicles; instead, transportation squadron specialists take care of the big problems. However, operators do have the responsibility for performing daily inspections on their vehicles using inspection guides and checklists. Most NDI laboratory vehicle inspections and deficiencies are recorded on AF Form 1800, Operator's Inspection

Guide and Trouble Report (General Purpose Vehicles) and brought to the attention of the appropriate agency. These inspections are essential for early detection of vehicle defects. Any person failing to properly document a known deficiency, and operating an Air Force vehicle, or operating a vehicle with undocumented, obvious defects affecting safe operation, may be charged with vehicle abuse and held personally liable for any resulting damage.

Speed limits

To minimize mishaps, a maximum speed limit of 5 miles per hour (mph) shall be enforced in and around shops. Below lists flightline speed limits for vehicles:

- General-purpose vehicles – 15 mph.
- Special purpose vehicles (tractors, tugs, forklifts, sweeper) – 10 mph.
- Vehicles in close proximity (within 50 feet) to aircraft – 5 mph.
- Vehicles responding to Red Balls (emergency flightline scenarios), exercises and precautionary landings are not authorized to exceed flightline speed limits.
- All emergency response vehicles (ambulances, and Security Forces) may exceed speed limits only with due regard for the safety of persons and property.

Vehicles will not be operated above these speed limits or exceed any speed deemed reasonable and prudent for existing traffic, road, and weather conditions.

Backing

The driver of a vehicle must not operate the vehicle in reverse unless it can be done with reasonable safety and without disrupting traffic. A spotter must be used when backing a vehicle towards an aircraft. Prepositioned wheel chocks shall be used to prevent vehicles backing into an aircraft.

Parked vehicles

Generally, vehicles will not be parked or driven less than 25 feet in front or 200 feet behind any aircraft with running engines. Unattended vehicles will be parked with the driver's side facing the aircraft and will not interfere with aircraft being towed or taxied. Additionally, the ignition will be turned off, keys left in the ignition, gear lever put in reverse gear for manual transmissions, and in 'park' if automatic. When leaving vehicles unattended, brakes will be set or chocks will be placed in front of and behind a rear wheel, or one chock placed between the tandem wheels of duel axle vehicles.

If you are parked next to an aircraft, you shall be clear of the wingtips and clearly visible from the aircraft cockpit.

Right-of-way

Vehicles must yield right-of-way to aircraft in all areas of the flightline including parking ramps, taxiways, and runways. Before crossing a taxiway, bring your vehicle to a complete stop and determine visually that the way is clear. Under NO circumstances will you drive a vehicle across a runway unless your duties require it AND you have received all appropriate training. If your duties do require you to cross a runway, you will receive comprehensive training on procedures to be followed.

Vehicle lights

If you are driving a vehicle at night you will need to turn on your flashing or parking lights when vehicles are temporarily parked on any part of the aircraft ramp or in inclement weather. Headlights will not be pointed toward moving aircraft, taxiing aircraft or towing operations and will be turned off immediately so pilots and vehicle operators will not be blinded. Turn on your vehicle parking lights so your position is known. Keep your headlight off until the aircraft or towing vehicle is out of range.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

021. Accidents

1. What is the foundation of accident prevention?

2. What are four examples of basic causes of accidents?

3. Name three methods of accident prevention.

022. Good housekeeping and fire prevention

1. Who is responsible for good housekeeping?

2. When should you clean up a spill?

3. What is fire?

4. What three things are necessary to have a fire?

5. What normally has a flashpoint below 100°F?

6. How may a normally safe cleaning solvent produce flammable vapors?

7. What two measures are used to prevent fires involving solvents?

8. How much of a flammable or combustible liquid is stored per cabinet in a closed container?

9. Where should you dispose of oily rags?

10. What are some rules to follow to aid in preventing ignition of flammable liquids?

023. General nondestructive inspection safety procedures

1. General aircraft safety and specific NDI safety measures relating to individual inspection methods are found in which safety guides?

2. What is a dangerous act when performing maintenance or inspections?

3. What describes the most efficient way to get the job done?

4. Describe an approved extension cord used with portable equipment.

5. What personnel protective equipment is normally used in the NDI lab?

6. What has specific information on hazards, effects, and protective equipment requirements?

024. Driving on the flightline

1. What are the primary causes of vehicle accidents on the flightline?

2. Who is responsible for performing daily vehicle inspections and checking for defects that affect vehicle safety?

3. What is the flightline speed limit for special purpose vehicles?

4. Vehicles will not be parked or driven less than what distance when engines are running?

5. What should you stay clear of, if you are parked next to an aircraft?

6. What must be turned on when the vehicle is temporarily parked at night?

Answers to Self-Test Questions

021

1. Identifying and eliminating accident causes.
2. Deficiencies in (1) training, (2) supervision, (3) attitude, and (4) design.
3. (1) Safety engineering, (2) education and training, and (3) enforcement of safety standards.

022

1. Everyone.
2. Immediately.
3. The rapid oxidation of a combustible material, producing light and heat.
4. Fuel, heat, and oxygen.
5. A flammable liquid.
6. By vigorous agitation.
7. Remove all sources of ignition and provide adequate ventilation.
8. No more than 10 gallons.
9. In a self-closing, metal container clearly marked, “Oily Waste Only.”
10. Do not light up or carry smoking materials into an area with flammable liquids. Wear only approved clothing. Bleed off any static charge before you enter the area.

023

1. AFI 91-203 *Air Force Consolidated Occupational Safety Instruction* and TO 33B–1–1, *Nondestructive Inspection Methods, Basic Theory*.
2. Wearing Jewelry.
3. Technical data.
4. It must be a three-wire cord with three prong plugs/receptacles and be of sufficient size to prevent overheating.
5. Face shields, goggles/safety glasses, rubber gloves, rubber apron, safety-toe boots, and ear protection.
6. SDS.

024

1. Carelessness, haste, and disregard of existing standards.
2. The vehicle operator.
3. 10 mph.
4. No less than 25 feet in front, 200 feet to the rear.
5. It must be clear of wing tips and visible from the cockpit.
6. Emergency flashers.

Complete the unit review exercises before going to the next unit.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter.

Do not return your answer sheet to AFCDA.

52. (021) What are commanders, staff officers, and supervisors responsible for when it comes to accident prevention?
    a. Training.
    b. Personnel.
    c. Standards and regulations.
    d. Accidents and unsafe conditions.

53. (022) The *minimum* temperature required for a substance to initiate self-sustained combustion is known as the
    a. flashpoint.
    b. flammable point.
    c. ignition temperature.
    d. combustion temperature.

54. (022) The danger from static electricity is highest during
    a. warm, humid weather.
    b. cold, humid weather.
    c. warm, dry weather.
    d. cold, dry weather.

55. (023) All of these have the potential for serious injury, when wearing jewelry *except*
    a. materials handling operations.
    b. wearing gloves on the hand to prevent injury.
    c. climbing, ascending or descending activities where personnel could fall or jump from elevated surfaces.
    d. any type of work where individuals are exposed to moving machinery, rotating or revolving parts, or activities that could result in their hands being caught by a moving part and injured.

56. (023) Which personnel protective equipment is not normally used in the nondestructive inspection (NDI) lab?
    a. Goggles or safety glasses.
    b. Safety-toe-boots.
    c. Rubber aprons.
    d. Long sleeves.

57. (024) Unattended parked vehicles on the flightline must
    a. be placed in neutral (transmission).
    b. have keys left in the ignition.
    c. have the lights left on.
    d. be locked.

Please read the unit menu for unit 5 and continue ➔

Unit 5. Aircraft Construction

IN THE PREVIOUS UNITS we have been discussing such subjects as technical orders, supply and maintenance management, and safety. In this unit we begin to explore the construction methods for aircraft and ground equipment. We will discuss the features of aircraft and ground equipment using Air Force terminology to identify specific parts. We also discuss the various markings used on aircraft. This information will help you to identify a particular part correctly and to identify and understand the various markings used in the Air Force.

5–1. Components

In this section, we discuss the construction features of aircraft and aerospace ground equipment. As an NDI technician, you will inspect a variety of equipment, parts, and components. Your knowledge of the construction features, location, and purpose of the various structural components is necessary for you to make intelligent decisions regarding NDI techniques and inspection results.

025. Aircraft structure

The main structural components of an aircraft are as follows:

- Fuselage.
- Wings.
- Nacelle.
- Empennage.
- Stabilizers.
- Flight control surfaces.
- Landing gear.

Fuselage

The fuselage is the main structure (or body) of the aircraft to which the wings and tail unit attaches. The fuselage can also house the crew, passengers, cargo, or power plant. Two basic types of fuselage construction are generally in use: the truss and monocoque (pronounced ‘ma-ne-kak’).

