Fundamentals
M7
MAINTENANCE PRACTICES

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M7.17
Aircraft Handling and Storage

EASA Part-66
CAT B1

Training Manual

Lufthansa Technical Training

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M7 MAINTENANCE PRACTICES

M7.17 AIRCRAFT HANDLING AND STORAGE

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AIRCRAFT TAXIING AND TOWING

Taxiing Movements

At airports in the area of airport ground services or in the maintenance area aircrafts are directed by maintenance personal.

This is the first step in which the maintenance personal has the responsibility for the aircraft. Since there is often no radio contact from the ground to the cockpit in this area, the international hand signals shown opposite are valid.

Also important in this step is the hazard zone of the engines. In this moment the aircraft is normally taxiing by the thrust of the engines.

The taxiing by maintenance personal is not done very often anymore and is only allowed in exceptional cases.

The wheels of the nose landing gear are moved hydraulically via the nose landing gear steering. This is controllable by a handwheel in the cockpit up to a maximal steering angle (depending on the aircraft type).

WARNING: ENSURE THAT, WHEN THE AIRCRAFT MOVES UNDER ITS OWN POWER ON THE GROUND, NO-ONE ENTERS AN AREA WHERE THE AIRCRAFT CAN CAUSE INJURY OR EVEN DEATH.

WARNING: DURING TAXIING/TOWING OPERATIONS EACH PERSON IN THE AIRCRAFT MUST BE IN A SEAT WITH THE SEAT-BELT FASTENED.

WARNING: ENSURE THAT NO OBJECTS (FOD) CAN BE BLOWN AWAY OR INGESTED BY THE ENGINES.

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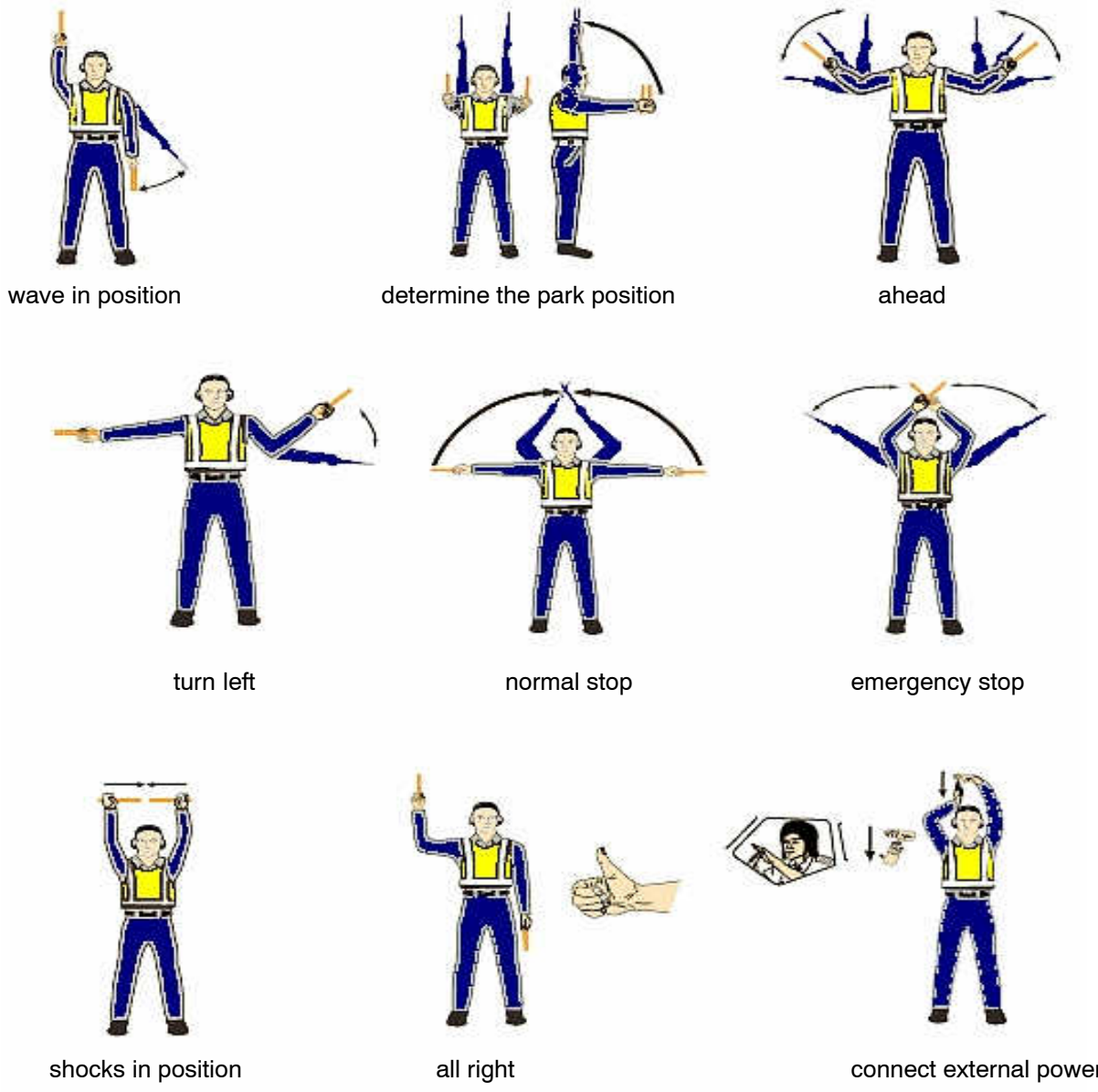


Figure 1 International hand signals

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Towing Movements

Towing Movements

Towing movements (Pushing or Pulling) are carried out with a aircraft tractor, which is connected via a tow-bar to the nose landing gear. The tractor must have a certain weight and a certain breaking force to assure the safety in case of a break fault of the towed aircraft.

Steering the aircraft during towing is effected by the tractor acting directly on the nose wheels via the tow-bar. The wheels of the nose landing gear can be turned to a maximum turning angle depending on the aircraft type during the towing. The maximal turning angle must not be exceeded during towing.

The push or pull towing of a bogged-down aircraft is achieved using a tractor and towing bridle, with a steering arm attached to the nose gear wheel axle. Is the aircraft pushed back during the towing, the steering angle has to be kept inside the limits.

WARNING: PRIOR TO ALL TOWING OPERATIONS, THE AIRCRAFT HYDRAULIC SYSTEMS ARE TO BE PRESSURISED AND THE BRAKE SYSTEMS TESTED.

WARNING: THE GEAR PINS HAVE TO BE IN PLACE.

WARNING: AT SOME AIRCRAFT UNWANTED STEERING ANGLES OF THE NOSE LANDING GEAR CAN BE CAUSED BY THE HYDRAULIC PRESSURE. THIS IS PREVENTED BY SETTING THE TOWING PIN.

Tools and equipment provided for towing are to be examined for serviceability prior to use. Before towing the aircraft, all doors and panels are to be closed.

The towing path and aircraft parking area are to be clear of obstacles. During towing, the cockpit is to be occupied so that the brakes can be applied in an emergency. The towing procedure must be continuously controlled.

