MÓDULO IV

4. Peso e Centragem

CENTER-OF-GRAVITY

The **center-of-gravity** (CG) is the point at which an aircraft would balance if it were possible to suspend it at that point. It is the mass center of the aircraft, or the theoretical point at which the entire weight of the aircraft is assumed to be concentrated. Its distance from the reference datum is determined by dividing the total moment by the total weight of the aircraft. The center-of-gravity point affects the stability of the aircraft. To ensure the aircraft is safe to fly, the center-of-gravity must fall within specified limits established by the manufacturer.

CENTER-OF-GRAVITY LIMITS

CG limits are specified longitudinal (forward and aft) and/or lateral (left and right) limits within which the aircraft's center of gravity must be located during flight. The CG limits are indicated in the airplane flight manual. The area between the limits is called the *CG range* of the aircraft.

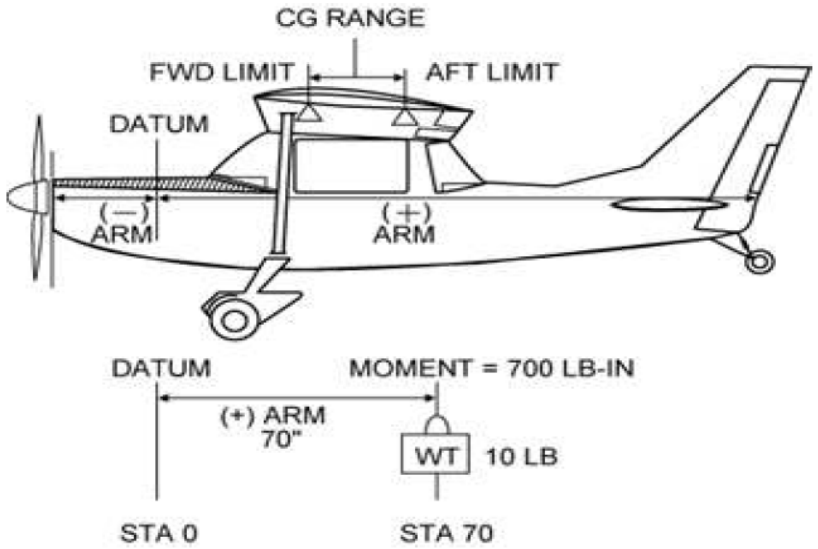
PESO E CENTRAGEM – WEIGHT AND BALANCE

The following method of computation can be applied to any object or vehicle where weight and balance information is essential; but to fulfill the purpose of this handbook, it is directed primarily toward the airplane.

By determining the weight of the empty airplane and adding the weight of everything loaded on the airplane, a total weight can be determined. This is quite simple; but to distribute this weight in such a manner that the entire mass of the loaded airplane is balanced around a point (CG) which must be located within specified limits presents a greater problem, particularly if the basic principles of weight and balance are not understood.

The point where the airplane will balance can be determined by locating the center of gravity, which is, as stated in the definitions of terms, the imaginary point where all the weight is concentrated. To provide the necessary balance between longitudinal stability and elevator control, the center of gravity is usually located slightly forward of the center of lift. This loading condition causes a nosedown tendency in flight, which is desirable during flight at a high angle of attack and slow speeds.

A safe zone within which the balance point (CG) must fall is called the CG range. The extremities of the range are called the forward CG limits and aft CG limits. These limits are usually specified in inches, along the longitudinal axis of the airplane, measured from a datum reference. The datum is an arbitrary point, established by airplane designers, which may vary in location between different airplanes. [Figure 4-2]



The distance from the datum to any component part of the airplane, or any object loaded on the airplane, is called the arm. When the object or component is located aft of the datum, it is measured in positive inches; if located forward of the datum, it is measured as negative inches, or minus inches. The location of the object or part is often referred to as the station. If the weight of any object or component is multiplied by the distance from the datum (arm), the product is the moment. The moment is the measurement of the gravitational force which causes a tendency of the weight to rotate about a point or axis and is expressed in pound-inches. [Figure 4-2] This is sometimes called *torque.* The metric equivalent, used commonly in engineering, is the *Newton-metre* (N-m). The *pound-inche* unit is used here only for the reason that most aircraft in service were designed with the older engineering units, as much as 50 or more years ago. Using the older units for weight and balance calculations cause no difficulty for most pilots as long as the aircraft can be balanced properly for flight.