Truss

Truss construction has a rigid framework that’s made up of beams, struts, and bars. The fabric-covered, truss-framed fuselage is built for low power ratings, slow speeds, and light construction. Helicopters and small light aircraft use truss construction features. Figure 5–1 illustrates truss fuselage construction on a helicopter.

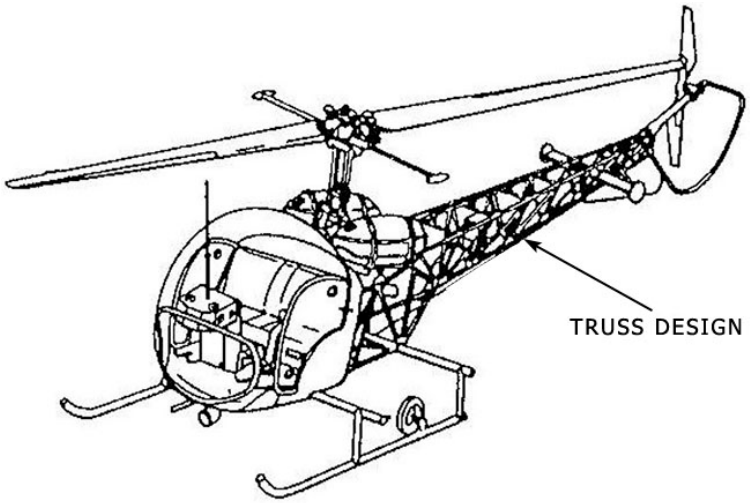


Figure 5–1. Truss fuselage construction.

Monocoque

A monocoque fuselage is built like a shell; and the skin of the fuselage must be strong enough to keep the fuselage rigid and to bear the primary stresses. Because of problems involved with maintaining enough strength, while keeping weight within allowable limits, aircraft manufacturer's developed a variation of monocoque, which is called semimonocoque; to overcome the strength-to-weight problem. Most modern military aircraft use this semimonocoque construction (fig. 5–2).

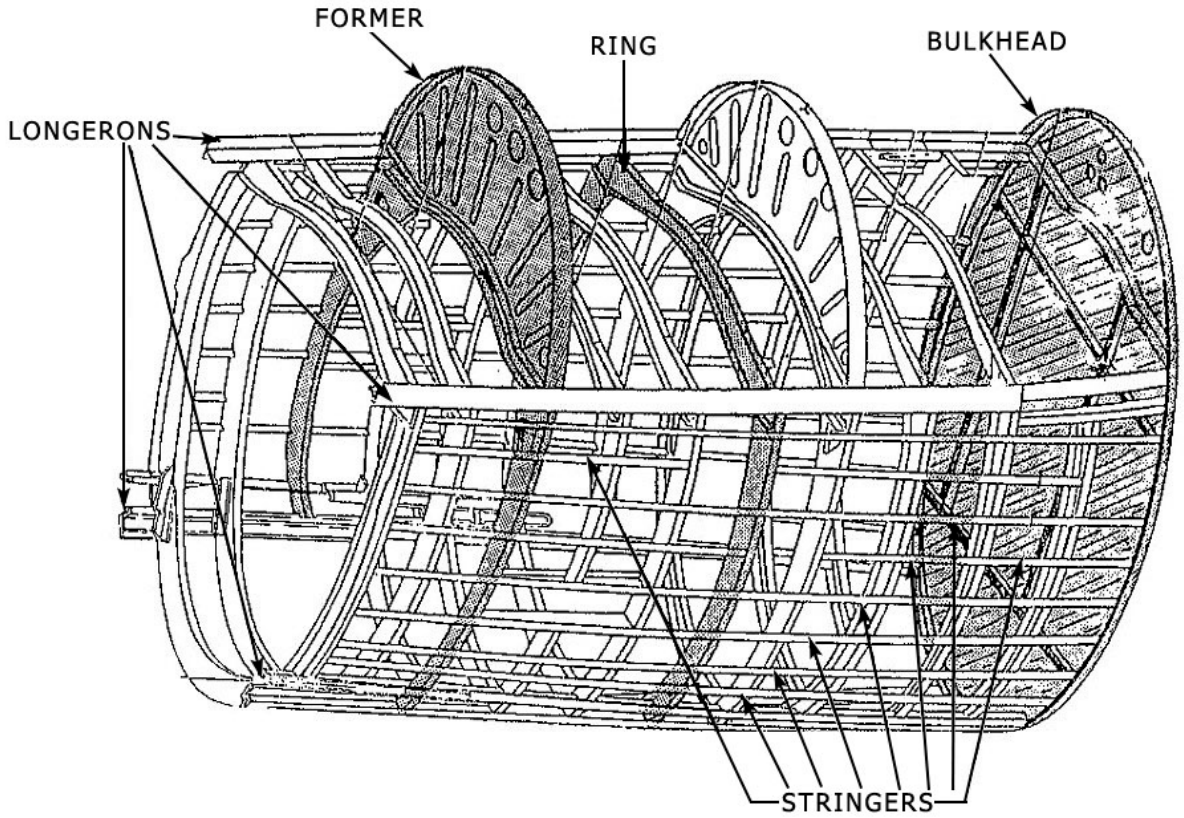


Figure 5–2. Semimonocoque construction.

Crosswise structural members

Bulkheads, formers, and rings (fig. 5–2) are the crosswise members giving shape, strength, and rigidity to the monocoque fuselage structure. Station webs (fig. 5–3) are built-up assemblies located at points where loads are concentrated and at points where fittings are used to attach external parts, such as wings, landing gear, and engine mounts.

The size and shape of the crosswise structural members vary considerably, depending on their function and position in the fuselage. Rings are the lightest, and are used primarily to fill the space between larger crosswise members and provide a structure to attach skin. Formers are heavier and stronger than rings; thus giving the fuselage most of its shape and strength. Sometimes, formers are used to close off one area from another. If so, they're reinforced and called bulkheads, and may be equipped with doors or other means of access.

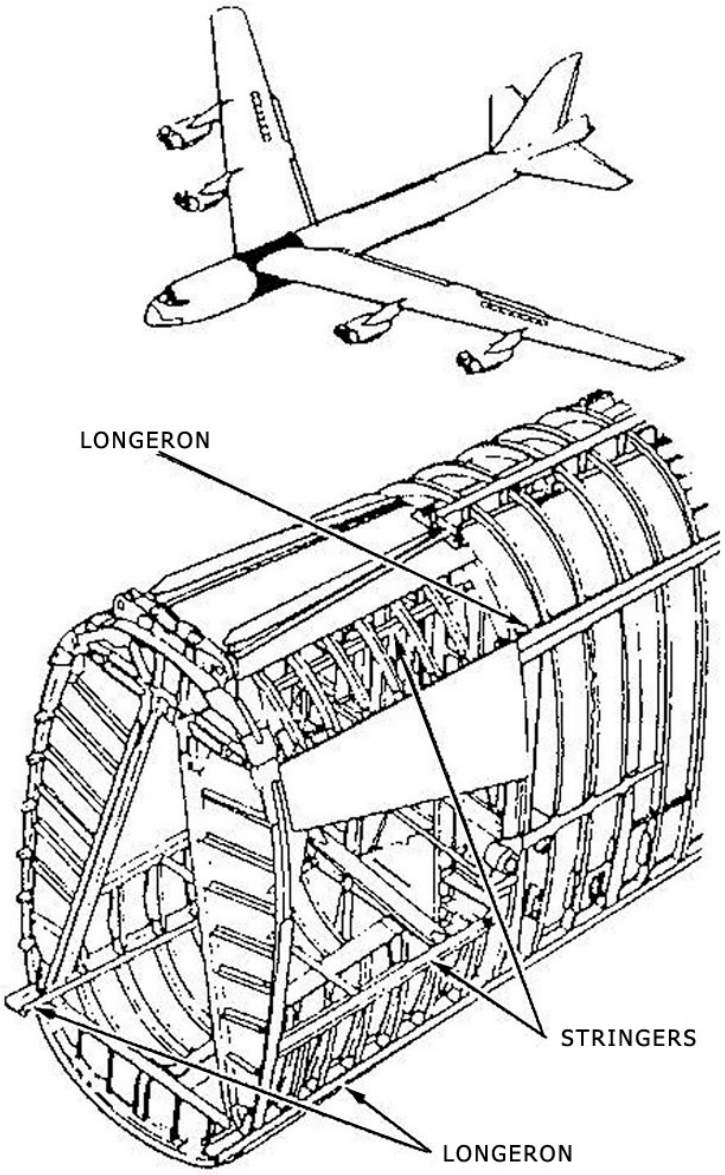


Figure 5–3. Wing attachment station web.