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Towing-Pin



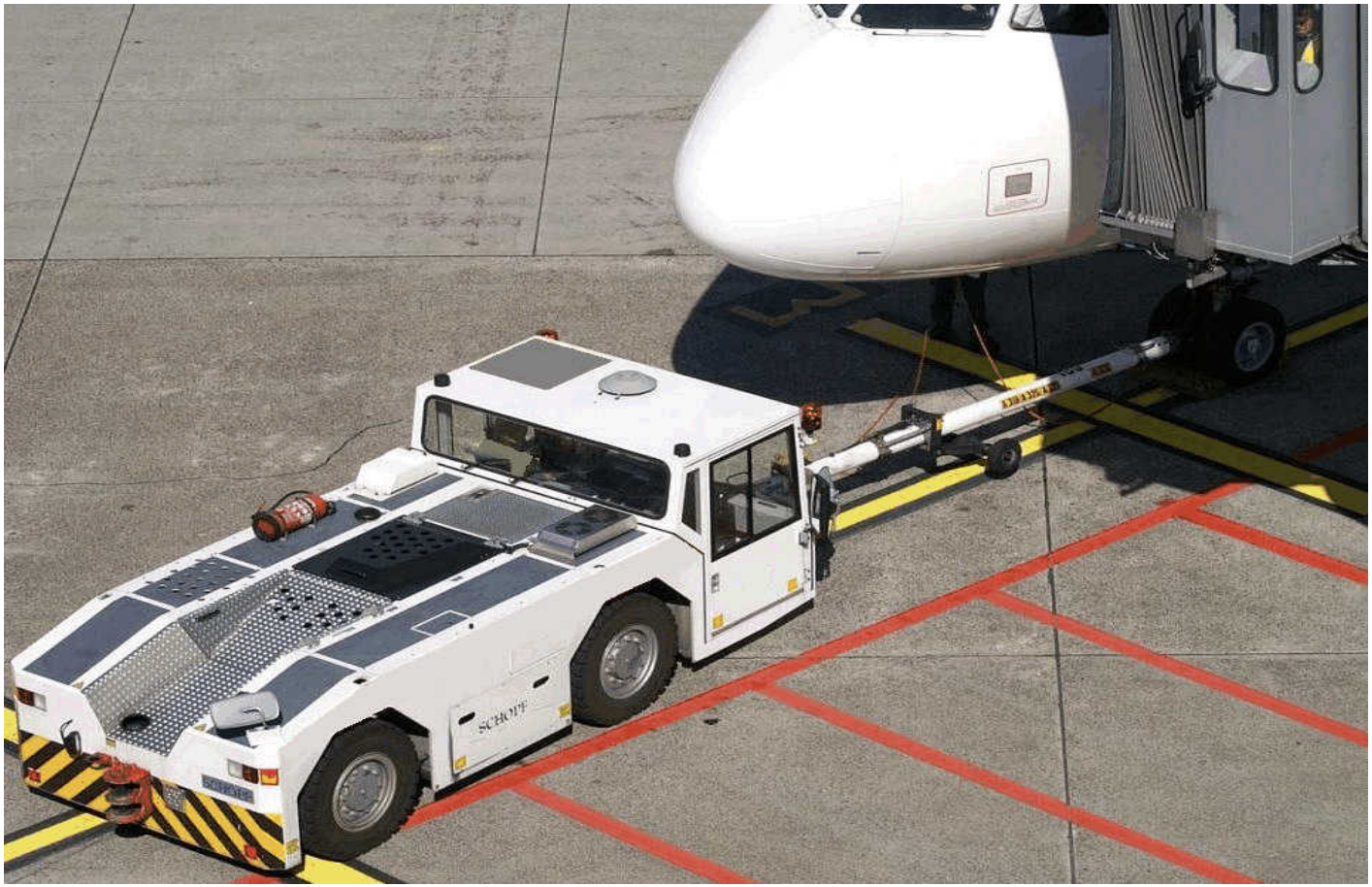


Figure 2 Towing via Nose Landing Gear

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Towing Movement

During maintenance work, the aircraft is normally moved and steered by a tractor attached to the nosewheel axle via a towbar. When towing in a limited space, it is essential that the aircraft does not turn on a locked wheel, since this can result in deformation and excessive wear of the tyres.

You can also use the MLG attachments to tow the aircraft, if:

- the engines are shut down
- or the aircraft is bogged down.

The maximum allowed towing speed, depends on the aircraft type.

Speed limits, when the door is closed and locked or removed:

- For a tractor with a tow bar, a maximum speed of 25 km/h (15.5 mph) is permitted.
- For a tractor without a tow bar (i. e. using a lifting device), a maximum speed of 32 km/h (19.8 mph) is permitted.

Speed limits, when the passenger/crew doors are fully open and locked and/or cargo doors open in vertical position:

- The permitted maximum speed is 10 km/h (6.21 mph).

You can use the nose landing gear tow–bar fitting to tow or push the aircraft:

- with maximum weight,
- with the engines between zero and idle.

WARNING: DURING TOWING IT HAS TO BE TAKEN CARE THAT SAFETY PERSONAL CAN KEEP UP WITH THE TOWING SPEED.

WARNING: GENERALLY THE AIRCRAFT IS SAFETIED AGAINST ROLLING AFTER THE TOWING WITH CHOCKS.

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Figure 3 Towing

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LIFTING AND SHORING

General

An aircraft should be lifted at a place that is protected from the wind, at best in an aircraft hangar. If it is lifted outdoors, it must be turned into the wind previously.

For recovering an aircraft in some procedures airbags are used for lifting the aircraft.

Three jacking points at the aircraft are designed for attaching the lifting device. One is located directly in front of the nose landing gear bay and each one under the wings next to the main landing gear struts (to the outside).

The points for the lifting device have a thread receptacle for the attachment of the removable lifting adapters.

Lifting

The aircraft is lifted by three hydraulically powered lifting devices, which are positioned in the front fuselage area and under the wings.

Individual landing gear struts are lifted with a landing gear lifting device, which is positioned at the corresponding point under every strut.

After lifting with a hydraulic lifting device and the installation of the safety jack (tail steady) for stabilizing, no further work for supporting the aircraft is necessary.

Shoring

During shoring considerably more lifting devices are used, which are located over the whole fuselage length and under the wings. So the fuselage is standing ‘‘stress free‘‘. This is very important for some structural work tasks, like e. g. the exchange of panels or fasteners.

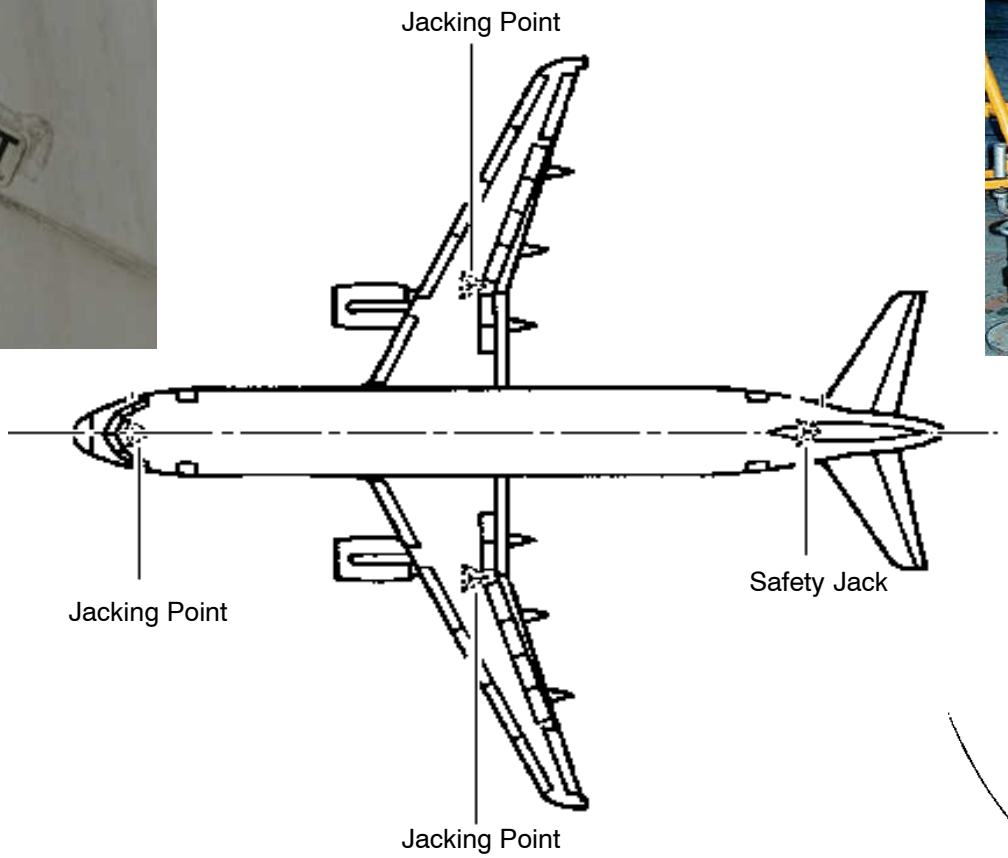
Partial two additional jacking points at every side of the middle fuselage are available, which can alternatively be used in the maintenance instead of the main jacking points.

All three methods for lifting an aircraft are provided in the AMM ATA Chapter 07.

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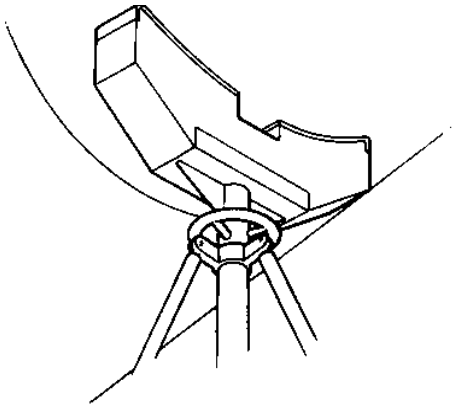


Figure 4 Lifting

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Jacking

In order to change only e. g. a tire, a single axis can be lifted. this is known as jacking.