To illustrate, assume a weight of 50 pounds is placed on the board at a station or point 100 inches from the datum. The downward force of the weight can be determined by multiplying 50 pounds by 100 inches, which produces a moment of 5,000 lb-in. [Figure 4-3]

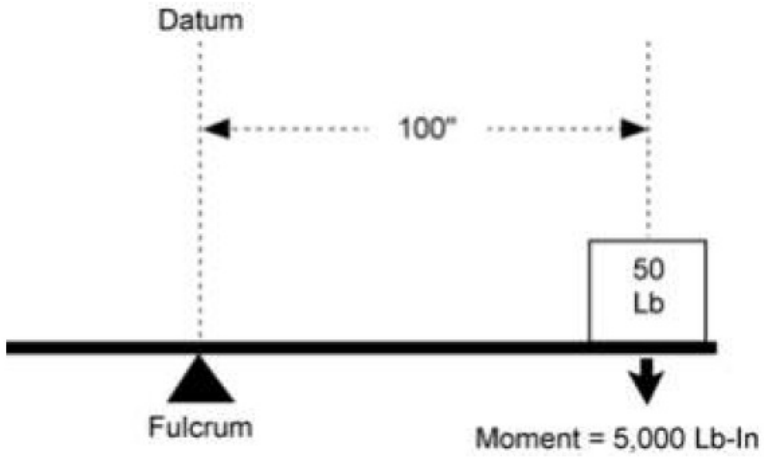


Figure 4-3.—Determining moments.

Wt * Arm = Moment
(Lb) * (In) = (Lb-In)

Determining Loaded Weight and CENTER OF GRAVITY

There are various methods for determining the loaded weight and center of gravity of an aircraft. There is the computation method, as well as methods which utilize graphs and tables provided by the aircraft manufacturer.
Computational Method

The computational method involves the application of basic math functions. The following is an example of the computational method:

Given:	
Maximum Gross Weight	3400 lb
Center-of-Gravity Range	78-86 in
Front Seat Occupants	340 lb
Rear Seat Occupants	350 lb
Fuel	75 gal
Baggage Area 1	80 lb

Step 1—List the weight of the aircraft, occupants, fuel, and baggage. Remember, fuel weighs 6 pounds per gallon.
Step 2—Enter the moment for each item listed. Remember "weight x arm = moment." To simplify calculations, the moments are divided by 100.
Step 3—Total the weight and moments.
Step 4—To determine the CG, divide the moments by the weight.

NOTE: The weight and balance records for a particular aircraft will provide the empty weight and moment as well as the information on the arm distance.

	Weight	Arm	Moment/100
Airplane Empty Weight	2110	78.3	1652.1
Front Seat Occupants	340	85.0	289.0
Rear Seat Occupants	350	121.0	423.5
Fuel	450	75.0	337.5
Baggage Area 1	80.0	150.0	120.0
Total	3330		2822.1/100

2822.1/100 divided by 3330 = 84.7

The total loaded weight of 3,330 pounds does not exceed the maximum gross weight of 3,400 pounds and the CG of 84.7 is within the 78-86 inch range; therefore, the aircraft is loaded within limits.