Lengthwise structural members

Longerons and stringers are the main lengthwise members of the monocoque fuselage. Figure 5–2 shows a semimonocoque fuselage, with the longerons and stringers identified.

Longerons are relatively heavy to provide lengthwise strength, and run most of the length of the fuselage. Normally, a fuselage contains four longerons that form the backbone of the aircraft.

Stringers are sometimes called stiffeners because they provide some rigidity to the fuselage; their main purpose is to give shape and to provide a means for attaching skin to the structure. They are smaller, lighter weight, and more numerous than longerons, and they serve as fill-ins between the lengthwise members.

Skin

The skin is the smooth outer cover of the fuselage. The thickness of the skin material depends on the stresses encountered in a given area. The skin primarily carries the shear loads and, with the longitudinal members, carries the loads of tension and bending stresses. Skin thickness may be constant or it may be tapered.

Materials

The metal generally used for fuselage construction is an aluminum alloy. Two of the more common alloys are 2024–T and 7075–T. These alloys are about one-third the weight of steel; but after heat treatment, they're approximately equal in strength to mild steel. For some uses (primarily surface covering), these alloys are made in sheets that have a thin covering of pure aluminum on both sides. This pure aluminum covering serves as a protective coating for the base metal. In addition to aluminum, titanium and magnesium may be used in certain applications.

Aircraft manufacturers are increasingly using nonmetallic materials, known as advanced composites, in the construction of their aircraft. Advanced composites use fibers that are bonded together in a resin type substance called a matrix. Advanced composites can be used in almost any application that calls for metal; they are just as strong and weigh less.

On the newer aircraft in the Air Force inventory, items previously metallic are being made from graphite, boron, aramid fibers, and other nonmetallic materials. In fact, the B–1B is about 10 percent advanced composite construction, and the V–22 is close to 85 percent composite.

Wings

The wings of an aircraft are the components designed to give lifting force and to support the weight of the aircraft while it's in flight. There are two types of wings: semicantilevered and cantilevered.

The semicantilevered wing requires both internal and external bracing. In contrast, the cantilevered wing is only internally braced. Most military aircraft employ the cantilevered wing design. The main structural parts of a wing (fig. 5–4) are spars, ribs, and stringers.

Spars are the main lengthwise members designed to provide a high degree of strength in the wing structure. Ribs serve the dual purpose of providing contour or shape to the wing and of adding rigidity to the structure. Wing stringers are usually extrusions formed into angles or channels. The stringers are placed lengthwise in the wing to provide strength, stiffness, and a means of attaching the smooth skin covering.

Like the fuselage, the metal used for wing structures is heat-treated aluminum alloy largely used for the outer covering. In addition, advanced composites are increasingly being used for structural parts, as well as for outer skin applications.

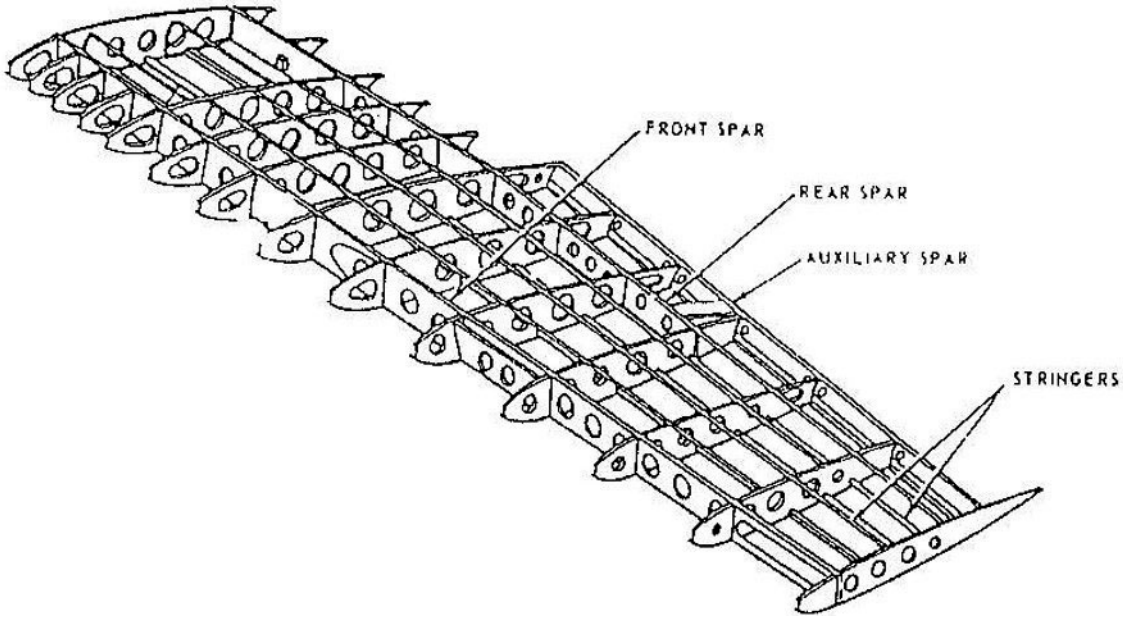


Figure 5–4. Typical wing construction.

Nacelle

The nacelle structure is similar to the fuselage. It is primarily a cover housing and streamlining the engines on multi-engine aircraft. The nacelle is comprised of the ring cowling and side cowlings. In certain cases, the nacelle is designed to transmit engine loads to the wing. The nacelle may be built directly into the wing, or it may be suspended below the wing by a pylon. (On earlier aircraft, pylons are sometimes referred to as struts).

On multiengine aircraft, position numbers distinguish nacelles, pylons, and engines from one another. The structures are numbered consecutively from the tip of the left wing to the tip of the right wing. Figure 5–5 shows a typical jet engine nacelle and supporting pylon.

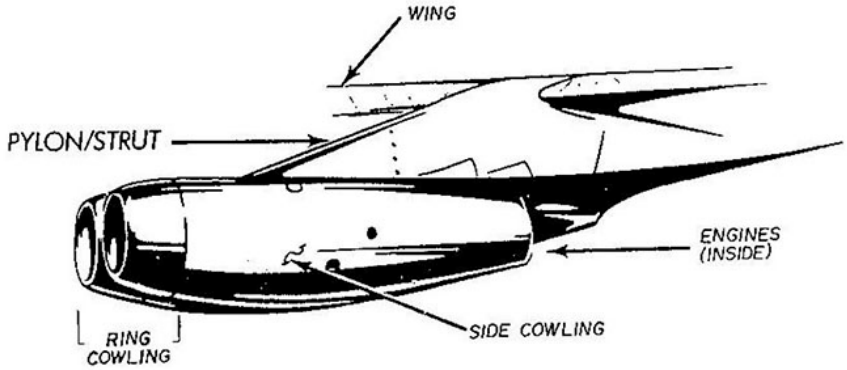


Figure 5–5. Engine nacelle.

Empennage

The empennage (fig. 5–6) is the tail section of the aircraft. It includes (1) the aft end of the fuselage; (2) horizontal and vertical stabilizers; (3) rudder; (4) elevator; and (5) trim tabs.

The vertical and horizontal stabilizers are fixed surfaces in the empennage group that stabilize the aircraft while it is in flight. The fixed vertical surface is often called the fin, and the fixed horizontal surface is generally called the stabilizer.

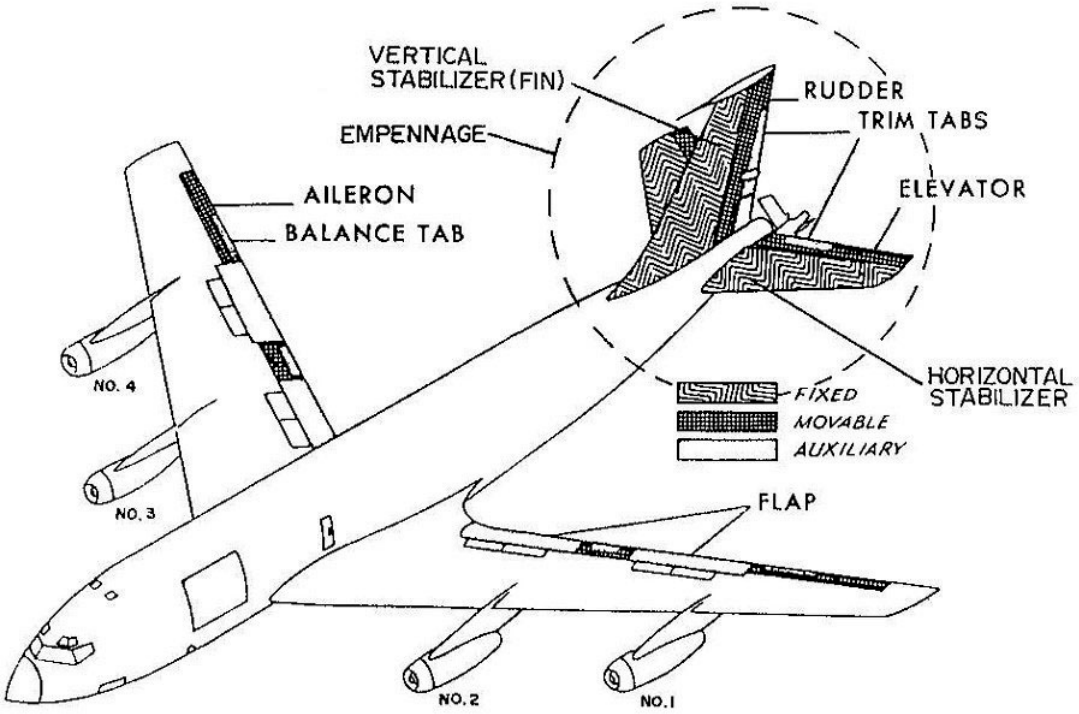


Figure 5–6. Aircraft control surfaces.

