Fundamentals
M7
MAINTENANCE PRACTICES

Rev.-ID: 1JAN2014
Author: WiM
For Training Purposes Only
©LTT Release: Mar. 24, 2014

M7.3
Tools

EASA Part-66
CAT B1

Training Manual

Lufthansa Technical Training

For training purposes and internal use only.

© Copyright by Lufthansa Technical Training (LTT).

LTT is the owner of all rights to training documents and training software.

Any use outside the training measures, especially reproduction and/or copying of training documents and software – also extracts there of – in any format at all (photocopying, using electronic systems or with the aid of other methods) is prohibited.

Passing on training material and training software to third parties for the purpose of reproduction and/or copying is prohibited without the express written consent of LTT.

Copyright endorsements, trademarks or brands may not be removed.

A tape or video recording of training courses or similar services is only permissible with the written consent of LTT.

In other respects, legal requirements, especially under copyright and criminal law, apply.

Lufthansa Technical Training

Dept HAM US
Lufthansa Base Hamburg
Weg beim Jäger 193
22335 Hamburg
Germany

Tel: +49 (0)40 5070 2520
Fax: +49 (0)40 5070 4746
E-Mail: Customer-Service@LTT.DLH.DE

www.Lufthansa-Technical-Training.com

Revision Identification:

- The date given in the column "Revision" on the face of this cover is binding for the complete Training Manual.
- Dates and author's ID, which may be given at the base of the individual pages, are for information about the latest revision of that page(s) only.
- The LTT production process ensures that the Training Manual contains a complete set of all necessary pages in the latest finalized revision.

© Lufthansa Technical Training

M7 MAINTENANCE PRACTICES

M7.3 TOOLS

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

OPERATION AND USE OF PRECISION MEASURING TOOLS

Torque Wrenches

General

Torque is the amount of rotational force applied when tightening a fastener.

To prevent over-tightening (and thus damaging threads), accurate application of torque is achieved by using a torque wrench.

A torque wrench is a precision tool that either indicates torque applied or, through adjustment of the tool, prevents over-tightening.

Depending on the range, a torque wrench is calibrated in inch-pounds or foot-pounds (Imperial) or Nm (metric).

Types of Wrenches

There are three basic types of torque wrenches

- Indicating torque wrenches
- Signalling torque wrenches

Indicating Torque Wrenches

Indicating torque wrenches show the actual torque on a mechanical scale, a dial gauge or an electronic scale. („Measuring wrench“).

An example is the defecting beam type or the torsion bar type torque wrench.

The indication on the torque wrench is based on mechanical or electronic measuring of the torque.

Signalling Torque Wrenches

Signalling torque wrenches are preset to the desired torque value and are starting a signal when the torque is reached („click wrench“).

There are different types available with a scale at the handle and with a fixed adjustment, which have to be preset at a rig.

Lubrication on threads can change the transmission of the torque and has therefore to be taken into account.

The given torque values are normally intended for dry and clean threads (not greased).

It is generally noticed if threads have to be greased.

Calibration

Because torque wrenches and setting rigs are precision instruments, they are subject to periodic calibration testing.

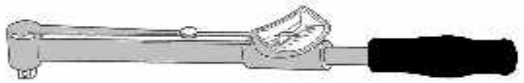
Depending on the required precision this should be done either 6–monthly or annually. If a wrench is in very frequent use it should be checked on a weekly basis.

FOR TRAINING PURPOSES ONLY!

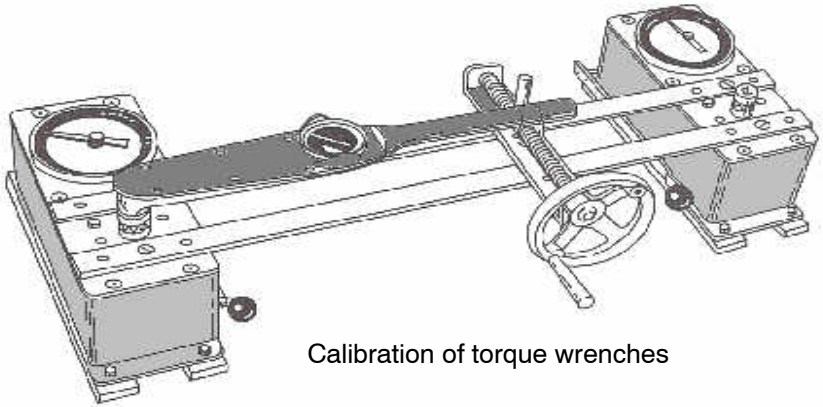
© Lufthansa Technical Training



Toggle



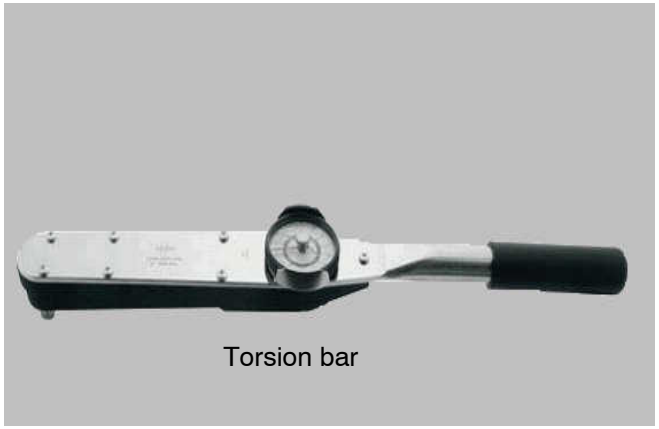
Deflecting beam



Calibration of torque wrenches



Calibration of torque wrenches



Torsion bar

Figure 1 Torque Wrenches

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

TORQUE VALUES

Torque values will normally be specified in the Maintenance Manual.

If, however, no figure is given, the torque values can be derived from the general part of the aircraft maintenance manual (AMM) in ATA chapter 20 or ATA chapter 70, alternatively from ATA chapter 51 of the structural repair manual (SRM).