The axis is therefore equipped with a special device.

Lifting on Landing Gear Struts

A jack point is provided on all three landing gear struts to accommodate the landing gear hydraulic jack.

Any strut and its wheel assembly can be individually lifted clear of the ground for maintenance procedures such as wheel or brake change.

If both tyres on one landing gear strut are deflated, there is insufficient clearance to insert the landing gear jack under the base of the strut. If, in this case, it is impractical to lift the aircraft using the main jacks, a landing gear ramp can be positioned in front of the affected wheels and the aircraft towed onto the ramp to give the required clearance for landing gear jack insertion.

- Chock the two other wheels when lifting one landing gear strut.
- Ensure aircraft parking brake is off.
- Position landing gear jack under jack point on base of strut.
- Operate jack until wheels are lifted just clear of ground.

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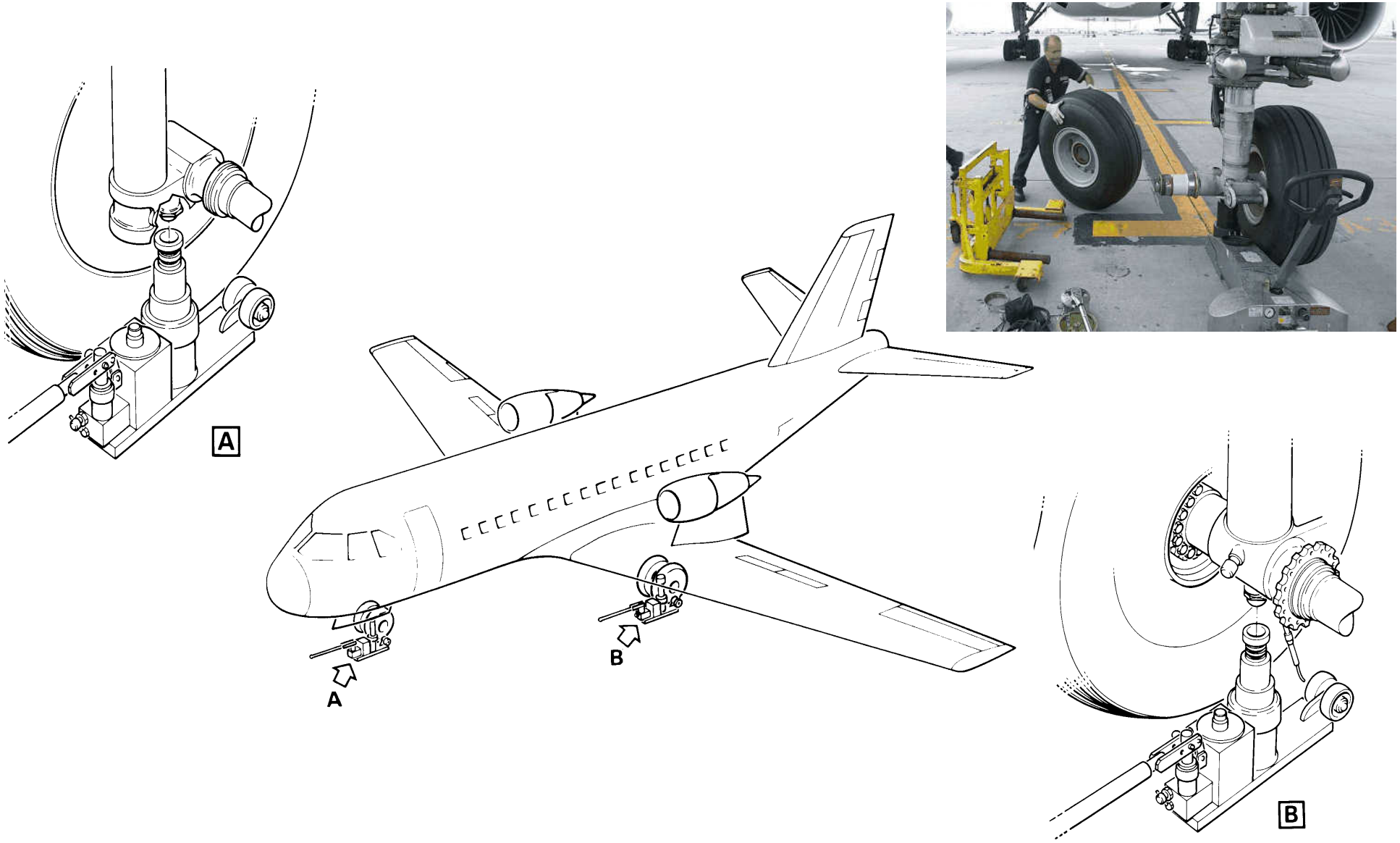


Figure 5 Landing Gear Jacking Points

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STORAGE OF AIRCRAFTS

Parking

This storage method keeps the ground readiness for a parking period for not more then 2 days.

WARNING: ATTEMTION. WHEN PARKING AN AIRCRAFT YOU MUST CONSIDER THE WEATHER CONDITIONS.

- If the aircraft is parked in high wind conditions, check the aircraft stability and moor the aircraft if necessary.
- If the aircraft is parked in cold weather conditions, do the cold weather maintenance procedures.

Safety Precautions

- Park the aircraft on a flat surface, ensuring that the wheel of the nose landing gear is on the aircraft axis and the aircraft points into the wind.
- Install safety devices on the landing gears.
- Make sure that the flaps, slats, spoilers and thrust reversers are retracted.
- Make sure that the THS is set to neutral.
- Put the wheel chocks, at the nose and the main landing gear, in front **and** behind the wheels.
- Ground the aircraft.

Installation of Protection Devices on the Fuselage

- temperature sensors,
- pitot probes,
- angle–of–attack sensors,
- static probes.
- Installation of the protective devices at the APU exhaust duct,
- Installation of the protective devices for the engines (air in- and outlet)

Aircraft Maintenance Configuration

- Push the DITCHING push button switch to close the avionics ventilation skin valves.
- Make sure that the windows of the cockpit are closed.
- Make an entry in the aircraft log book or attach a tag on the captain's side-stick to inform the crew that protection covers/devices are installed.
- Remove the ground support and maintenance equipment, the special and standard tools and all other items.
- Make sure that you close all access/doors.

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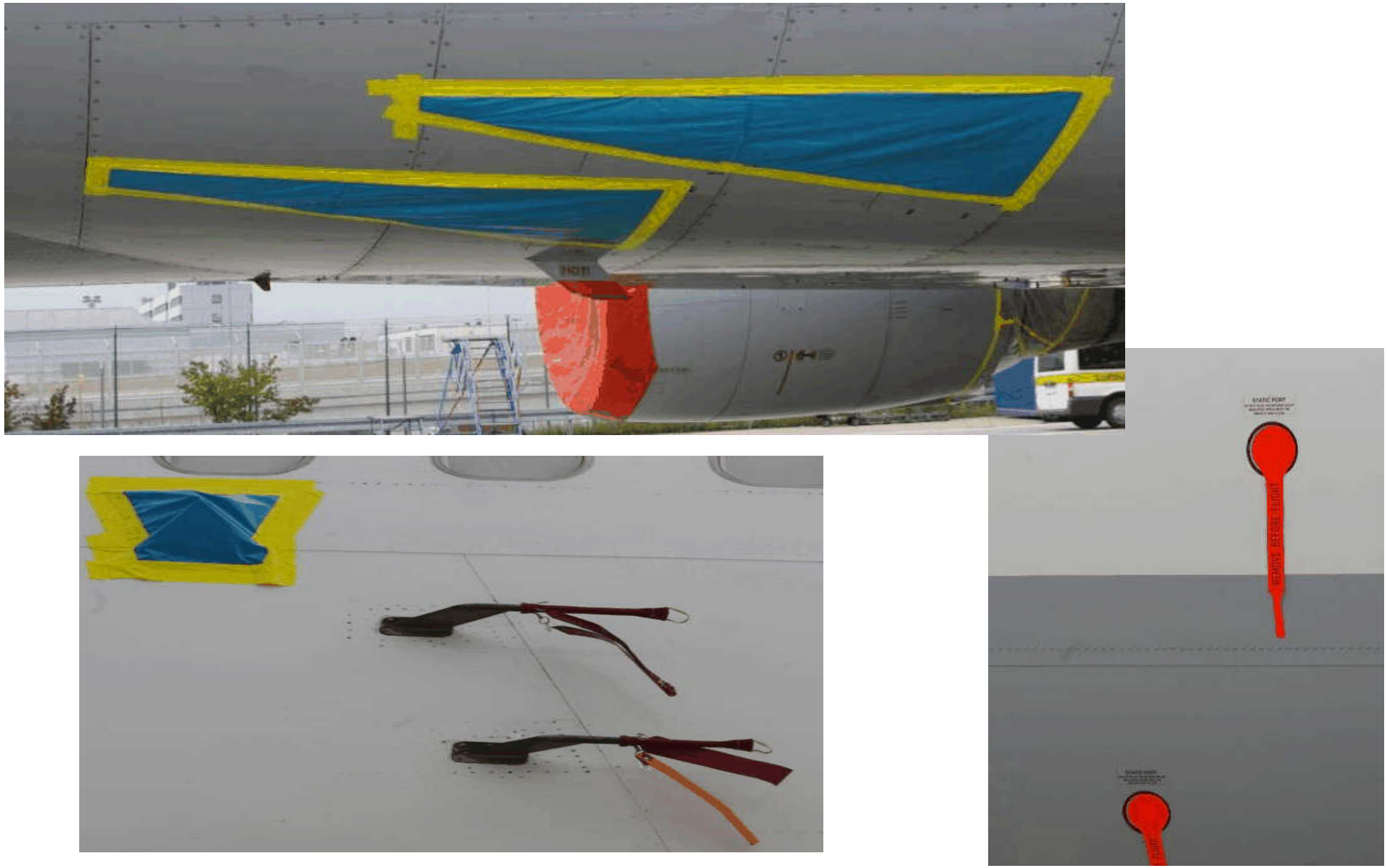