Construction features of fixed tail surfaces are, in many respects, identical to those of the wings. The tail surfaces are usually the cantilever type, having a spar (or spars) and ribs to which the skin is attached. A fairing is used to round out the angle that's formed between the fixed tail surfaces and the fuselage.

Flight control surfaces

Flight control surfaces (fig. 5–6) consist of two major groups: primary control group and secondary/auxiliary control group.

The primary group includes ailerons, rudder, and elevator. These are used to control the attitude of the aircraft while it is in flight by moving it about its various axes. Most fighter aircraft use a movable stabilizer, called a stabilator, which acts as both a stabilizer and an elevator. The secondary group is comprised of trim tabs, balanced tabs, and servo tabs. They are used for reducing the force required to operate primary control surfaces or for trimming and balancing the aircraft in flight. This group also includes landing flaps used to reduce landing speed of fast aircraft and to shorten the landing run.

Control surface construction is *basically* the same as the construction used on the wings with emphasis on the use of spars, stringers, ribs, and a covering. A unique method of construction found in control surfaces is the honeycomb or sandwich process. The sandwich is a layered composite that is formed by bonding two thin facings to a core.

If proper choice of materials for facings and cores is made, control surface constructions with high ratios of stiffness-to-weight can be achieved. These structures or panels are usually made of low-weight facings and some type of cellular construction (honeycomb core that is formed of thin sheet material) or of corrugated sheet material (fig. 5–7). The thin outer skins or facings may be made of aluminum, titanium alloys, or advanced composite material.

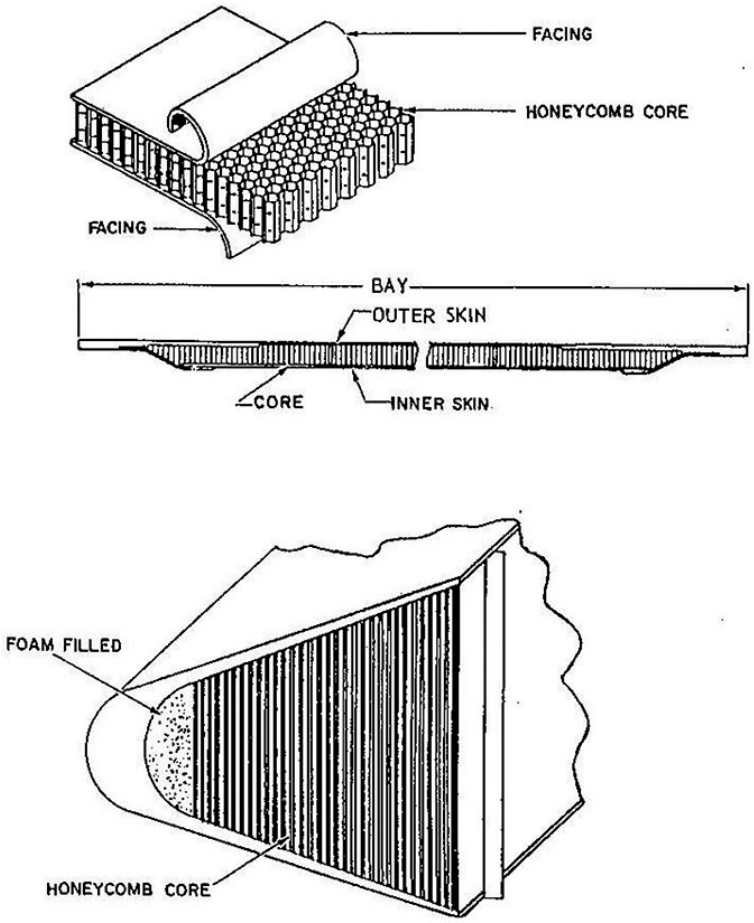


Figure 5–7. Honeycomb construction.

Newer aircraft assemblies use various advanced composites because of their excellent strength-to-weight ratios; or the advanced composite material may be used in conjunction with metal facings to improve its rigidity. Many panels differ from the typical sandwich construction because the core is cut to fit the contour of the upper and lower skins. This type of construction is identified as a full-depth core honeycomb construction. Full-depth core honeycomb is a common method of control surface construction used on small, high-performance aircraft.

Landing gear

The main landing gear consists of the portion of landing gear providing the principal support of the aircraft when it is on land or water. The gear may include any combination of wheels, floats, skids, or skis. Brakes and shock absorbing, steering, and retracting mechanisms are parts of the landing gear.

The *auxiliary landing gear* consists of tail or nose wheel installations and outboard floats or wheels that increase stability during landings and ground or water handling.

Reference lines and stations

Many inspections you perform on the aircraft will depend on your knowledge of the aircraft. Suppose, for example, you need to inspect an upper longeron at fuselage station 194.25. In order to do this you must know your aircraft locations. Most NDI aircraft technical orders (–36, 15 GS) explain in Section 1, *General Information,* a breakdown of reference points and station numbers. Other sources are the –3 aircraft structural repair manual or section VI in the general vehicle (GV) aircraft manuals. To help you locate specific areas on the aircraft, manufacturers use reference lines and station numbers similar to map coordinates. Just as the numbers and letters on the top and sides of a map can

help you pinpoint the exact location of a city, town, or street, the manufacturer's station numbers can help pinpoint exact locations on the aircraft. Now, we look closely at the methods of finding locations on an aircraft. These methods are as follows:

1. Fuselage stations.
2. Waterlines.
3. Buttock lines.
4. Wing stations.
5. Other structural stations.

Fuselage stations

Fuselage stations are measured along a longitudinal plane (fore and aft). The manufacturer determines its own system for establishing station numbers. The manufacturer denotes a specific place to start the numbers. They may start at the nose of the airplane, in front of the nose, or behind the nose. From this starting point, all measurements are made in inches.

Figure 5–8 shows a breakdown of fuselage stations and lines for the F–16A aircraft. As you can see, the first fuselage station is –26.7; this tells you the "0" fuselage station is located 26.7 inches aft of the tip of the pitot tube assembly. The last fuselage station is at 566.7 and is located at the top aft edge of the empennage.