Caso prático

FIM DO MÓDULO IV

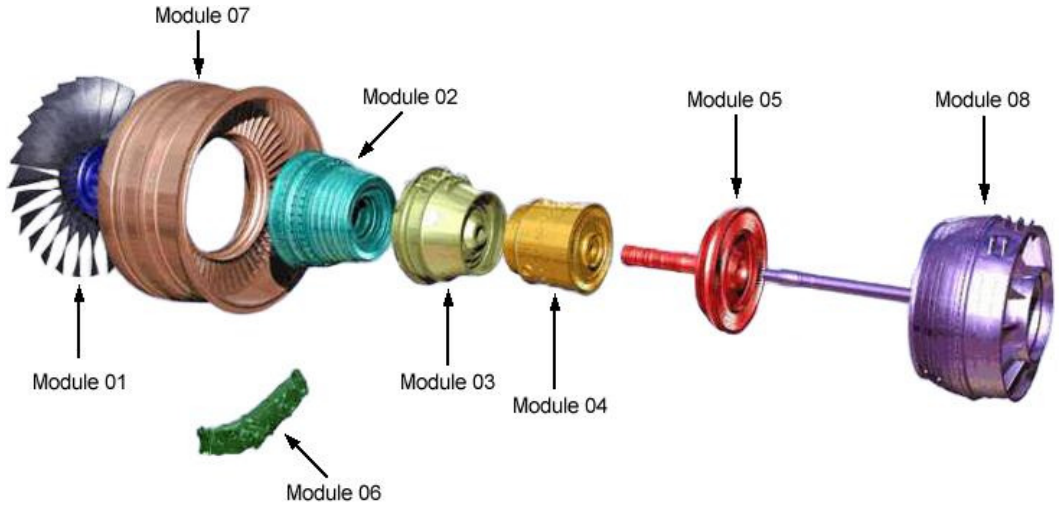
MÓDULO V

5. Manutenção de Motores

- On-wing maintenance
- Borescope inspection
- Run-Up
- Overhaul

On-wing maintenance

On-wing engine maintenace usually is limited to servicing and visual inspections which may include the use of a borescope.
Also, it may include modular parts replacement.



Borescope Inspection

The purpose of the borescope inspection of the engine is to evaluate the condition and, if necessary, monitor under a cycle limitation, repair or remove the engine before a failure of the engine components.

A **borescope** (aka **boroscope)** is an optical device consisting of a rigid or flexible tube with an eyepiece on one end, an objective lens on the other linked together by a relay optical system in between.

Flexible borescope

A flexible borescope includes a bundle of optical fibers which divide the image into pixels. It is also known as a fiberscope and can be used to access cavities which are around a bend, such as a combustion chamber, in order to view the condition of the compressed air inlets, turbine blades and seals without disassembling the engine.