Figure 6 Examples of Protection Devices on Fuselage

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Return to operation (not longer than 2 days)

- Push the DITCHING button (if existent) to open the valves for the avionic room.

Removal of the protective coverings:

- At the APU,
- At the engine,

Remove the cover slips from:

- Temperature sensors,
- Pitot probes,
- Angle–of–attack sensors,
- Static probes.

The general condition of the aircraft is checked by a visual inspection of airframe.

Look in the following areas for leakages:

- The wings,
- The fuselage,
- The landing gear,
- The engines,
- The APU,
- The horizontal and vertical stabilizers.

Remove ground cables from the aircraft.

Remove the wheel chocks from the main and nose landing gears.

Remove tag from the captain side-stick or write in the log book that the protection covers/devices are no longer installed.

Remove the ground support and maintenance equipment, the special and standard tools and all other items.

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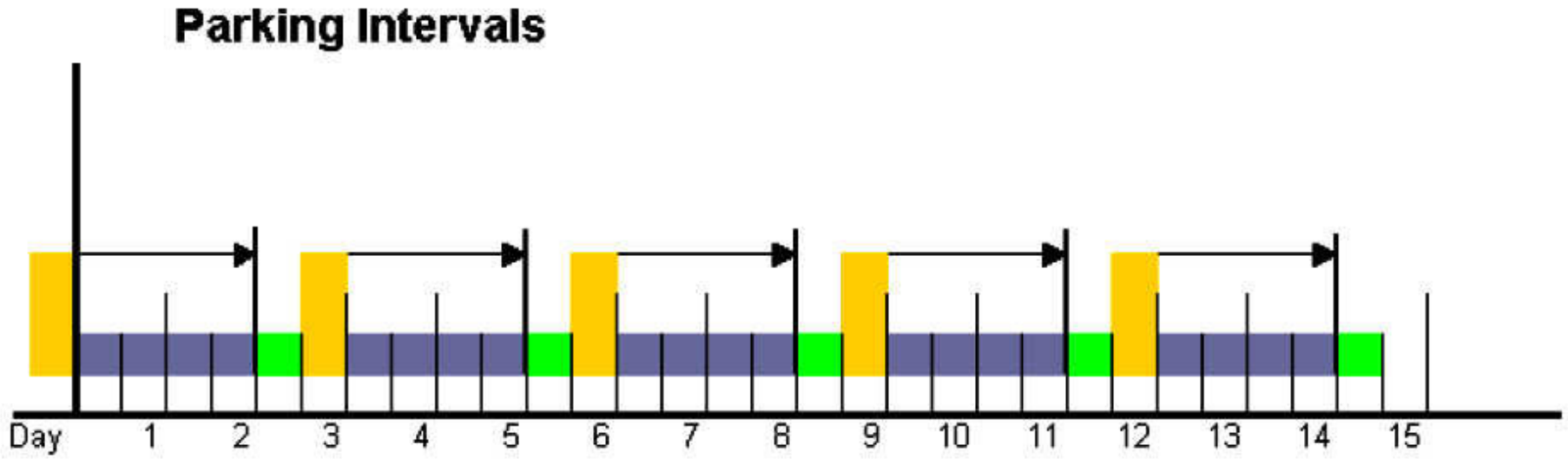


Figure 7 Parking Intervals (not more than 2 Days)

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Parking

This storage method keeps the ground readiness for a parking period for not more then 12 days.

So the flight ready condition of the aircraft is kept.

Periodic Ground Checks must be carried out at 7–day and 15–day intervals.

- If the aircraft is parked in high wind conditions, check the aircraft stability and moor the aircraft if necessary.
- If the aircraft is parked in cold weather conditions, do the cold weather maintenance procedures..

Aircraft configuration:

- Ensure that the fuel tanks are 90% full (minimum).

Protection for engines and APU:

- Operate the APU for at least 5 min without load.
- Run the engines and let them become stable at ground idle for 15-20 mins
- Do a thrust reverser full cycle.

Protection of the water and toilet system:

Potable water system:

- Ensure the system is empty and dry. If necessary, drain, flush and dry the system.

Toilet system

- Ensure that the system is empty. If necessary, drain, flush and use disinfectant to clean the system.

Protection of the air data system:

- Flush the total pressure line of the air data module.
- Flush the static pressure line of the air data module
- Drain and flush the standby static and standby total pressure lines of the air data module

Protection of the electrical system:

- Remove or disconnect the batteries.

Protection of the fuel system:

- Drain water from all the fuel tanks. You must wait for one hour after refuelling is completed before you do the water drain procedure.

Protection of the cabin:

- It is recommended to do the protection of the cockpit and passenger seats with STORAGE PRESERVATION, to prevent discolouration by the sun during a long parking period.
- Protection of the doors, open the following doors:
  - the passenger/crew doors,
  - the emergency exit doors,
  - the cargo compartment doors,
  - the landing gear doors,
  - all other the pressurized access doors.
- All door sealings are treated with a special material
- After that all doors are closed.

Put aircraft in parking configuration. Ensure that all the external structural drain holes are not clogged. Ensure that all the engine drains are not clogged.

Carry out full parking procedure. Seal the air conditioning /ventilation inlets and outlets with STORAGE PRESERVATION Material and adhesive tape. Put tarpaulins on the MLG wheels.

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Figure 8 Protection Devices on Engine

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Periodic Ground Check (at 7–day intervals) :

- Check the general condition of the aircraft.
- Ensure that the protection covers/plugs are correctly installed.
- Do a general visual inspection of the airframe from the ground.
- Look in the following areas for leakages:
- Wings
- Lower fuselage
- The landing gear
- Engines
- APU
- The horizontal and vertical stabilizer.

Periodic Ground Check (at 15–day intervals) :

- Checking the condition of the fuselage on leakages.
- Bird nesting in all areas of the aircraft to which birds have access.
- Bird excrement. If present, remove it.
- Outer skin for unusual contamination.
- Make sure that the extension of the landing gear shock absorbers is correct.
- Do a check of the tire pressure.
- Do a check of the hydraulic reservoir level.
- Drain water from all the fuel tanks.
- Move the aircraft.

System test:

- Do the functional test of the nose wheel steering with the handwheel and with the pedals
- Do the operational test of the normal and alternate braking system.
- Operate Air Conditioning system.
- Operate all the flight control surfaces on full travel and ensure that they operate correctly.
- Do the operational test of the bleed air system.
- Do the operational test of the wing–ice protection system.
- Do the operational test of the engine air intake ice protection.

Checking the APU and the engines:

- Start the APU
- Start the engines with APU bleed and operate them at idle power.
- Do a thrust reverser full cycle.

Put the aircraft in parking configuration.

Let the engines and the APU become cool and install protection covers/plugs on the fuselage, the engines and the APU area.

Record any discrepancy in the log book.

Install tarpaulins on the MLG wheels.