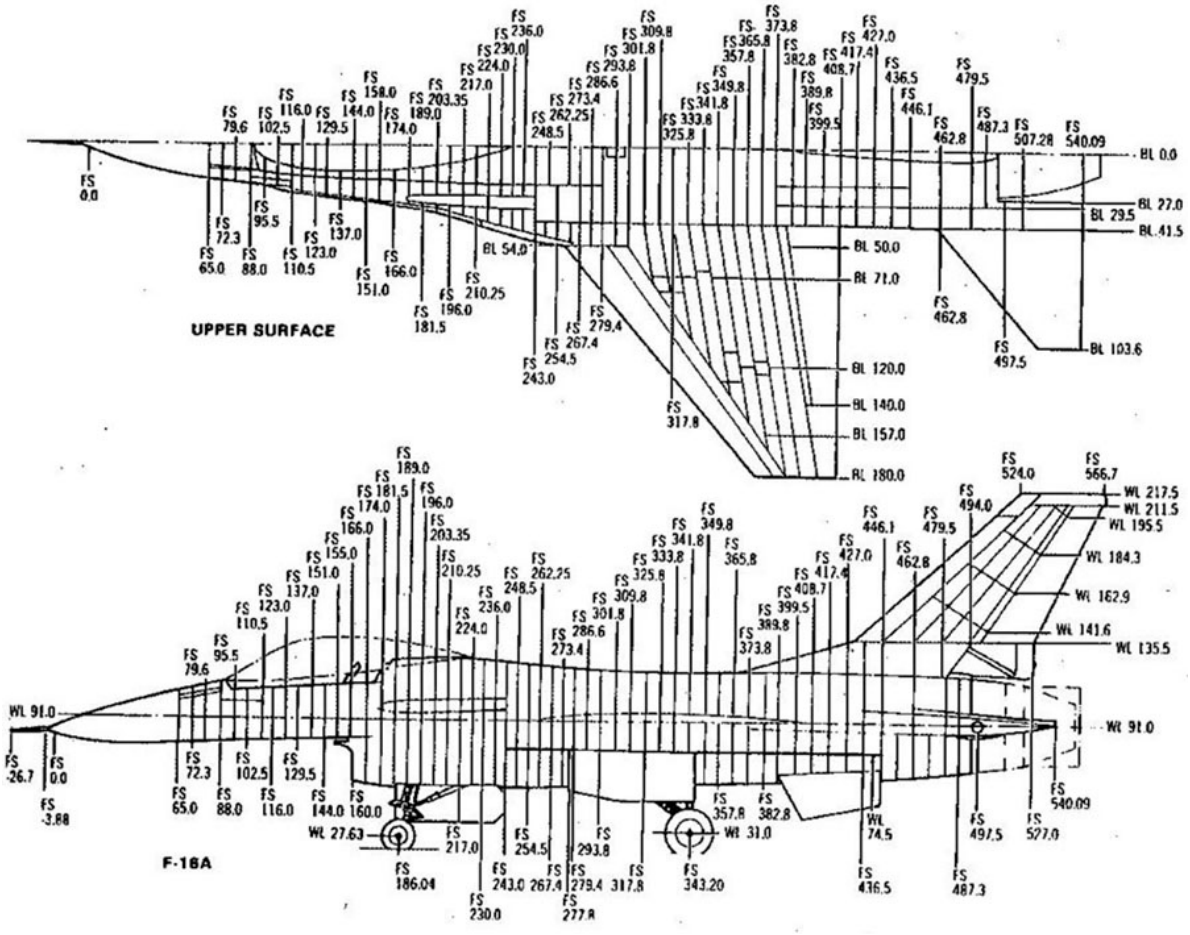


Figure 5–8. Fuselage stations and lines.

Waterlines

Waterlines are lines measured along the horizontal plane. For the F–16A aircraft in figure 5–8, the waterline centered on the engine bay is established as the reference line 91.0. Waterlines are measured in inches, with those above the horizontal reference line added to 91.0 and those below it subtracted from 91.0. Note that the waterline for the center of the nose wheel is 27.63. This tells you that the center of the nose wheel is 63.37 inches below the reference line. It does not mean the center of the nose wheel is 27.63 inches above the ground. In fact, the center of the nose wheel is only about 8 inches above ground level. The ground is never used as the waterline reference line. This is because an aircraft's height will vary depending on whether it has a full fuel load or is empty, whether it is loaded with munitions, and even how much pressure is in each landing gear strut assembly.

Buttock lines

Buttock lines are measured along the vertical plane on either side of the fuselage centerline, with buttock line 0.0 located at the centerline. Buttock lines are identified as "left" or "right". On the F–16A in figure 5–8, the buttock line at the end of the wingtip is 180.0. Therefore, there is a right 180.0 buttock line and a left 180.0 buttock line, one for each wing. For a better illustration, imagine the face of a clock. The hands at 6 o'clock or 12 o'clock would represent the 0.0 buttock line, or centerline. One side is left, and the other side is right. Again, these measurements are in inches.

Wing stations

Variations to the basic measuring system are used on the wing. Normally, a combination of wing station numbers and spar lines is used for identification. Wing stations are measured in inches from center fuselage line outboard, and are designated as either left or right wing. In some cases, the wing itself is broken down into center wing box, left wing box, and right wing box. Spars are identified by the percentage corresponding to their location on the wing or by the buttock line corresponding to their location.

Other structural stations

Additional reference points can be located for the horizontal empennage structural stations and vertical stabilizer structural stations.

026. Aerospace ground equipment

Under certain circumstances, many of the aircraft and missile systems must be operated on the ground. This ground operation is done in order to ensure safety in flight and to aid in troubleshooting a faulty system. As an example, let's say a major part of the aircraft landing gear retraction system has been replaced. In this case, the operation of the gear retraction system may be checked by jacking up the aircraft and retracting and extending the gear several times. Since it isn't practical to run the aircraft engine to supply hydraulic pressure for the functional check of the retracting mechanism, hydraulic pressure is supplied by—more specifically, a hydraulic test stand.

AGE is designed for use where required energy is not readily available for starting, servicing, or testing aircraft. AGE can be towed to the job site. Often, AGE is powered by gas turbine or gasoline engines. As such, AGE is highly portable and can deliver a supply of required energy when and where it is needed. Due to varied requirements, the Air Force has many different types of AGE. Some of the more common are listed:

1. Alternating current (AC) and direct current (DC) power generators.
2. Air compressors.
3. Heaters.
4. Coolers.
5. Hydraulic test stands.
6. Portable lighting systems.

Compared to aircraft, AGE uses a relatively simple construction; typical construction consists of:

1. Suspension.
2. Frame.
3. Power system.
4. Enclosure.

Refer to figure 5–9 as we discuss each of these.

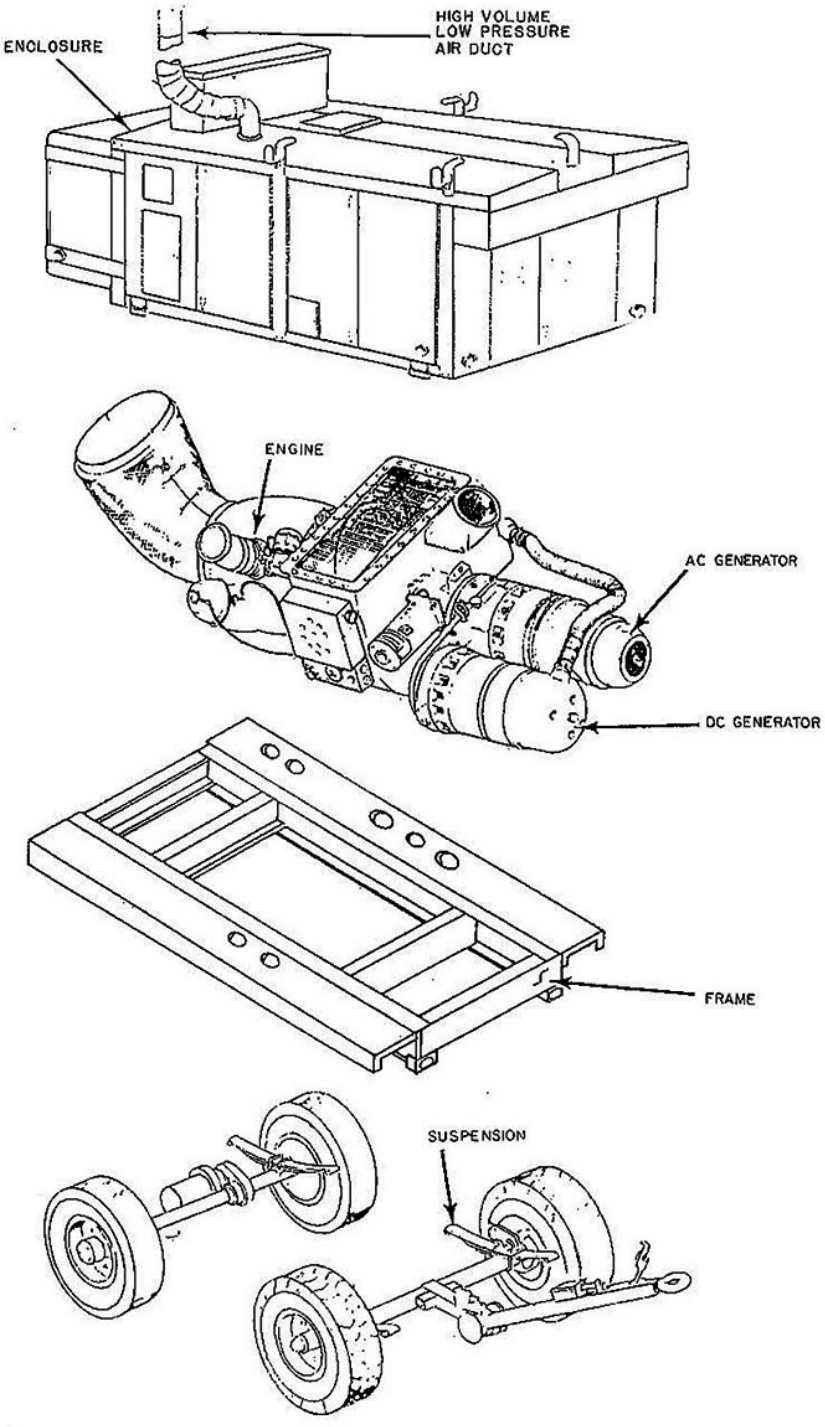


Figure 5–9. Typical AGE construction.