WARNING: REMEMBER, TORQUE LOADING VARIES CONSIDERABLY BETWEEN WET AND DRY THREADS. THE VALUES IN THIS TABLE ARE FOR DRY THREADS.

It is common practice to give a minimum and maximum value when specifying torque figures.

Example: In the case where a castle nut is tightened then secured with a cotter pin, always torque initially to the lower figure. Adjust the torque loading upwards (but not exceeding the upper value) to align the cotter pin hole with the nut castellation gaps. If this is unsuccessful, replace the washer for one with a different thickness and re-try.

WARNING: ROTATING A NUT BY A VERY SMALL AMOUNT INCREASES THE TORQUE CONSIDERABLY. WITH THIS IN MIND, ALIGNING COTTER PIN HOLES SHOULD BE CARRIED OUT VERY CAREFULLY.

Using Extension Bars

Indicated torque on either a deflecting beam or torsion bar torque wrench is taken from the centre of the square drive. If an extension bar is to be used, its length MUST be taken into consideration (see calculation example).

The actual amount of torque applied to a fastener when a 5–inch extension is used with 120 pounds of indicated torque is 150 inch-pounds.

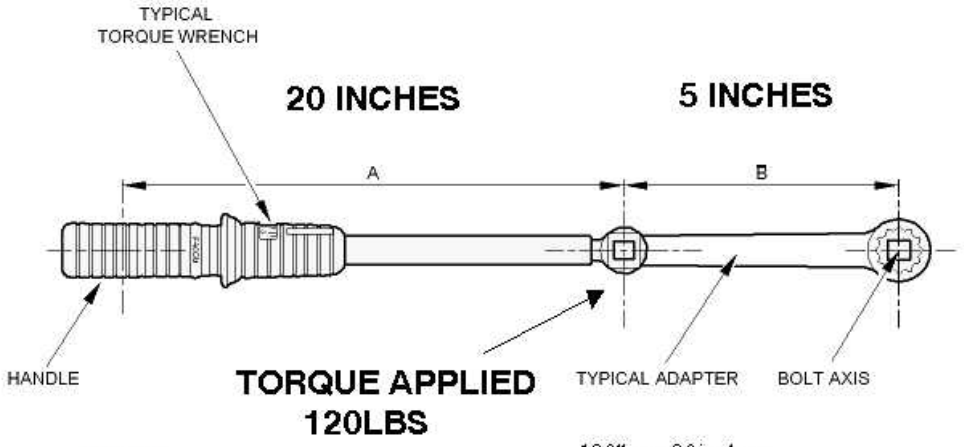
This means the torque value shown on the scale decreases with a longer lever, so:

$$T2 = \frac{T1 \times A}{A+B}$$

T1 = Value that you must apply on the fastener.
A = Length of the torque wrench.
B = Length of the adapter.
T2 = Tourque-wrench dial-reading.

FOR TRAINING PURPOSES ONLY!

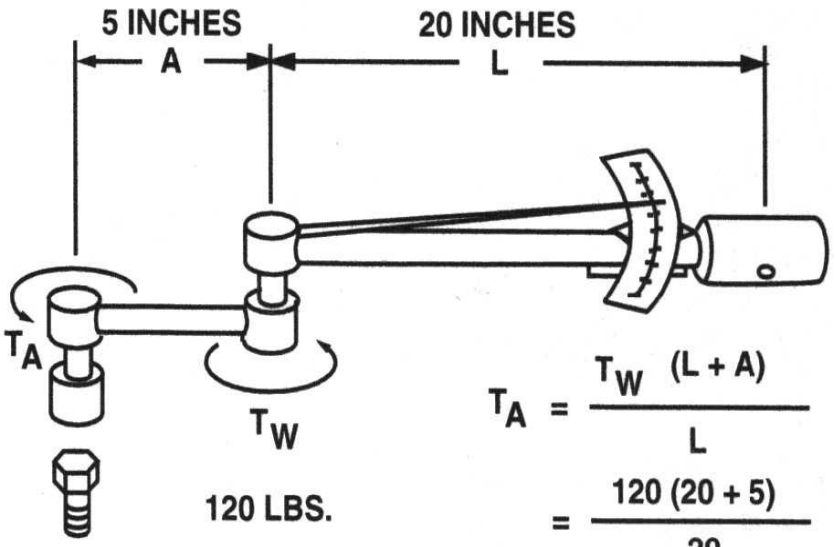
© Lufthansa Technical Training



$$T2 = \frac{T1 \times A}{A + B}$$

$$T2 = \frac{120\text{lbs} \times 20\text{inches}}{20\text{inches} + 5\text{inches}} = 96\ \text{IN / LBS}$$