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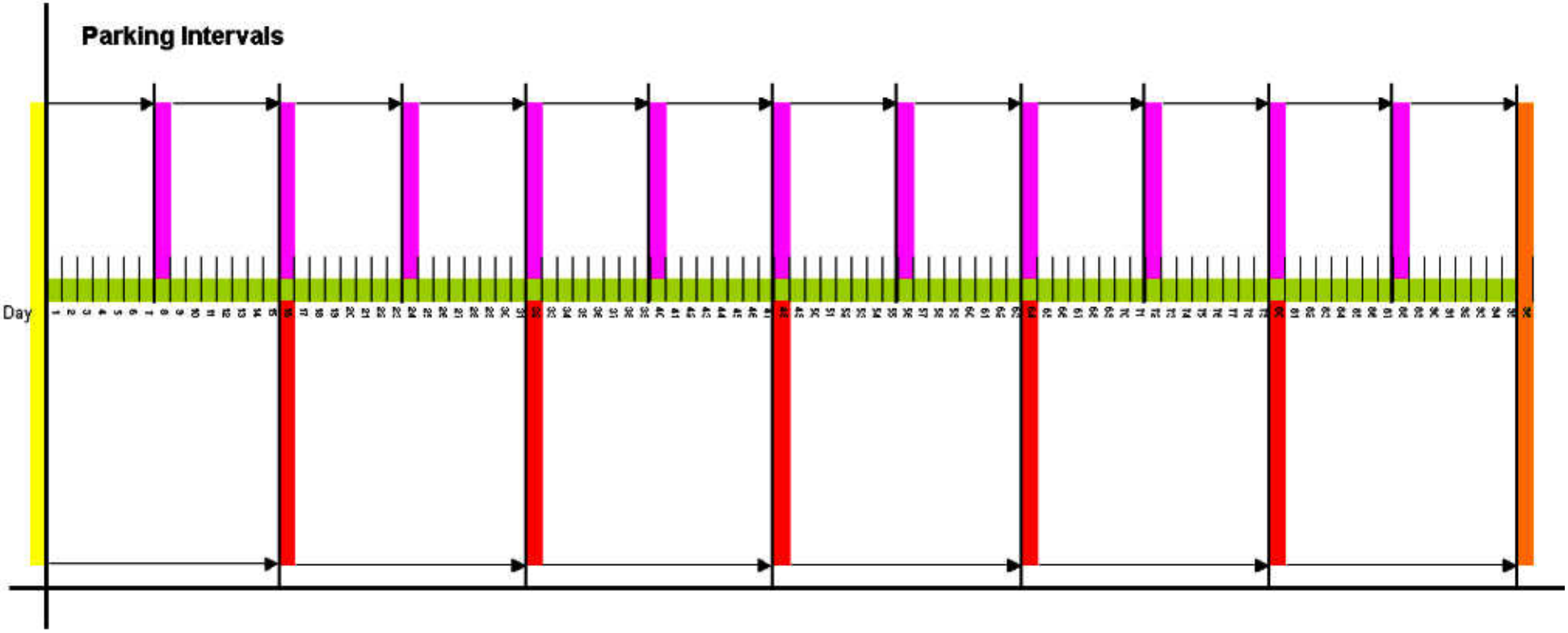


Figure 9 Parking Intervals (not more than 12 weeks)

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Storage

Storage Procedure (not more than 1 month)

- Clean the aircraft externally and internally.
- Drain of the potable water system.
- Drain the toilet system.
- Open all doors and apply Special Material to all the seals of the doors.
- Make sure that there is no blockage in any structural drain holes
- Flush the total pressure line and the static pressure line of the Air Data Module.
- Lubricate the mechanical control chains of the THS.
- Lubricate all rollers and pinions of slat tracks, all spoiler linkage bearings that have grease nipples and hinge and attachment fittings of horizontal stabilizer.
- Close the valve of the oxygen cylinder and bleed the oxygen system.
- Check tyre pressures.

Protection of the engines:

- Do the preservation of the engines.

Protection of the APU:

- Do the preservation of the APU.

Protection of the fuel system:

- Fill all the fuel tanks to 90% of their total capacity and all the fuel system lines.
- Make the vents wet (so that the sealants will not become dry and will not crack). Operate the water drains one hour after you refuel the tanks.

Protection of the electrical system:

- Remove battery.

Seal the following areas with the storage preservation material attached with adhesive tape (record the location) :

- Inlets and outlets of the air conditioning packs.
- Pre-cooler outlets.
- Anti−ice air outlet and the access panels which are on the engine air intakes.

Close access:

Close all the window shades, emergency exit doors, cargo compartment doors and gear doors.

Put the aircraft in the storage area.

Do the full parking procedure.

During the storage period, do the periodic checks:

- at 7−day intervals
- at 15−day intervals.

For return-to-service, do the return-to-service procedure.

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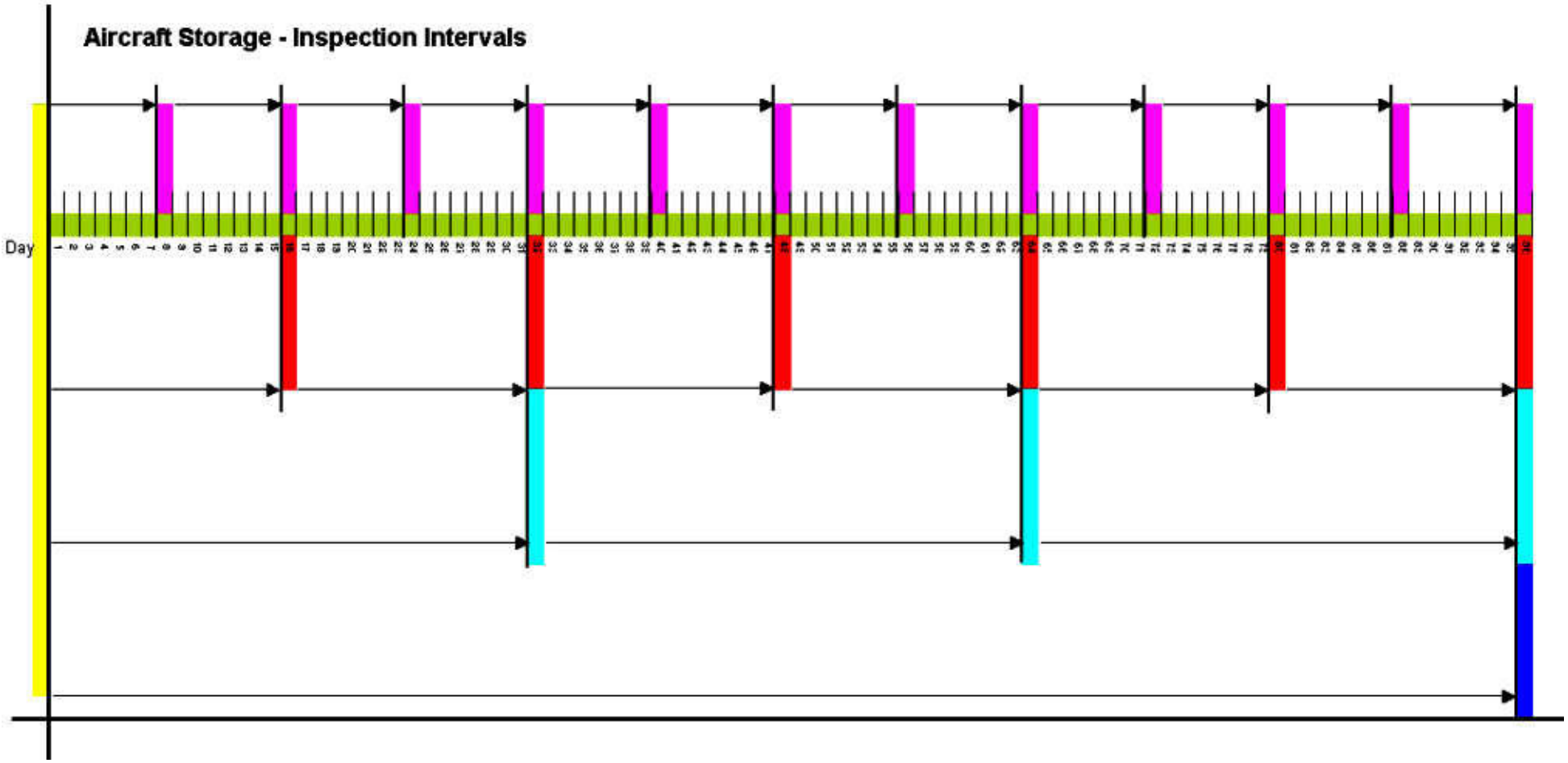


Figure 10 Aircraft Storage - Inspection Intervals

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Storage (continued)

Storage (for a period as long as 2 years)

Clean

Clean the aircraft.