Suspension

To be portable, most AGE is mounted on wheels and pneumatic tires providing an integral trailer. The rest of the unit is suspended above the axles on leaf or coil springs, much the same as an automobile. The unit is moved by a tow vehicle attached to the tow bar. Some exceptionally heavy AGE units incorporate an electromechanical drive assembly for propelling the unit under its own power. Controls for operating the self-propulsion system are normally located on the tow bar, which is used to steer the unit. A drum and an internal expanding-shoe brake system are normally used to stop the unit when in the self-propelled mode. The brake is locked for parking. Suspension components on AGE, except for tires, are almost exclusively manufactured of ferrous metals.

Frame

The frame, or chassis, is normally ferrous metal, but it may be made of aluminum. It is the main structural unit of the complete assembly. The frame's primary function is to provide a platform for mounting power system components, engine, battery, accessories, fuel tank, and enclosure. The frame usually has tie-down rings installed on all four corners to secure the unit during airlift. It may also have a lifting ring attached above the center of gravity of the assembled unit for hoisting the complete assembly.

Power system

The power system, or payload, is the reason the other components exist. It provides the energy that will be delivered to the aircraft. The power system consists of the following components:

1. Generator.
2. Hydraulic pump.
3. Compressor.
4. A prime mover of some sort to drive it.

Normally, a gas turbine or gasoline engine (similar to a small aircraft engine) is used as the prime mover; however, electric motors may supply power for equipment intended for use in hangars or maintenance docks. Power system components are constructed of the same type of materials as aircraft engines and accessories — mostly steel, aluminum, or magnesium.

Hydraulic and pneumatic ground equipment generates very high pressure in some systems. Air receivers, hydraulic accumulators, and hydraulic rams or filter cases may need to be inspected in the interest of personnel safety or equipment dependability. Some of the components may contain pressures as high as 6,000 pounds per square inch (psi).

Enclosure

The enclosure provides a weather-tight covering for the power system. The enclosure on electrical power AGE is made from tempered aluminum, and uses low-stress aircraft fasteners. Permanent joints are normally riveted; and removable panels and components usually are attached with nut plates and machine screws. For AGE other than generators, enclosures may be either riveted aluminum or welded steel. They are normally bolted to the frame for easy removal to facilitate maintenance or removal of the power system.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

025. Aircraft structure

1. Most modern military aircraft use this type of construction.

2. Name the three crosswise structural members in a monocoque fuselage.

3. What two lengthwise structural members are designed to provide strength and rigidity to the monocoque fuselage?

4. What is the purpose of stringers?

5. What are the main lengthwise members that give wings most of their strength?

6. What is the purpose of wing ribs?

7. Which structure houses and streamlines the engines on multiengine aircraft?

8. What is the purpose of the fixed surfaces in the empennage group?

9. Name the three *primary* aircraft flight control surfaces.

10. Name two publications besides the NDI inspection TOs that you can use to help locate reference points.

11. Who establishes station numbers?

12. On the F–16A aircraft, what is another name for the horizontal reference line?

026. Aerospace ground equipment

1. What type of material is *normally* used in the construction of AGE suspension systems?

2. What is the *primary* function of the AGE frame?

3. Name three common metals used in the manufacture of AGE power system components.

4. What is the purpose of an AGE enclosure?

5. Name two common construction methods used in manufacturing panels for AGE enclosures.

5–2. Markings

All aircraft, vehicles, and AGE in the Air Force's inventory must be readily identifiable and accountable. This is accomplished by use of standardized markings. It is the responsibility of anyone working on or around aircraft to understand each type of marking and the reason for the placement of each marking. Markings are not placed on equipment without a specific purpose. Some of the most important markings you will see during your career are those on aircraft. Aircraft markings can generally be placed into one of these four categories: standard, special purpose, identification, and safety.

027. Standard and special purpose markings

Two categories of markings that everyone should become familiar with are perhaps the most important ones—standard and special purpose markings. You will come to appreciate the fact that no matter what aircraft you work on, you will always be able to locate the same information in the same location on each aircraft. How do you tell one aircraft from another? If you park 50 F–15C aircraft together on one flightline, they will all look the same if we did not have a standardized way of marking them. Knowing the meaning and use of special purpose markings will make you aware of potential hazards and keep you safe.

Standard markings

There are only six standard markings applied to all Air Force aircraft:

1. The national star insignia.
2. USAF marking.
3. U.S. AIR FORCE marking.
4. Serial number.
5. Aircraft data legend.
6. Aircraft radio call number.

These markings serve to rapidly identify an aircraft as belonging to the Air Force in peacetime and during conflict.

National star insignia

The oldest marking currently used on Air Force aircraft is the national star insignia (fig. 5–10). This insignia has been used (in various forms) on United States aircraft since World War I. The national star insignia is applied to all aircraft and helicopters in either full color or subdued paint schemes. It is applied on the left and right fuselage, upper left wing, and lower right wing of all aircraft.

Figure 5–10. National star insignia.

On helicopters, four national star insignia are used. They are placed so they are visible from each side, above, and below. The locations are standardized by helicopter model and series.

USAF marking

The USAF marking is applied to the lower left surface and upper right surface of aircraft wings. The markings should be located to correspond with the national star insignia on the opposite wings with the top of the letters facing forward. The specific location on helicopters will vary depending on model and series. The USAF is not required on camouflaged aircraft.

U.S. AIR FORCE marking

The U.S. AIR FORCE marking is applied to the left and right fuselage of all aircraft and helicopters. It is not required on camouflaged aircraft. Figure 5–11 shows the standard letter format for the USAF and U.S. AIR FORCE markings.

U.S. AIR FORCE
USAF

Figure 5–11. USAF and U.S. AIR FORCE markings.

Serial number and data legend markings

Aircraft serial numbers consist of two digits signifying the year the aircraft was contracted followed by a hyphen and a unique number; for example, 88–001346. The standard serial number marking is included as part of the aircraft data legend marking. A complete data legend marking (fig. 5–12) includes the owning military component, the aircraft type, model and series, aircraft serial number, grade of fuel used, and the aircraft identification plate location. The aircraft data legend marking may be located on the left side of the fuselage near the cockpit or near the single point refueling location.

U.S. AIR FORCE (MODEL DESIGNATION)
AF SERIAL NO. _____ A
SERVICE THIS AIRCRAFT WITH GRADE _____
IDENTIPLATE LOCATION _____
_____

Figure 5–12. Sample aircraft data legend marking.

Aircraft radio call numbers

Radio call numbers are applied to each side of the vertical stabilizer or, in the case of multiple vertical stabilizers, to the outboard side of each outermost vertical stabilizer. Because of their location, radio call numbers are nearly always referred to as tail numbers. Helicopters with no vertical fins apply radio call numbers to both sides of the fuselage.

Radio call numbers consist of five numbers derived from the aircraft serial number. Normally, the last five numerals of the serial number are used. If there are insufficient numerals for five digits, the second numeral of the contract year is followed by the necessary number of zeros to make five numerals.

A camouflaged aircraft authorized a distinctive aircraft identification marking on its tail does not require the radio call number marking. Distinctive identification numbers (fig. 5–13) consist of several elements. Each unit is assigned a standardized code using two alphanumeric characters, typically referred to as “tail letters.” An aircraft tail number is created using the first two and last three digits of the serial number. The tail letters, tail number, and the letters “AF” completes the makeup distinctive unit marking on camouflaged tails.

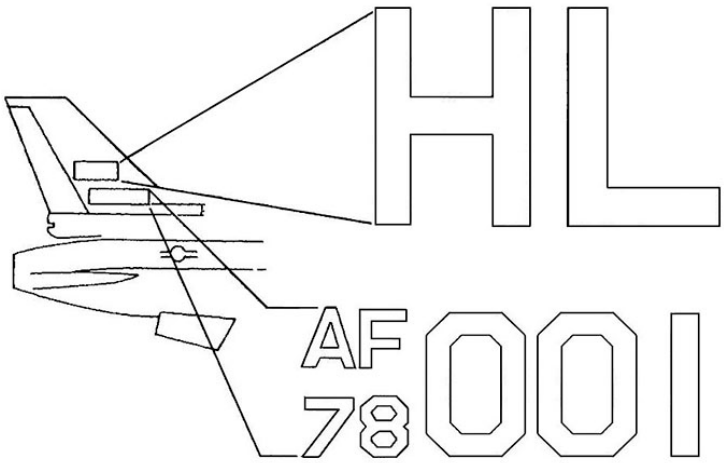


Figure 5–13. Distinctive tail marking (camouflaged aircraft).