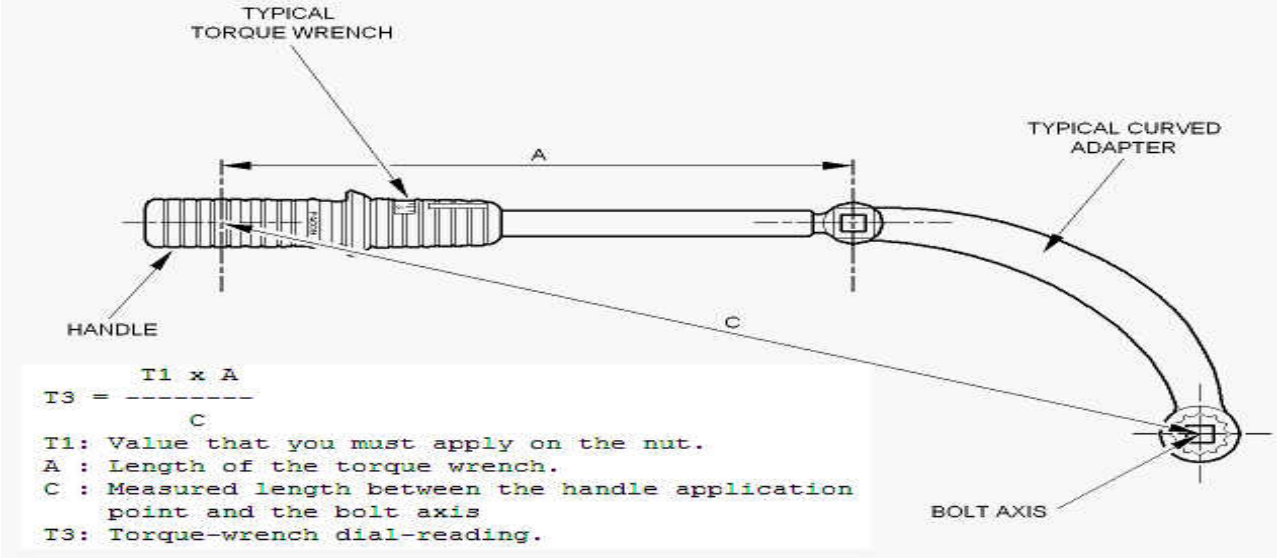
T1: Value that you must apply on the fastener.
A : Length of the torque wrench.
B : Length of the adapter.
T2: Torque-wrench dial-reading.



$$T_A = \frac{T_W\ (L + A)}{L}$$

$$= \frac{120\ (20 + 5)}{20}$$

$$= 150\ \text{IN / LBS.}$$



$$T3 = \frac{T1 \times A}{C}$$

T1: Value that you must apply on the nut.
A : Length of the torque wrench.
C : Measured length between the handle application point and the bolt axis
T3: Torque-wrench dial-reading.

Figure 2 Conversion of Torque Values

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

LUBRICATION EQUIPMENT AND METHODS

GENERAL

What are Lubricants?

Lubricants control friction and wear by introducing a friction-reducing film between moving surfaces in contact. They may be fluid, solid or plastic.

Lubricants are high complex mineral or synthetic substances. Example: engine oil. The engine oil reduces fiction, increases fuel efficiency, reduces wear of moving parts, protects the inside of the engine against corrosion, cools the piston and other hot components, removes combustion impurities and blow–by gases and helps to seal the piston during combustion, thus it improves energy conversion.

Lubricants are highly sophisticated products, not easily formulated.

What is the difference between mineral and synthetic oil?

Mineral oil is derived from crude oil. Crude oil consists out of carbon hydride. In the industry you differentiate between the mineral oil products fuel and lubricant.

In the refinery process crude oil is split up in different substances by heat (atmospheric distillation). These materials are cleaned through vacuum distillation, freed from unwanted aromatic components by an extraction process and dewaxed with the help of solvents.

This so produced crude oil types are then brightened by another cleaning.

Synthetic oils are manufactured by chemical reactions, which have an advantage concerning a constant composition and quality. The particular viscosity is based on the molecular weight of the material produced. The key differences are that mineral based oils contain some impurities and are less thermally stable than equivalent synthetic oils.

However, catalytic techniques are making mineral oils almost identical to synthetic oils.

Interestingly, it has been found that impurities in mineral base stocks can enhance certain performance aspects, for example anti–oxidant properties.

What is Grease?

Grease is a lubricant composed of oil and sometimes the oil is thickened with soap or other thickener to make a solid or semi–solid product.

Methods of Application

Oils and greases are normally applied via oil cans and grease guns, in order to bring the lubricant into the area requiring it. Usually the lubricant is hand-pumped, but large grease pumps can be fitted to pneumatic devices to facilitate greasing of multiple points.

Personal Safety

Oil and grease in contact with the skin can result in dermatitis. Barrier cream should be applied prior to handling these lubricants.

The accidental subcutaneous injection of oil or grease can also have serious health implications. Oiling and greasing equipment should be handled with care and horseplay can result in disciplinary action.

Oil or Grease?

The Maintenance Manual will indicate the correct lubricant, method and frequency of application.

WARNING: LUBRICANTS SHOULD NOT BE INTERCHANGED OR MIXED. THEY ARE CHOSEN FOR THE PARTICULAR APPLICATION. IMPROPER USE CAN RESULT DAMAGES. OILS AND GREASES SHOULD BE KEPT IN CLEARLY-MARKED CONTAINERS, PREFERABLY THAT IN WHICH THEY ARE RECEIVED FROM THE MANUFACTURERS. OIL CANS AND GREASE GUNS SHOULD BE CLEARLY MARKED WITH THEIR CONTENTS.

WARNING: LUBRICANTS ARE VOLATILE AND FLAMMABLE AND HAVE TO BE STORED IN COMPLETELY CLOSABLE CONTAINERS AND MARKED LOCKERS AND ROOMS.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