Hydraulics

- De-aerate the hydraulic systems
  - Put a warning notice in position to tell persons not to operate the systems during the aircraft storage procedure
- Do a check of the hydraulic components for external leakage.
- Use SPECIAL MATERIALS for:
  - all the hydraulic unions in the landing gear bays,
  - the bolt heads of the hydraulic reservoirs,
  - the pipe clamps,
  - the trailing edge of the wing.
- Use SPECIAL MATERIALS for the solenoids of the hydraulic flap manifold.
- Inspect the flight controls.
- Check the oil level of the flap PCU and slat PCU gearbox.

Drains

Visually inspect the drains.

Water removal

Remove the water from the pitot/static lines.

Rain Repellent System

De−activate the rain repellent system.

Lubrication

- Lubricate the mechanical control chains of the THS, all the rollers and pinions of the slat tracks, spoilers, linkage bearings, cargo compartment doors, passenger/crew doors and emergency exit doors hinges and the attach fitting of the horizontal stabilizer, rudder bearing and sliding window.

Protection

- Apply SPECIAL MATERIALS to all the seals of the doors.
- Carry out protection of all the light-alloy areas that are unpainted
- Apply SPECIAL MATERIALS or COMMON GREASE to the steel parts that are unpainted and on the mechanical rods in unpressurized areas.
- Apply SPECIAL MATERIALS (Material No.05−027) to:
  - the cases, electrical connectors, solenoids, brackets, screw- and bolt-heads located in the APU compartment
  - in all the holes, especially in the areas where condensation can occur.

landing gear

- Apply COMMON GREASE to:
  - the sliding tube of the shock absorber, the actuator rods and the uplock mechanism.
- Apply talcum to all the rubber parts but not the tyres.
- Ensure that there is no corrosion on the brakes and on each half wheel.

Tyre storage (more then 2 months)

Protection (for a period of 0 to 2 months)

- Open the cockpit and cabin window shades.
- Cover the cockpit and passenger seat with a STORAGE PRESERVATION.
- Apply BONDING AND ADHESIVE COMPOUNDS on the cockpit and cabin windows.

Protection of the engines (for a period of 0 to 90 days)

- Carry out the preservation of the engines.

Protection of the engines (for a period of 90 days to 1 year)

- Remove the IDG.
- Carry out the preservation of the engines.

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Figure 11 Aircraft Storage

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Protection of the Engines (for a period of > 1 year)

Ref. TASK 72–00–00–600–805.

Protection of the APU

Carry out the preservation of the APU.

Protection of the fuel system

- Fill
  - all the fuel tanks at 90%of their total capacity.
  - all the fuel system lines.
- Make the vents wet (so that the sealants will not become dry and will not crack).
- Mix MICROBIOLOGICAL CONTAMIN. PROTECT. MATERIALS with the fuel as a preventive step.
- Operate the water drains one hour after you refuel the tanks.
- Check all the fuel tanks for leakage
- Apply SPECIAL MATERIALS to the switches on the REFUEL/DEFUEL panel.

Protection and lubrication of the landing gear

- Apply SPECIAL MATERIALS on the electrical components (microswitches, connectors, proximity detectors)
- Apply COMMON GREASE to the towing and debogging fittings
- Put tarpaulins on the bottom sections of the landing gear (this includes the tyres and brakes).

Removal of components

Remove the following:

- digital flight data recorder
- cockpit voice recorder
- oxygen cylinder/valve assys
- crew portable oxygen–equipment
- cabin emergency lights
- emergency power–supply units
- first aid kits
- emergency locator beacon
- portable and toilet fire–extinguishing bottles
- life vests
- escape slide
- escape slide/raft
- autonomous standby power supply unit
- wiper arm and wiper blade
- cartridges of the engine fire–extinguishing bottles
- cartridge of the APU fire–extinguishing bottle
- APU fire–extinguishing bottles
- cartridge of the cargo fire–extinguishing bottle
- cargo fire–extinguishing bottle
- batteries

Put blanking caps on the disconnected electrical connectors.

Protection of the water/waste system

- Make sure that the water/waste and potable water systems are empty; dry them with air if necessary
- Drain, clean and deodorize the toilets.

Close the avionics ventilation extract–valve.

Close the overboard extract valve.

Remove the batteries.

Disconnect and remove the batteries.

Protection

Seal with STORAGE PRESERVATION Material No.15–002 attached with adhesive tape (record the location) :

- the inlets and outlets of the air conditioning packs,
- the battery venturi,
- the precooler outlets,
- the anti–ice, air outlet and the anti–ice duct access panel on the engine air intakes,
- the scoops.

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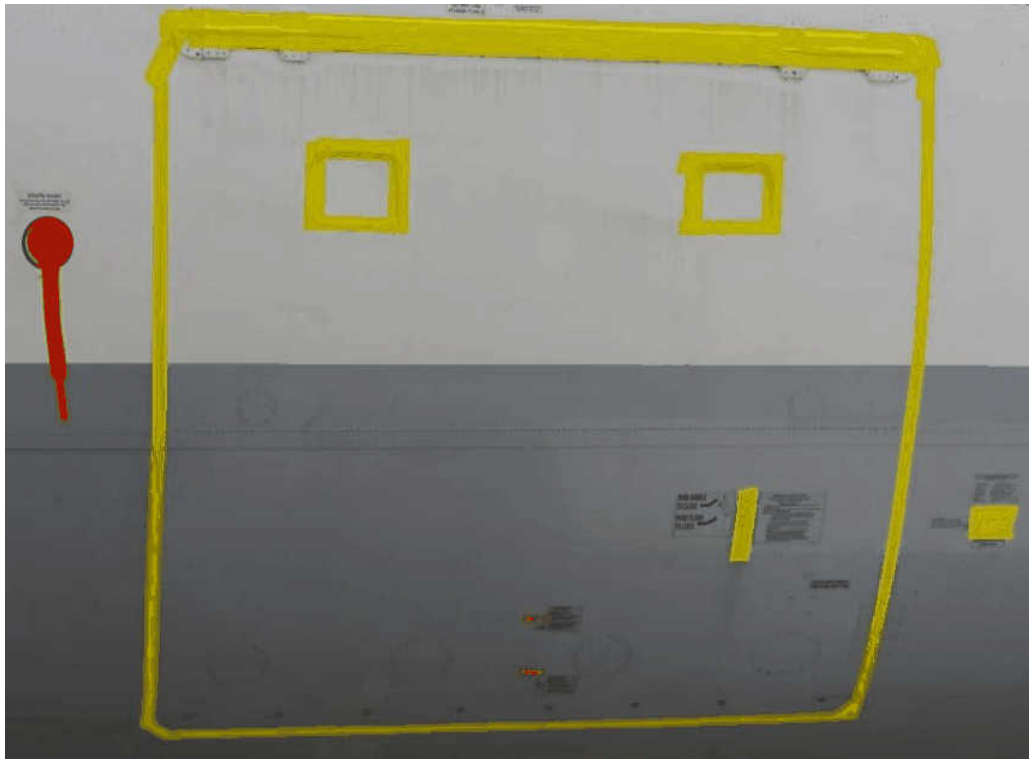




Figure 12 Aircraft Storage

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Seal the two spray nozzles with plastic bags or films, fixed on the structure with adhesive tape.

Seal all the openings that give access to:

- he passenger compartment,
- the cockpit,
- the cargo compartment,
- the APU,
- the engines,
- the landing gear.

Seal these areas with STORAGE PRESERVATION Material No.15−002 attached with adhesive tape.

Close access

Close the passenger/crew doors.

Close all the access doors and panels that you opened during the storage procedure.

Put the aircraft in the parking condition.

Put the aircraft in storage condition.

Inspection Check List: Weekly Check

Visual Inspection:

- Examine all the areas of the aircraft where birds can access. Ensure that there are no bird's nests.
- Make sure that the covers and the plugs are correctly installed.

Make sure that there is no leakage under:

- the wings,
- the lower fuselage,
- the engines,
- the APU,
- the horizontal stabilizer,
- the vertical stabilizer,
- the landing gears.

Inspection Check List: 15 Days Check

Move the aircraft by a 1/4 turn of the wheels, to prevent damage to the tyres and brinelling of the bearings.

Visual Inspection**:**

- Examine all the areas of the aircraft where the birds can access.
- Ensure that there are no bird's nests. (cont'd)
- Inspection Check List: 15 days check (cont'd)
- Ensure that there is no leakage.
- Ensure that the pressure/extension of the shock absorber is correct.
- Examine the condition of the wheels of the landing gear.
- Do a tyre pressure check (the correct pressure is the pressure specified for the aircraft storage weight).