Special purpose markings

In addition to the standard markings on all aircraft, the Air Force has identified special purpose markings authorized for use. Special purpose markings are used to identify an aircraft’s assigned location, aircraft crew, or special function. Special purpose markings can also assist in matching specific components to a particular aircraft and promote aircraft safety. In most cases, special purpose markings must be removed when an aircraft is transferred or reassigned.

American flag marking

Display of the American flag on aircraft exteriors is intended for specific diplomatic purposes. As such, its use will only be approved by Headquarters USAF and restricted to particular aircraft. When authorized, the American Flag is located on both sides of the rudder or vertical stabilizer and above all other markings of significance. The flag is placed horizontally, with the union up and the bars trailing to the rear, as if flying in the wind.

United States of America marking

The words UNITED STATES OF AMERICA are authorized on the fuselage of certain aircraft displaying the American Flag. When used, the words are painted on both sides of the fuselage, parallel to and above the top of the cabin windows. The U.S. AIR FORCE marking is removed from aircraft using the UNITED STATES OF AMERICA marking.

Organizational insignia or emblems

These markings identify the major command, base, wing, and squadron where an aircraft is assigned. Examples include major command shields, base or wing shields, and squadron patches (fig. 5–14). Organizational markings serve to assist in aircraft identification as well as promote *esprit de corps* and unit pride. Approved emblems or insignia are applied in various locations on aircraft and are standardized by model and series.

Figure 5–14. Organizational insignia and emblems.

Crew markings

The names of the pilot, crew chief, or other members of the flight or ground crew may be applied to the exterior of the aircraft. Generally, names are located on the left side of aircraft and right side of helicopter fuselage, near the pilot's window, and clearly visible from ground level.

Local station numbers and markings

Station numbers are normally authorized where a large number of aircraft are assigned, duplication of the last three digits of serial numbers occurs, or visibility is poor due to prevailing weather conditions. They are located on the nose of fixed wing aircraft and the deflector shield or other forward component on helicopters. To assist personnel in visually identifying the unit an aircraft is assigned to, tail stripes are added. Tail stripes are located on both sides of the topmost portion of the vertical stabilizer. These stripes are unique for each unit, are usually painted in bright, easily seen colors, and may or may not include unit nicknames, mottoes, or other lettering.

Walkways and honeycomb panels

When walkways do not contrast with surrounding areas, they are bordered by a $^1/_2$-inch wide, camouflage/flat black (light backgrounds) or camouflage/flat white (dark backgrounds) border with the word WALKWAY placed at intervals. On the side of the border not intended as a walkway, the words NO STEP may be placed opposite the word WALKWAY. Steps on the fuselage of aircraft and helicopters are conspicuously marked.

Honeycomb panels with thin skins on wing upper surfaces are marked with $1^1/_2$ inch wide, 45 degree striped hash marks, 2 inches long, with 2 inches between the stripes. The hash marks are painted bright yellow. On camouflage aircraft, the words NO STEP inside a honeycomb symbol can be used to indicate the honeycomb area.

028. Identification and safety markings

Identification and safety markings are those used to allow individuals to visually identify specific areas on an aircraft or identify where there are certain hazardous conditions. Types of markings include servicing, ground handling, emergency, and hazard warning markings. Each symbol and its placement will vary with each type of aircraft or aircraft configuration. Camouflaged aircraft will use only the minimum number of these markings consistent with safety, performance, and maintenance of the aircraft. Identification symbols are used to provide the following:

1. Rapid identification of required servicing points.
2. Identification of the type of ground servicing required.

3. Hazard warnings or safety precautions to prevent personal injury or equipment damage.
4. Rapid entry or exit under emergency conditions.

Let's look at a few of the more important markings.

Ejection systems

Ejection seats on aircraft are marked with a red or camouflage equilateral triangle with the apex pointing down (fig. 5–15). The marking is placed on each side of the fuselage adjacent to the explosive device used to fire the ejection system.

Figure 5–15. Ejection seat marking.

Propeller/turbine blade warning stripes and signs

Propeller and turbine blade warning markings are used to mark areas known as the *plane of rotation*. The plane of rotation extends out in all directions from the ends of these components and represents the potential area covered if the propellers or blades were to separate from the engine.

Exterior propeller warning markings

A 3-inch wide red or camouflage stripe extending completely around the aircraft fuselage is used to mark the plane of rotation of inboard engine propellers. Outboard propeller plane of rotation is marked on the cowling of the inboard engine. Noncamouflaged aircraft will have the word PROPELLER superimposed in white on the red stripe. They also have a red arrow with the word DANGER in white pointing toward the warning stripe.

Some pieces of AGE also use warning stripes on outside cowlings to mark the plane of rotation of internal engines with turbine blades. These are 1-inch wide, red stripes extending completely around the piece of equipment. When in operation, AGE will be positioned so that the plane of rotation does not point toward parked aircraft, munitions, parked vehicles, or personnel to the greatest extent possible.

Interior propeller warning markings

A red warning stripe 3 inches wide is marked on both sides of bomb-bay doors, emergency exits, or any other potential opening within 6 feet of the propeller plane of rotation. This is to warn personnel exiting the aircraft of the proximity of a propeller. The word PROPELLER in white is superimposed on these stripes also.

Aircraft emergency exits

Air Force aircraft emergency exits and removable escape panels are marked internally by painting a 1-inch wide yellow-orange stripe around the entire outline of the opening. The words EMERGENCY EXIT are painted on the hatch, door, or exit. All handles, releases, catches, and knobs for emergency exits are also painted yellow-orange.

Warning text

In some cases, safety markings can be as simple as text that warns you about a hazardous or potentially hazardous condition. All warning text is important although it may be small or subdued. A good example would be text reading WARNING HOT EXHAUST VENT. If an aircraft or piece of AGE is operating and has this marking, you should stay clear of the vent.

029. Flightline hazards and precautions

The flightline can be a very dangerous place for someone who is not familiar with its hazards. We can best describe these hazards by categorizing them as follows: aircraft, noise, and radiation.

Aircraft hazards

Aircraft operations are inherently dangerous for people working on the flightline. When aircraft engines are running, there are two major dangers to personnel:

1. Suction toward the intake.
2. Thrust from the exhaust.

Intake

Aircraft intakes can produce sufficient suction to pull objects up off the ground, down the intake, and into the engine causing foreign object damage (FOD). Small objects like screws, rocks, or pieces of wire are not the only possible causes of FOD. People have actually been drawn into the intake ducts of jet engines. It takes very little imagination to realize the dangers associated with the front area of propeller-driven aircraft. As you would expect, there is a safety zone for intakes. These zones vary with different aircraft, but are normally 25 feet to the front of the intake.

Exhaust

Thrust, whether from a propeller or jet, can turn many objects into missiles. Flying debris can include sand, small rocks, tools, toolboxes, and even small pieces of equipment. This debris can severely injure personnel and damage equipment. Because of these dangers, you must ensure equipment under your control is secured. You must also observe the safety zone for the exhaust. As before, these zones vary with different aircraft, but are normally 200 feet directly behind the exhaust.

Cockpit

If you have no business in this area, stay out of the cockpit. If you are required to work in the cockpit, you must observe several safety precautions. Make sure all safety pins are installed. If you have forgotten or just do not know the locations of the pins, have someone who does know check before you enter. Once you are in the cockpit, leave switches, levers, and buttons alone. Playing with these items could end in disaster.

Take special precautions with crew egress systems. These systems contain explosive charges to blow the canopy and seat from the aircraft. Accidental ignition of these charges on the ground is *extremely* hazardous and has resulted in fatalities.

Movable surfaces

Most aircraft flight control surfaces are moved by electric or hydraulic power. Because of this “fly by wire” system, personnel moving the controls in the cockpit cannot tell if they have met an obstruction. Your hand, arm, head, or body could be the obstruction. Many flight control surfaces move extremely quickly and are as deadly as a guillotine. To prevent injury to yourself or others, ensure safety locks or pins are installed when you are working around movable surfaces. Additionally, follow local lock out/tag out procedures established by your workcenter.

Maintenance stands

When your access to areas of an aircraft is not possible from the ground, a suitable maintenance stand is used. If they are not used correctly, these stands can be hazardous. To protect yourself from falls, do not allow slippery substances and tools to accumulate on platform areas or on stairs. Install

guardrails and do not stand on the rails for extra height. Finally, ensure all safety pins, locks, or brakes are properly set before using the stand.