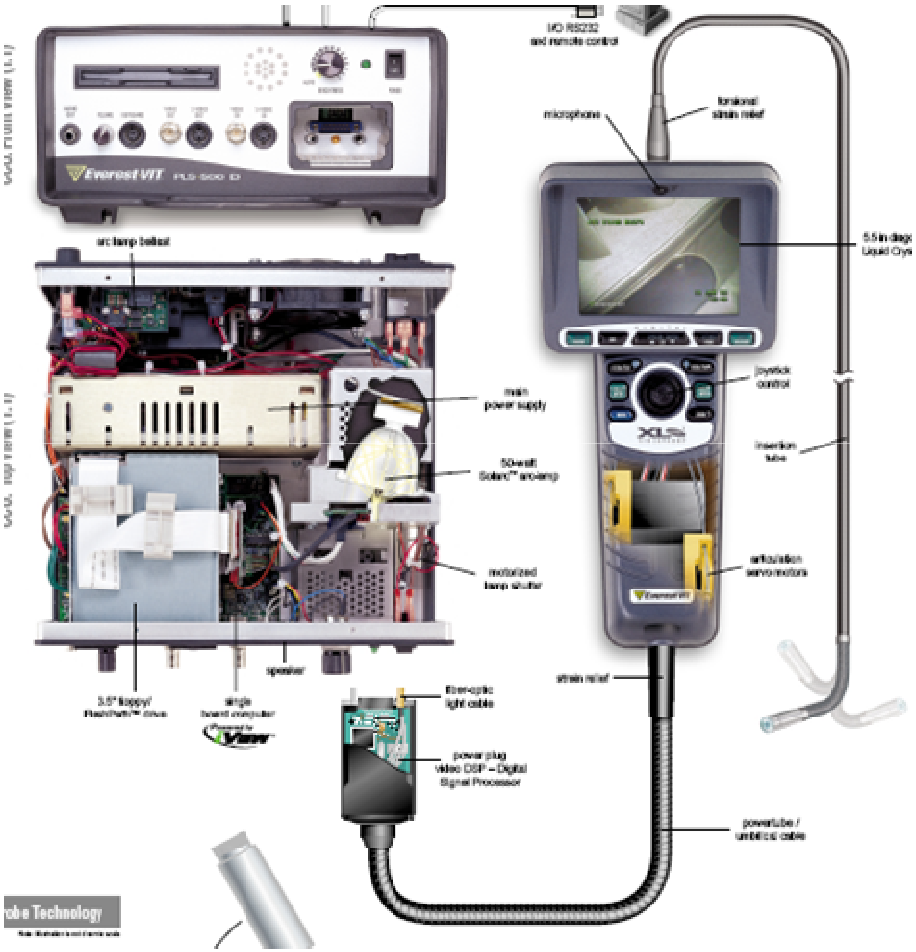
Video borescope

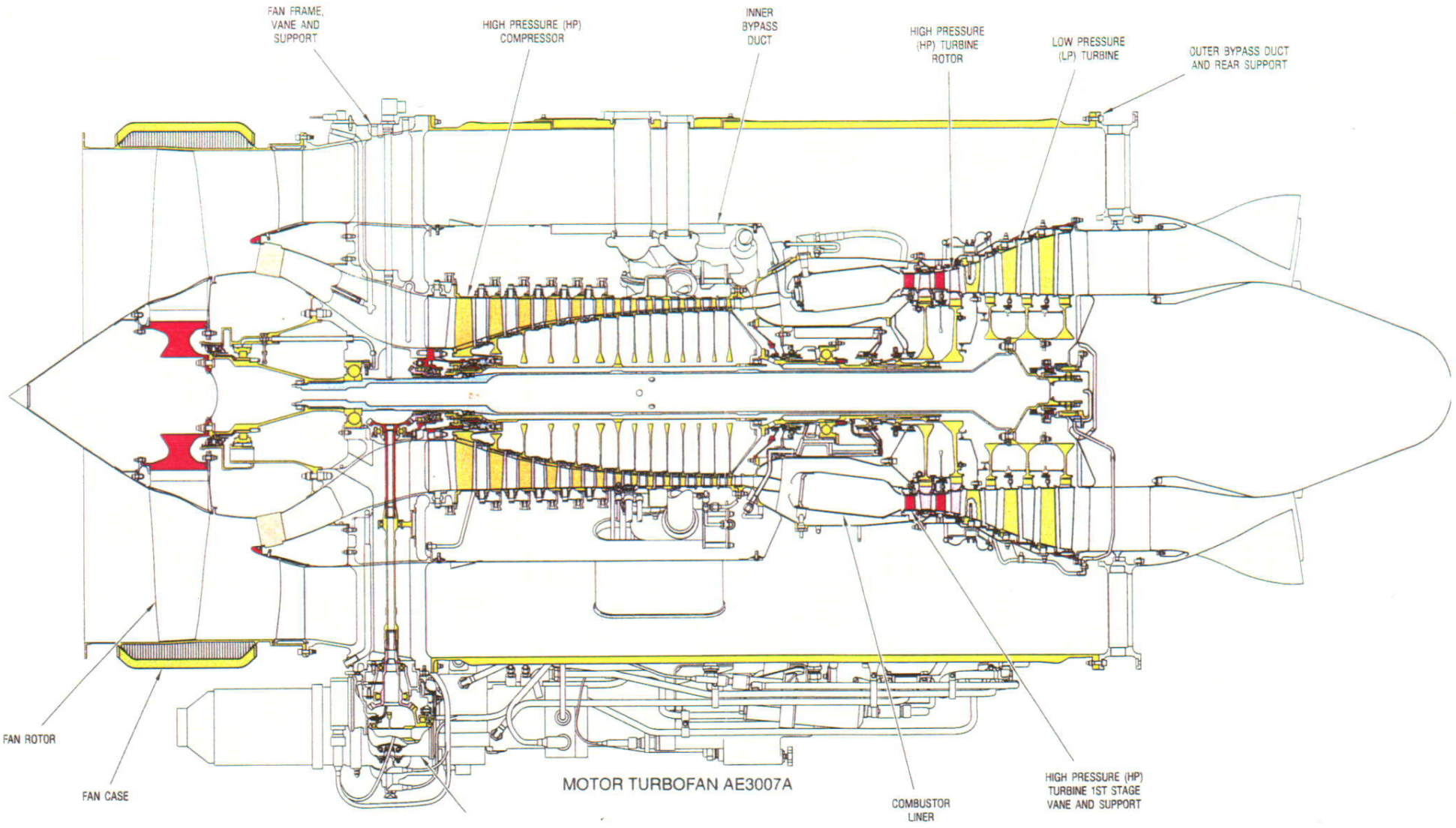
A video borescope or "inspection camera" is similar to the flexible borescope but uses a miniature video camera at the end of the flexible tube. The end of the insertion tube includes a light which makes it possible to capture video or still images deep within equipment, engines and other dark spaces. As a tool for remote visual inspection the ability to capture video or still images for later inspection is a huge benefit.