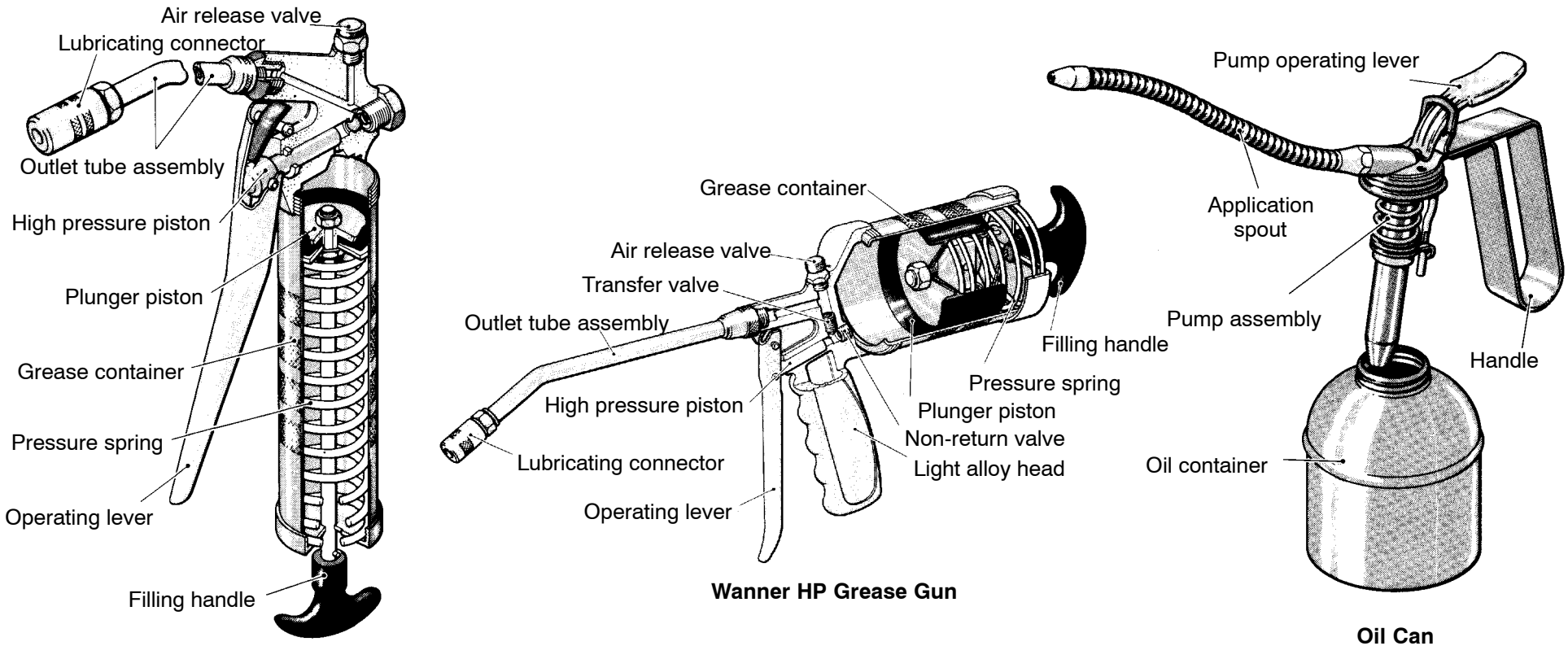


Figure 3 Lubrication Tools

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

General Lubrication Instructions: Boeing

General Instructions for Lubrication

This section of the AMM gives the normal aircraft lubrication procedures. Specific data about where to lubricate is given in the subsequent subjects of this section.

There are other lubrication instructions in other ATA sections of the AMM about equipment removal and replacement.

General–Purpose Aviation Grease

Boeing selects the grease to use based on the specific application.

Greases that meet the following specifications are considered general–purpose aviation grease for the –100ºF (–73ºC) to 250ºF (121ºC) range:

- BMS 3–33
- MIL–PRF–23827
- MIL–G–21164 (NATO G–353).

BMS 3–33 is the preferred general–purpose aviation grease recommended by Boeing for applications exposed to temperatures of less than 250ºF. It is recommended because it shows better wear, corrosion protection and low temperature torque properties.

Greases that have been used before and approved by Boeing for the specific assembly are listed as flag notes on the lubrication instructions for the specific assembly. If there is an application where only one kind of grease must be used, it will be listed with the word ”ONLY” after it.

Special Performance Greases

Special performance greases include:

- Royco 11MS
- MIL–PRF–81322 (NATO G–354)
- BMS 3–24.

In some applications special purpose grease is necessary. Where only one kind of grease is recommended for a specific application, it will be listed with the word ”ONLY” after it.

Other Lubricants

- BMS 3–32, Type II Landing Gear Shock Strut Fluid, Anti–Wear
- MIL–H–5606, Hydraulic Fluid, Petroleum base, Aircraft (NATO H–515)
- MIL–PRF–7870, Lubricating Oil, General Purpose, Low Temperature (NATO O–142).

Lubrication Symbols

Lubrication blocks are used to show the part or unit to be lubricated.

Examples of lubrication blocks used in the manual are shown opposite. If necessary, more data is given near the lubrication block to help you lubricate the airplane correctly. Each block shows this data:

- The lubrication method
- The type of lubricant
- The access panel number is given above or below the lubrication block for points if it is not easy to find the area you must lubricate.

More data on commonly-used grease is available in Boeing Service Letter 737–SL–20–027, Summary of Most Commonly Used Greases on Boeing Airplanes.

Lubrication Application Procedures and Cautions

Do the following to prevent lubricant contamination:

- Put lubricant identification labels on all containers, guns and dispensers.
- Keep lubricants in containers that have tight covers.
- Make sure that the container material will not absorb contamination.
- Keep out dust and other contamination when the container is open.
- Keep grease guns, brushes and oil cans clean.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