Noise hazards

Flightline operations produce hazardous noise from powerful aircraft engines. The volume and pitch of this noise can cause severe damage to the human ear. Always protect your ears when you are working around operating engines. The safety zone is approximately a 300 to 400 foot circle, depending on the type of aircraft and engine.

Aircraft engines are not the only noise hazards on the flightline. Noise hazards can be generated by the shrill sound of a siren, the whine of pneumatic tools, or the roar of aerospace ground equipment. Whatever the noise hazard, your precaution is always the same. Wear the appropriate ear protection for the situation: earplugs, earmuffs, or both.

Radiation

During technical training, you were taught protective procedures associated with industrial X-ray radiation. Industrial radiation safety is covered in detail in the volume on radiography. However, there's another type radiation present on the flightline—radar.

Aircraft radar is extremely dangerous at close ranges because of the intensity of the radiation it produces. When operating at sufficient intensity, radar can damage body tissue, particularly the eyes. It can also ignite flammable materials and set off ammunition or other explosives. Protection from this radiation is the same as for industrial X-rays: distance, shielding, and time.

The only variable you have direct control over is distance, so stay clear of operating radar. The danger zone will vary by aircraft type, but generally extends in a radius of 50 feet and covers an arc of 100 degrees from the antenna of the aircraft.

Self-Test Questions

After you complete these questions, you may check your answers at the end of the unit.

027. Standard and special purpose markings

1. What are the six standard markings applied to all USAF aircraft?

2. What is the oldest marking currently used?

3. Which marking identifies the type of fuel used by the aircraft?

4. When is the aircraft radio call number *not* required?

5. In most cases, when must this special purpose marking be removed?

6. What is the purpose of an aircraft tail stripe?

028. Identification and safety markings

1. What are the four types of identification and safety markings?

2. What do you call the area extending from the ends of propeller or turbine blades?

3. Even though this safety marking may be small or subdued, what informs you about a potentially hazardous condition?

029. Flightline hazards and precautions

1. What are the two major dangers to personnel from running engines?

2. What actions are used to ensure it’s safe to work in a cockpit?

3. What precautions should you take before you perform an inspection on movable surfaces?

4. What protection is required when working around noise hazards?

Answers to Self-Test Questions

025

1. Semimonocoque.
2. Rings, formers, and bulkheads.
3. Longerons and stringers.
4. To give shape and provide a means for attaching the skin.
5. Spars.
6. To give contour or shape and add rigidity to the wing structure.
7. Nacelle.
8. They stabilize the aircraft in flight.
9. Ailerons, rudder, and elevator.
10. The –3 structural repair and GV manual.

11. Each aircraft manufacturer determines its own system.
12. Waterline.

026

1. Ferrous metal.
2. To provide a platform for mounting system components, engine, battery, accessories, fuel tank, and enclosure.
3. Steel, aluminum, and magnesium.
4. It protects the power system from the weather.
5. Riveted aluminum and welded steel assemblies.

027

1. (1) National star insignia, (2) USAF, (3) U.S. AIR FORCE, (4) serial number, (5) data legend, and (6) radio call number.
2. National star insignia.
3. Data legend.
4. On camouflaged aircraft authorized a distinctive tail marking.
5. When the aircraft is transferred or reassigned.
6. To assist in visual identification of an aircraft's unit.

028

1. (1) Identification of servicing points, (2) type of ground servicing required, (3) hazard warning or safety precaution, and (4) emergency entry or exit points.
2. Plane of rotation.
3. Warning text.

029

1. Personnel may be pulled into the intake or blown by the exhaust.
2. Ensure all safety pins are properly installed.
3. Install safety locks or pins and follow local lock out/tag out procedures.
4. Ear muffs, earplugs, or both.
5. A 50-foot radius in a 100 degree arc in front of the operating radar.

Unit Review Exercises

Note to Student: Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field Scoring Answer Sheet.

Do not return your answer sheet to AFCDA.

58. (025) Engine position numbers on multi-engine aircraft are assigned consecutively from the
    a. tip of the left wing to tip of the right wing.
    b. tip of the right wing to tip of the left wing.
    c. fuselage centerline outward, left side odd and right side even.
    d. fuselage centerline outward, right side odd and left side even.

59. (025) Where is an aircraft elevator located?
    a. On the wing.
    b. In the galley.
    c. On the empennage.
    d. In the landing gear.

60. (026) The tie-down rings on aerospace ground equipment (AGE) are normally attached to the
    a. frame.
    b. enclosure.
    c. suspension.
    d. power system.

61. (026) Aerospace ground equipment (AGE) power system components are *not* made from
    a. steel.
    b. copper.
    c. aluminum.
    d. magnesium.

62. (026) How are permanent joints on aerospace ground equipment (AGE) enclosures normally attached?
    a. Bolted.
    b. Welded.
    c. Riveted.
    d. Soldered.

63. (027) How many standard markings are applied to all Air Force aircraft?
    a. Four.
    b. Five.
    c. Six.
    d. Seven.

64. (027) Where are station numbers located on fixed wing aircraft?
    a. Tail.
    b. Nose.
    c. Wing.
    d. Fuselage.

65. (028) Which is *not* an aircraft identification and safety marking?
    a. Ground handling.
    b. Emergency.
    c. Servicing.
    d. Crew.

66. (028) What symbol is used to indicate an installed ejection system?
    a. Triangle with apex pointed down.
    b. Circle placed on right fuselage.
    c. Triangle with apex pointed up.
    d. Circle placed on left fuselage.

67. (028) What small and subdued safety marking alerts you to a hazardous condition?
    a. Warning text.
    b. Walkway lines.
    c. Crew markings.
    d. Empennage markings.

68. (029) Depending on the type of aircraft and engine, how big is the noise safety zone circle surrounding the aircraft?
    a. 100 to 200 feet.
    b. 300 to 400 feet.
    c. 100 to 200 yards.
    d. 300 to 400 yards.

Student Notes

Glossary of Abbreviations and Acronyms

AGE	aerospace ground equipment
ALC	Air Logistics Center
AMC	Air Mobility Command
ALS	Airman Leadership School
ARMS	Aviation Resource Management System
AS	allowance standard
ATC	action taken code
BL	buttock line
CCI	controlled cryptographic item
CCP	command control point
CD	compact disc
CDC	career development course
CFETP	Career Field Education and Training Plan
COMSEC	communications security
COTS	commercial-off-the-shelf
CW	complied with
DC	direct current
DD	a Department of Defense form
DOD	Department of Defense
DR	deficiency report
DVD	digital versatile disc
EMS	equipment maintenance squadron
ETIMS	Enhanced Technical Information Management System
eTO	electronic technical order
eTools	Electronic Tools
FAA	Federal Aviation Administration
FEDLOG	Federal Logistics Information System
FMP	Flight Manual Program
FOD	foreign object damage

FOM	facilitate other maintenance
FS	fuselage station
FSC	Federal Supply Classification
GEO-LOC	geographic location
GS	general system
GV	general vehicle
HPO	hourly post-flight
HSC	home station check
HTML	hypertext markup language
IAW	in accordance with
ID	initial distribution or identification
IMDS	Integrated Maintenance Data System
INFOCEN	information central web interface
IPB	illustrated parts breakdown
ISO	isochronal
ITCTO	interim time compliance technical order
JCN	job control number
JG	job guide
LAN	local area network
LOAP	list of applicable publications
LOEP	list of effective pages
MAJCOM	major command
MDD	maintenance data documentation
MIDAS	Maintenance Integrated Data Access System
MIL STD	military standard
MIP	material improvement project
MIS	maintenance information system
mph	miles per hour
NAS	National Aerospace Standard
NATO	North Atlantic Treaty Organization
NCB	National Codification Bureau
NCO	noncommissioned officer
NDI	nondestructive inspection

NIIN	national item identification number
NLG	nose landing gear
NSN	national stock number
O&M	operations and maintenance
OC-ALC	Oklahoma City Air Logistics Center
OJT	on-the-job training
OMMS	Organizational Maintenance Manual Set
OS	operational supplement
OTI	one-time inspection
PCAMS	Process Control Automated Management System
PDF	portable document format
PE	periodic
PH	phased
PIM	product improvement manager
PMA	portable maintenance aid
psi	pounds per square inch
QA	quality assurance
RC	recommended change
SDS	safety data sheets
SE	support equipment
SNCO	senior noncommissioned officer
SS	safety supplement
TAS	Tool Accountability System
TCM	technical content manager
TCTO	time compliance technical order
TM	type maintenance or technical manual
TMDE	test, measurement and diagnostic equipment
TO	technical order
TODO	technical order distribution office
TOPS	technical order page supplement
USAF	United States Air Force
UT	ultrasound
WDC	when discovered code

WL	waterline
WUC	work unit code

Student Notes

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