Rigid borescope

Rigid borescopes are similar to fiberscopes but generally provide a superior image at lower cost compared to a flexible borescope. Rigid borescopes have the limitation that access to what is to be viewed must be in a straight line. Rigid borescopes are therefore better suited to certain tasks such as inspecting automotive cylinders, fuel injectors and hydraulic manifold bodies.

MANUTENÇÃO DE MOTORES – ENGINE MAINTENANCE





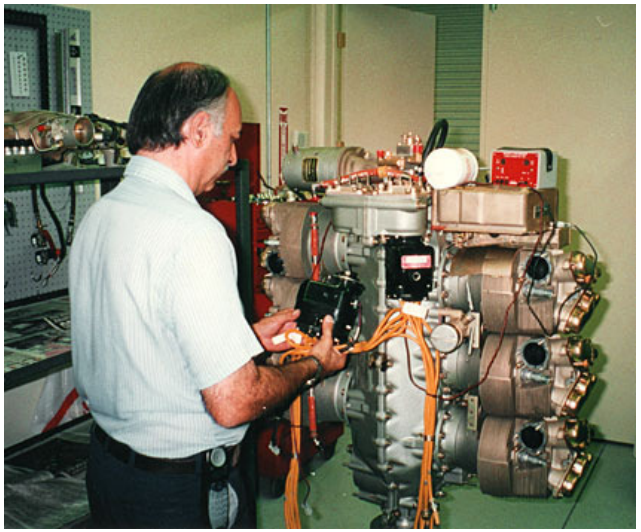
MOTOR TURBOFAN AE3007A

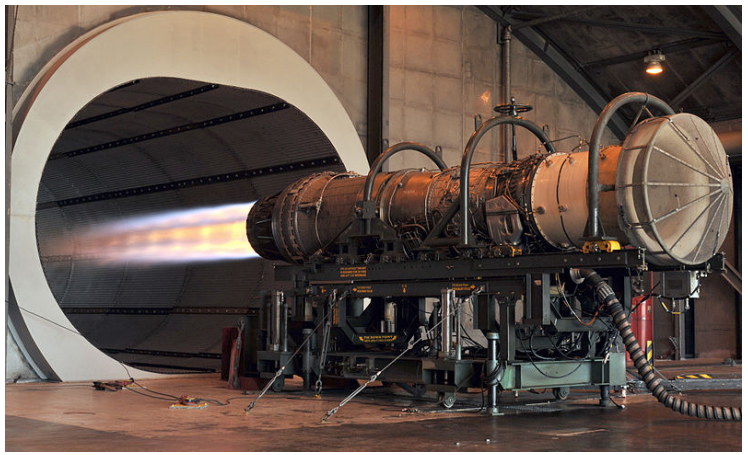
Engine Run-Up

An engine run-up is necessary after certain types of maintenance procedures are performed on an aircraft.