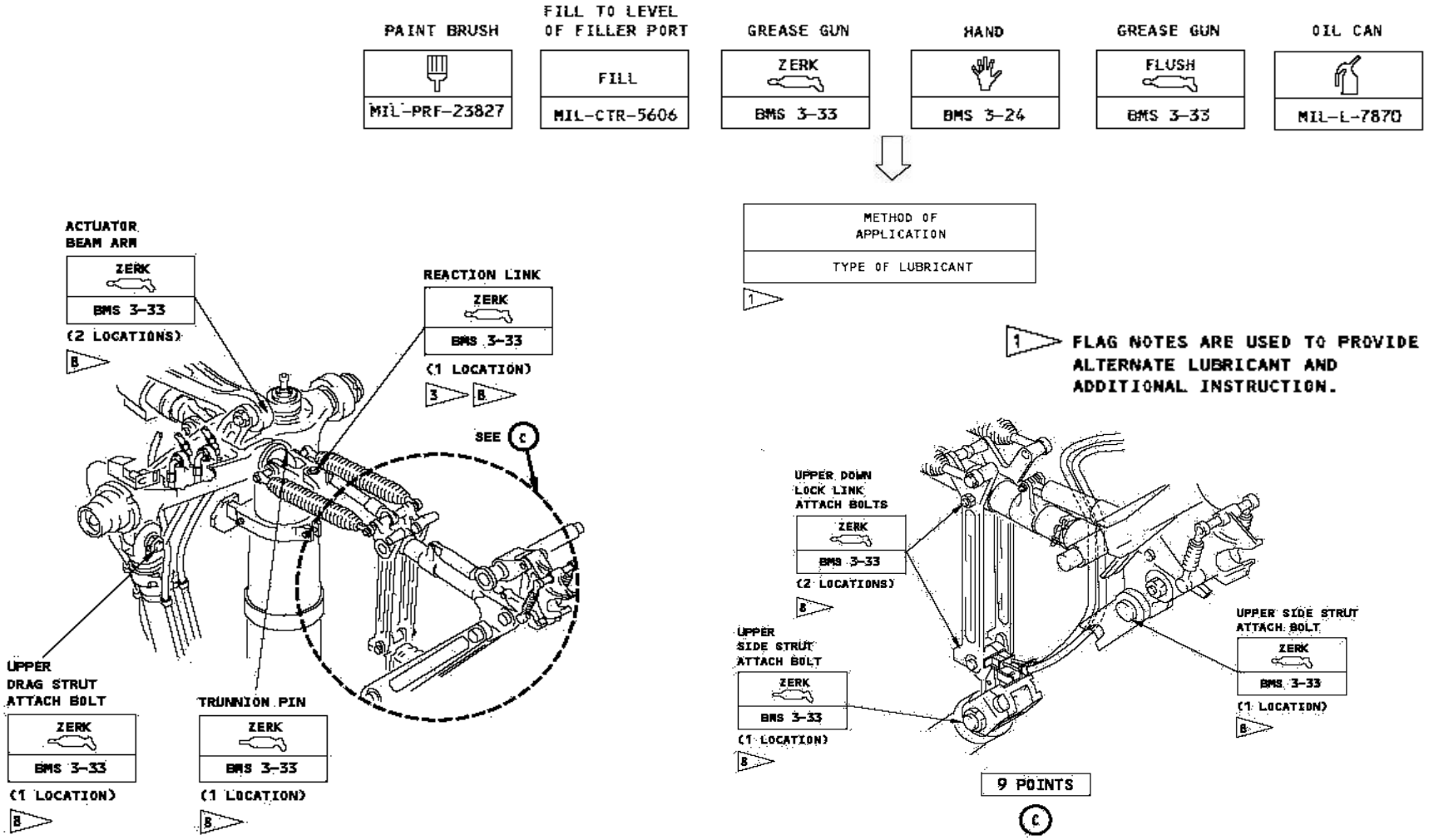


Figure 4 Lubrication Symbol Examples

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Correct Lubrication

Do not

- let dirt, swarf and other unwanted material get in the lubricant during and after lubrication. Remove dirt from the grease fittings before you attach the grease gun.
- lubricate Teflon bearings and bushings; lubricants may cause damage to the Teflon and decrease the bearing life.
- push the seal out with the grease.

Do

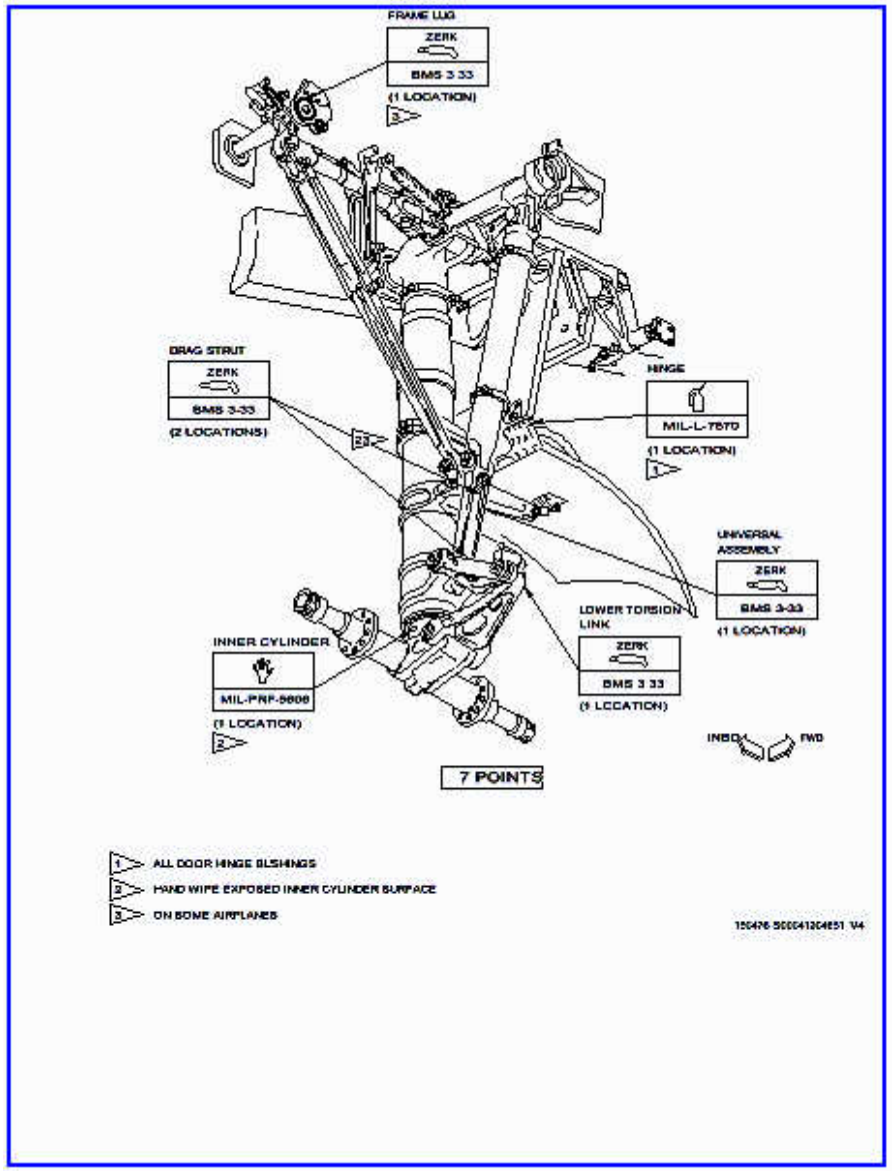
- ensure that the pressure that you set is less than 2500 psi (17237 KPa). Too much pressure will cause the fitting to blow out, resulting in injuries to personnel and/or damage to equipment.
- set the pressure at 100 to 200 psi (689 – 1379 KPa) unless otherwise specified. This is usually sufficient to push out used grease.
- find all of the lubrication points that are identified in the specific maintenance task.
- use the specified lubricant.
- use an Alemite Midget flush adapter (No. 314150) for flush–type grease fittings.
- apply all lubricants slowly and smoothly.
- dispense grease into the grease fitting until the used grease is visually removed and only new grease comes out.
- remove unwanted grease or lubricating fluid that is around the part or on other parts to prevent contamination and damage to other surfaces.
- be careful when you lubricate sealed–ball or sealed–roller bearings that have a grease fitting.
- Use a restrictor–type adapter to decrease the flow rate of the grease.
- Stop the operation if the shape of the seal starts to change, or if the grease comes out of the bearing.