Inspection Check List: 1 Month Check

Check the condition of the aircraft during the storage period:

- Open the passenger/crew doors.
- Open cargo compartments.
- Open all the access doors.
- Apply SPECIAL MATERIALS Material No.05−043 on all the seals of the doors.
- Make sure that all the doors operate correctly.
- Bleed the standby air−data system.
- Operate the air conditioning system to remove moisture through the low−pressure ground connection or through the high−pressure ground connection or with the APU.

Do the following tests:

- operational test of the avionics equipment ventilation system,
- operational test of the bulk cargo ventilation system,
- operational test of the ice protection system of the wing
- operational test of the ice protection system of the engine air intake

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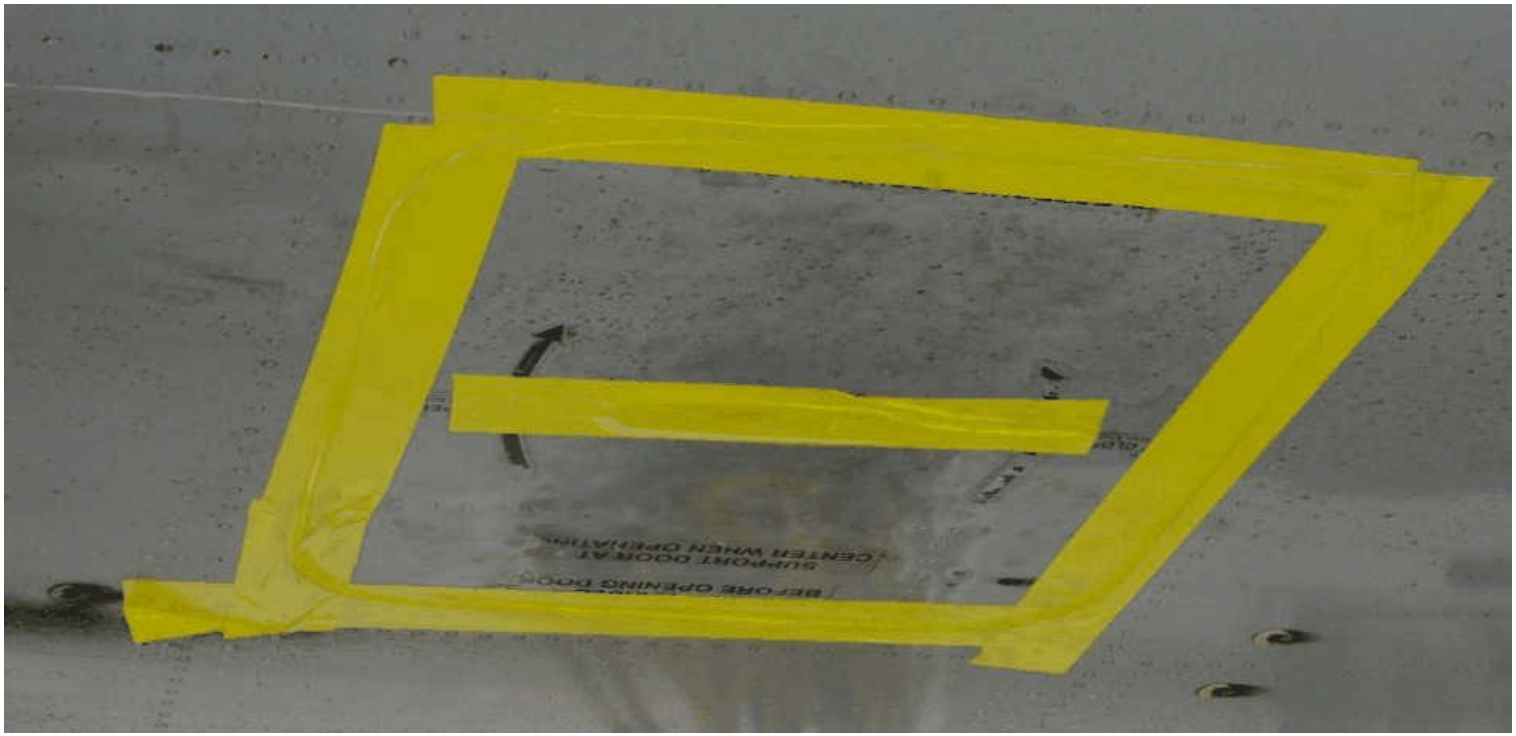


Figure 13 Aircraft Storage

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Inspection Check List: 3 Months Check

Check the condition of the aircraft during the storage period:

- Do a visual inspection of the aircraft for impact by foreign objects, fluid leakages (hydraulic fluid, fuel), missing parts, blockage and corrosion.

Protection:

- Apply SPECIAL MATERIALS Material No.05–027 in all holes, specially in the areas prone to condensation.
- Apply COMMON GREASE Material No.04–011 on:
  - the sliding tube of the shock absorber,
  - the actuator rods,
  - the locking mechanism.

Inspection of Fuel Tanks:

- Drain water from the fuel tanks.
- If necessary, fill all the fuel tanks at 90%of their total capacity and the fuel system lines.
- Make the vents wet (so that the sealants will not become dry and will not crack).

Inspection of the Hydraulic System:

- Check that at least the MINIMUM level of hydraulic fluid is in hydraulic reservoirs
- Check for corrosion on hydraulic pipes and unions on the landing gear bays, wings and the stabilizers. (cont'd)

Inspection of the Landing Gear:

- Remove the tool installed during the mooring procedure and the tarpaulins.
- Put the aircraft on jacks.
- Turn the wheels by hand to make sure that there are no defect on bearings.
- Put the aircraft on its wheels.
- Put the aircraft in the storage condition. Carry out the following:
- operational test of the operation of the engine LP–fuel shut–off valves,
- operational test of the operation of the ailerons and their hydraulic system,
- operational test of the operation of the elevators and their hydraulic system,
- operational test of the operation of the rudder and its hydraulic system,
- operational test of the operation of the flap system,
- operational test of the operation of the spoiler hydraulic system,
- operational test of the slat system,
- operational test of the landing gear doors.

Close–Up

Put the aircraft back to its Initial Configuration.

When bringing the aircraft back to operation a very extensive program is done the other way around.

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Figure 14 Aircraft Storage

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AIRCRAFT REFUELING AND DEFUELING

There is a high danger of explosion during the fuelling procedure due to the leaving gases. This is the reason for the following safety precautions.

- 'No Smoking' signs should be displayed at a minimum distance of 15m (50 ft) from fuelling equipment and aircraft tank vents.
- A fuelling zone at least 6m (20') from fuelling equipment and aircraft tank vents should be established.

Within this zone:

- No electrical system should be switched on or off, and only those circuits necessary for the operation should be on.
- Strobe lighting must not be on.
- There must be no use of naked lights.
- There must be no use of the engines of equipment/vehicles unless they have been designed for that purpose.
- If necessary for the refuelling/defuelling operation, an APU (Auxiliary Power Unit) must be started prior to filler caps being removed or connections made.
- GPUs (Ground Power Units) should be as far as practicable from aircraft fuelling points and vents.
- Fire extinguishers should be at hand.
- The aircraft should be earthed and bonded to fuelling equipment.
- After the fuelling operation, bonding should not be removed until hoses have been disconnected and filler caps refitted.
- Ground equipment must be moved away from the aircraft to prevent damage as the aircraft settles due to its increased weight.
- Fuel bowsers will normally position themselves facing away from the aircraft being refuelled, for rapid emergency evacuation.
- Aircraft engines must not be operated.
- People and vehicles within the fuelling zone must be kept to a minimum.
- Fuelling is suspended during electrical storms in the vicinity.

Pollution by Spillage of Fuel

Actions to be taken should there be a spillage of fuel will depend on the size and location, the type of fuel and prevailing weather conditions.

- Spillage onto the aircraft structure must be cleared prior to the engines being started.
- Minor spillage onto the ground must be cleared and the area allowed to dry prior to any engines being started in the vicinity.
- If there is a major spillage, fuel-flow must stop, all personnel evacuated from the area and the Fire Services alerted.
- Every attempt must be made to prevent contamination of drains and culverts by damming the area with specialist equipment and using absorbing/mopping agents designed for the job, which are subsequently disposed of in suitable containers in accordance with local regulations.

Gravity Fuelling

The easiest way to fuel an aircraft is to put the filler plug directly into the tank and let the fuel flow due to the gravity, like when fuelling a car.

This method is still used for small aircraft or to fill additives into the fuel.

Fuel Bowsers

In this method the fuel is flowing through pumps in a fuel bowser via a fuel hose and a filling connector into the lower side of the wing of the airplane.