During an engine run-up several parameters are checked, such as engine temperatures, oil pressure, generators, among others.
Also other aircraft parameters are checked, such as pressurization, air conditioning, radios, etc.
Obtained values are then compared with manual standard values to check their good operation

Engine Overhaul and testing on Test Bench





FIM DO MÓDULO V

MÓDULO VI

6. Danos por Objectos Estranhos (DOE/FOD)

DANOS POR OBJECTOS ESTRANHOS – FOREIGN OBJECT DAMAGE
DOE - FOD

Foreign Object Debris (FOD): A substance, debris or article alien to a vehicle or system which would potentially cause damage.

Foreign Object Damage (FOD): Any damage attributed to a foreign object that can be expressed in physical or economic terms which may or may not degrade the product's required safety and/or performance characteristics.

Potential FOD: The condition where foreign object debris may cause damage, and/or failure should the product be put into use. Examples are:

- Metal or wire clippings, solder balls and debris lying in the vicinity or electrical terminals, circuitry, connectors, components, etc.
- Tools, hardware, or debris left in the vicinity, or in a migratory path or a vehicle's control system or engine inlets
- Debris lying on runways, ramps and taxiways
- Propwash exhaust blasts
- Inclement weather
- Ice and salt
- Birds and other animals
- Electro-Static Discharge (ESD)
- Construction debris

FOD Critical Area: Any area where flight hardware is in place and exposure to foreign objects would potentially cause a system or product failure due to deterioration, malfunction or damage.

Critical FO: Foreign objects in areas from which migration is possible, e.g., through tooling holes, bend relief cutouts, drain holes, intakes, etc., which are probable to cause system or component malfunction or deterioration should the product be put into use.

Foreign Object Elimination (FOE): A program or process used to assure a FOD-free product/system.

Tote Tray: A device for storing/carrying/transporting tools or equipment in a secure manner to prevent inadvertent dropping: i.e., a tool holder, an apron with pocket rings to which tools can be secured. Tote trays with lids will have the lid secured to the tote tray body.

Clean As You Go:

- Clean the immediate area when work cannot continue.
- Clean the immediate area when work debris has the potential to migrate to an out of sight or inaccessible area and cause damage and/or give the appearance of poor workmanship.
- Clean the immediate area after work is completed and prior to inspection.
- Clean at the end of each shift.
- If you drop something or hear something drop - pick it up!

Consumables: Supplies provided to workers that are expendable. Examples are:

- Issued apparel Safety glasses
- Glue, paint, sealant Rags
- Sandpaper, brushes, applicators
- Stock items such as rivets, washers, fasteners and other hardware.

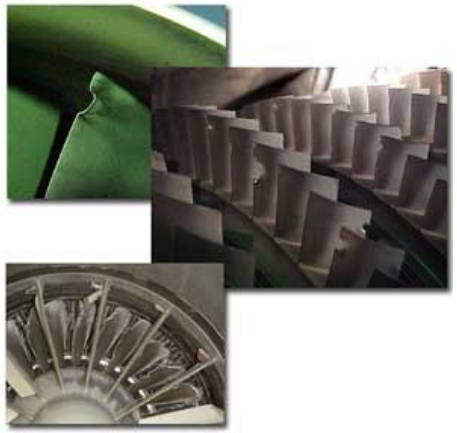
Shadowbox: A tool box with specific, marked locations for each tool so that a missing tool will be readily noticeable.

Tether: A lanyard of sufficient strength (wire, rope, cable, etc.) attached to the tool/equipment and to the user or fixed secure object. The tether should be minimum length to preclude damage from tethered tool "free swing."

DANOS POR OBJECTOS ESTRANHOS – FOREIGN OBJECT DAMAGE
DOE - FOD

Establish and maintain an effective FOD prevention program that is planned and implemented using the "continuous improvement" approach.

All incidents of actual or potential FOD should be reported and investigated. When a FOD incident occurs, operations should immediately cease and an investigation initiated to determine the cause. Cause and corrective action should be attained in a timely manner to preclude similar occurrences from happening in the future - "lessons learned." Cause may be determined by visual observation, forensic analysis, or by location of the object.



FIM DO MÓDULO VI