If a grease fitting comes out, carry out the following:

- Look for blockage in the fitting or part.
- If necessary, dismantle the part to remove the blockage.
- Install a new fitting (AMM TASK 20–10–24–421–001).

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training



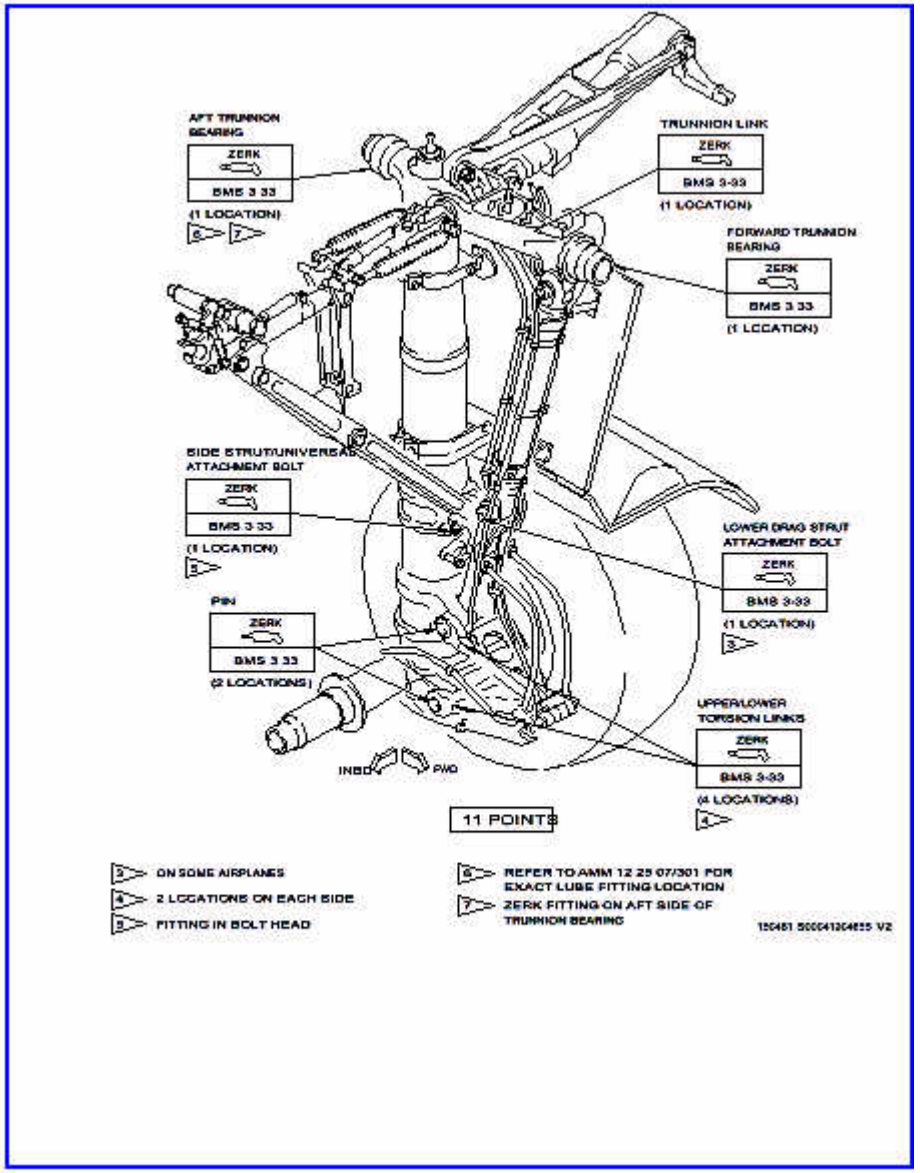


Figure 5 B737 Main Landing Gear Lubrication Example

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Example: B737 Lubrication Fittings Removal/Installation

Lubrication Fittings – Installation

WARNING: ENSURE YOU SEE THE CORRECT TOOL TO INSTALL THE LUBRICATION FITTING. DRIVE THE LUBRICATION FITTING IN STRAIGHT TO PREVENT DAMAGE OF THE MATING SURFACES.

1. Get the specified standard lube fitting for installation.
2. Clean the lube fitting hole as follows:
   A. use cotton swabs to remove as much grease as possible from the lube fitting hole.
   B. use cleaner on a clean cotton swab to clean the hole to a depth of 1/2 in minimum.
3. Use the correct driving tool to fit the lube fitting into the hole in the mating part.

Installation of a Lubrication Fitting which has Blown Out

1. Get the specified standard size or a modified size lube fitting for installation.
2. Clean the lube fitting hole as follows:
   A. use cotton swabs to remove as much grease as possible from the lube fitting hole.
   B. use cleaner on a clean cotton swab to clean the hole to a depth of 1/2 in minimum.
3. Carry out the following steps to apply the primer:
   A. Use a cotton swab to apply a thin coat of primer to the bore of the hole.
   B. Let the primer air-dry at room temperature for a minimum of 5 minutes before you apply the retainer compound.
4. Use a cotton swab to apply a thin coat of adhesive to the bore of the hole. The depth of the adhesive should be 0.25 to 0.40 inch.
5. Put the lube fitting into liquid nitrogen for a minimum of 1 minute to ensure the lube fitting cools equally.
6. Use the correct driving tool to fit the lube fitting into the hole in the mating part.

   NOTE: Put the lube fitting into the hole in the mating part as quickly as possible so that it does not warm up too much.
7. Let the lube fitting cure for 12 hours at room temperature before using it.

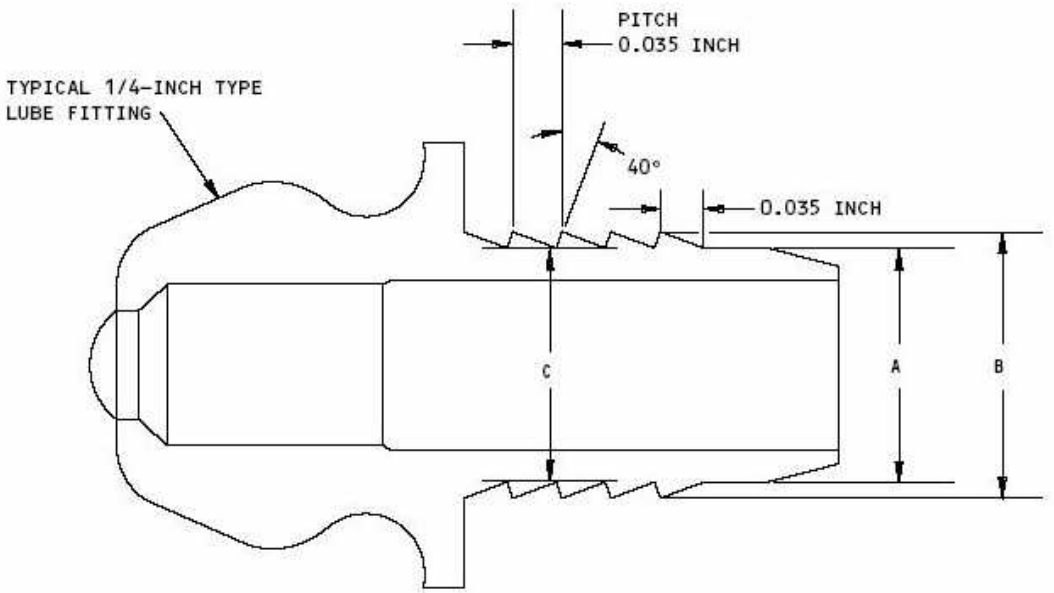
FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

DESIGN LUBE HOLE DIA IS .188/.189 INCHES

LUBE HOLE DIA (X) (INCHES)	LUBE FITTING DIA (INCHES)
0.194 MAX	3/16 1
0.195–0.247	1/4 MODIFIED 1
0.248–0.249	1/4 2
0.250–0.254	1/4 1

1 INSTALL WITH ADHESIVE
2 INSTALLATION WITH ADHESIVE OPTIONAL



ALL DIMENSIONS ARE IN INCHES
X (NOT SHOWN) = HOLE DIA IN MATING COMPONENT
A = SHANK DIA (X MINUS 0.007/0.012)
B = SERRATION OD (X PLUS 0.005/0.010)
C = SERRATION ROOT OD (X MINUS 0.003/0.010)

Figure 6 Lubrication Fitting Modification and Installation

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

Example: A320 MLG and Doors Lubrication

MLG and Doors Lubrication

No specific lubrication equipment required.

Equipment Preparation

1. Ensure that the lubrication equipment is in a serviceable condition before you fill it.
2. Operate the lubrication equipment to make sure that the lines and adaptor are full of new lubricant.
3. Clean the greasers with a clean MISCELLANEOUS (Material No. 19–003) and CLEANING AGENTS (Material No. 11–026).

MLG Lubrication

NOTE: Use the Tables that follow to determine the correct greaser.

Lubricate the MLG Uplock:

WARNING: DO NOT OPERATE POWER–OPERATED LUBRICATION EQUIPMENT AT MORE THAN 103.5 BARS (1500 PSI). HIGH LUBRICATION PRESSURE CAN CAUSE DAMAGE TO THE AIRCRAFT.

- Lubricate the MLG Uplock, Item No. 5 of the MLG Door and Uplocks Table, with COMMON GREASE (Material No. 04–004) as follows:

Lubricate the greasers Items 1 thru 4 in the Main Landing Gear Door and Uplock Table with COMMON GREASE (Material No. 04–004) until new grease comes out.

If you use hand–operated lubrication equipment, lubricate each greaser with a maximum of two full strokes.

Remove the unwanted grease:

- clean the greasers with a clean MISCELLANEOUS (Material No. 19–003) and CLEANING AGENTS (Material No. 11–026).
- ensure that the greaser ball has seated correctly.

FOR TRAINING PURPOSES ONLY!

© Lufthansa Technical Training

MAIN LANDING GEAR			
Item No.	Specified Components to be Lubricated	Greasers Total QTY	Quantity of Lubrication Greasers at each Position
1	Retraction Actuating Cylinder	6	1 on the piston rod 2 on the piston rod attachment pin 3 on the structure attachment pin
2	Upper Leg	7	1 on the forward pintle housing 1 on the aft pintle housing 3 on the aft pintle pin 2 on the aircraft structure at the forward pintle bearing (1 accessible when MLG installed)
3	Towing Lugs	2	1 on each lug
4	Torque Link	9	3 on the top torque link 2 on the top torque link attachment pin 3 on the bottom torque link 1 on the spacer assembly adjacent to the torque link damper
5	Gland Housing	3	3 on the bottom bearing
6	Leg Side-Stay Attachment	2	2 on the leg attachment bracket
7	Side-Stay	15	5 at the top cardan joint 7 at the middle joint 3 at the bottom cardan joint
8	Lockstay	13	2 at the side-stay attachment 3 at the middle joint 2 on the lockstay attachment lugs of the upper leg 2 on the lockstay carden joint 2 on the top of the lockstay 2 at the actuator attachment
9	Lockstay Actuating Cylinder	2	1 at each end of the actuating cylinder

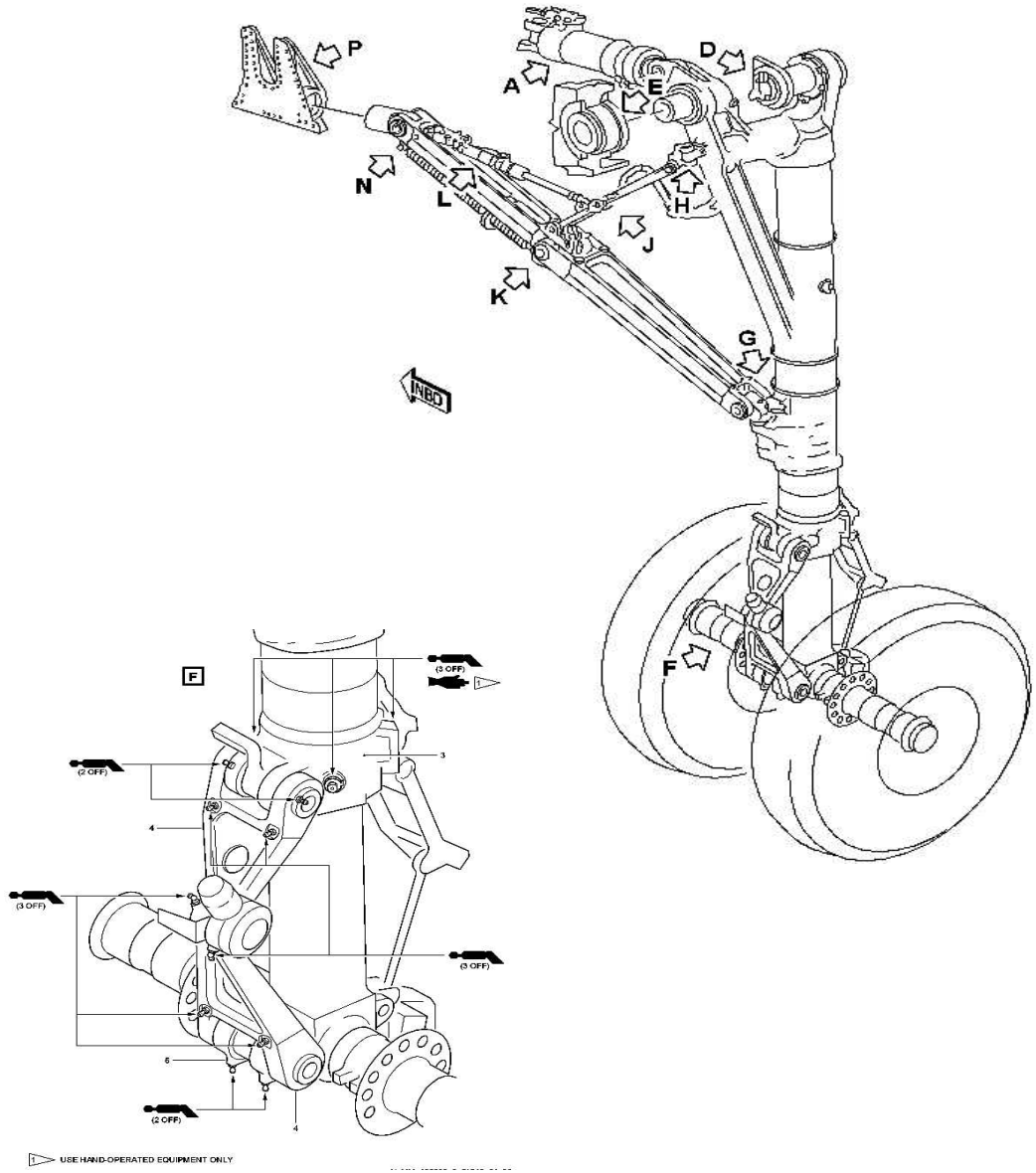


Figure 7 Greaser Table

FOR TRAINING PURPOSES ONLY!

TABLE OF CONTENTS

M7 MAINTENANCE PRACTICES 1

M7.3 TOOLS 1

OPERATION AND USE OF PRECISION MEASURING TOOLS 2

TORQUE WRENCHES 2

LUBRICATION EQUIPMENT AND METHODS 6

GENERAL LUBRICATION INSTRUCTIONS: BOEING . 8

CORRECT LUBRICATION 10

EXAMPLE: B737 LUBRICATION FITTINGS REMOVAL/INSTALLATION 12

EXAMPLE: A320 MLG AND DOORS LUBRICATION .. 14

TABLE OF FIGURES

Figure 1 Torque Wrenches 3
Figure 2 Conversion of Torque Values 5
Figure 3 Lubrication Tools 7
Figure 4 Lubrication Symbol Examples 9
Figure 5 B737 Main Landing Gear Lubrication Example 11
Figure 6 Lubrication Fitting Modification and Installation 13
Figure 7 Greaser Table 15