Fuelling from the Ground Connector

This fueling method is very similar to the one described above only the fuelling bowser is missing because the fuel is flowing out of the ground tanks.

Pressure Defuelling

In this method of defuelling the aircraft pumps are used to defuel the aircraft.

Suction Defuelling

Suction is created by the fuel bowser pumps, which sucks the fuel out of the aircraft fuel tanks.

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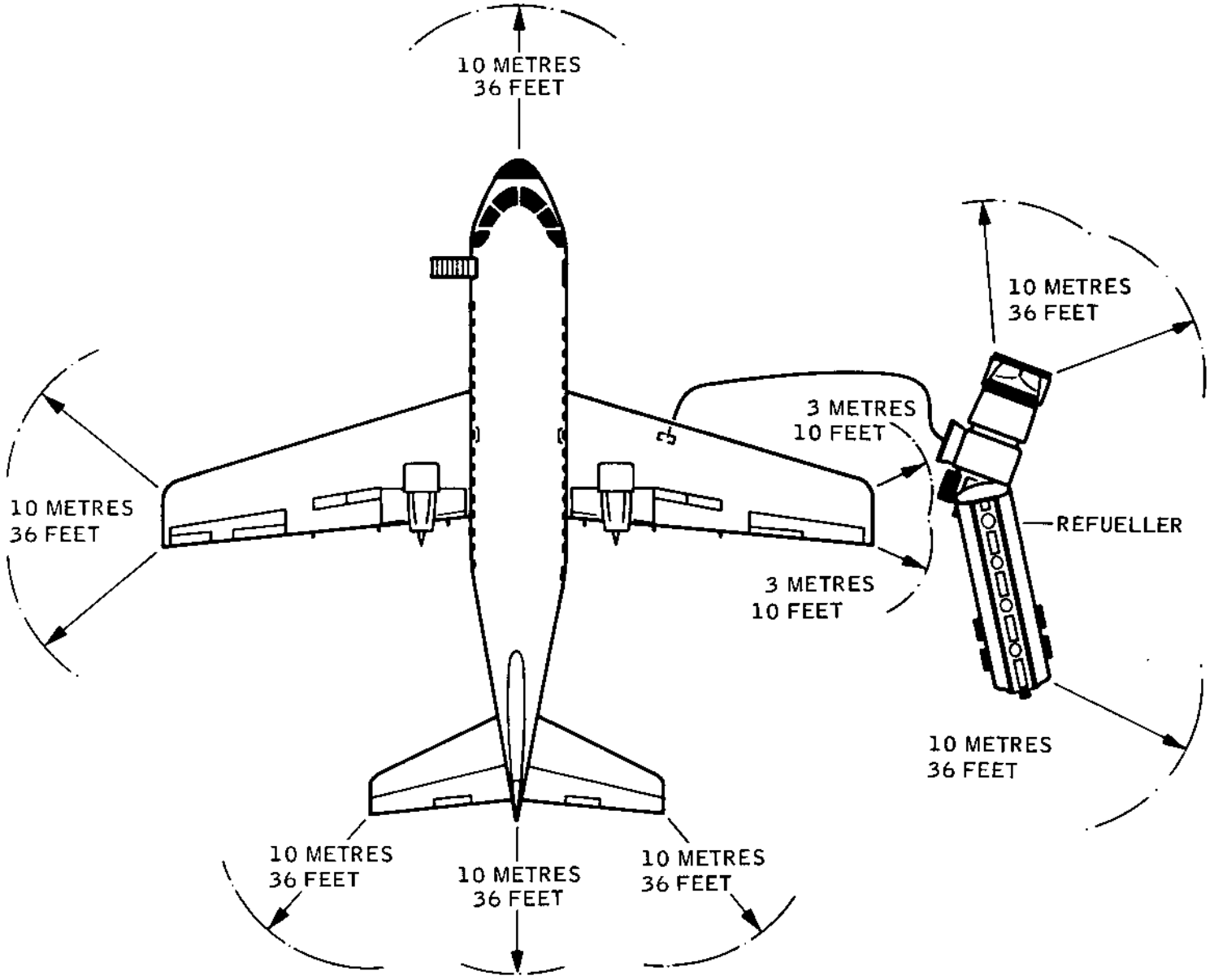


Figure 15 Aircraft Fueling

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DE- AND ANTI-ICING

General

The operation of aircraft in cold weather conditions raises specific problems. It happened that aircraft were aerodynamically changed by ice in such a way that they that they had fatal crashes.

The denoted performance curves base on values of an aircraft with a clean and smooth aerodynamic surface. Ice, snow and frost (or a combination of all three) have a disturbing effect on the airflow and so are changing the lift and the drag of the aircraft. Also they increase the gross weight.

The aircraft fuselage, especially the surfaces which create lift and stability, have to be aerodynamically clean. If not. a safe operation of the aircraft is not possible.

If the fuel temperature is below the freezing point, precipitation on the wings (in the area of the wing tanks) can create an ice formation (clear ice), even if the ambient temperature is 15 degree C. If the aircraft is scheduled for flight operation, areas which are critical for the flight operation (wings, vertical- and horizontal stabilizer and the ailerons) have to be clean from ice, frost, snow and slush.

Due to winterly weather conditions aircraft downtimes and delays can occur, which could be reduced by preventative servicing actions. Therefore the operator has to define servicing procedures for cold weather conditions.

This servicing must meet their specific requirements based on:

- their cold weather experience,
- available equipment and materials
- and the climatic conditions existing at airport.

This topic contains information defining, developing and implementing cold weather preventative maintenance procedures that will minimize aircraft downtime and improve the safe operating level of aircraft in adverse climatic conditions.

The aircraft is in cold-weather configuration when it is parked in cold weather (Outside Air Temperature (OAT) lower than 0 deg. C / 32 deg. F) and there is no supply of power to the aircraft (no air-conditioning).

De-Icing

De−icing is a procedure to remove frost, ice, snow and slush from the aircraft surfaces. De−icing fluids are normally applied heated.

Typical de−icing fluids are:

- Heated water
- Newtonian fluids, non−newtonian fluids
- Mixtures of water and the fluids above.

Anti-Icing

Anti−icing is a precautionary procedure which provides protection against the formation of frost or ice and snow accumulation on the treated surfaces of the aircraft for a limited period of time.

Anti−icing fluids are normally applied cold directly onto clean aircraft surfaces.

The holdover time is the estimated time during which anti−icing fluids will prevent the formation of frost or ice and snow accumulation on the protected surfaces of the aircraft. The holdover time starts at the beginning of the anti−icing treatment.

De-Icing and Anti-Icing

De−/Anti−icing is a combination of de−icing and anti−icing procedures and is performed in one or two steps. One step De−/Anti−icing is carried out with an anti−icing fluid, normally heated. The aircraft is de−iced and the fluid that remains on the aircraft gives limited anti−ice protection. Two step De−/Anti−Icing, as inferred, comprises two completely separate steps:

1. De−ice the aircraft.
2. Follow this immediately with an anti−icing procedure.

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Figure 16 De- and Anti-Icing (1)

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De-/Anti-icing Recommendations

A pre−flight inspection of the aircraft must cover all parts of the aircraft. This visual inspection must be done from a position which gives a clear view of all surfaces. Because accumulations of clear ice are sometimes not easily visible, it is recommended that critical surfaces (wings, vertical and horizontal stabilizers and rudder) are inspected by hand.

Weather conditions determine when the aircraft de−/anti−icing must be carried out. During checks on the ground, electrical or mechanical ice detectors must not replace physical checks.

If the aircraft arrives at the gate with the flaps/slats in a position other than fully retracted, they must be inspected and, if necessary, de−iced before retraction.

Dilution of De-/Anti-Icing Fluids

De-/anti-icing fluids can be diluted with water. This may be done if, due to weather conditions, there is no requirement for a long conservation time, or the higher freezing points are sufficient for the present climatic conditions.

The Anti−Icing Code

It is important that the flight crew get clear and precise information from persons who have carried out any de−/anti−icing procedures. In order to improve the quality of communication between the de−/anti−icing team and the flight crew, it is recommended that an anti−icing code be used. This will enable the flight crew to assess the Holdover Time. This code must contain the following information:

- Type of fluid
- Percentage of fluid to water
- Time de−/anti−icing application began (preferably local time).

Time of Protection

The time of protection will be shorter in very bad weather conditions. High wind speeds and jet blast can cause damage to the protective film. If these conditions occur, the time of protection will be much shorter. The time of protection can also be much shorter if the wing temperature is lower than the OAT. Because conditions are not always the same, a pre−take−off inspection is necessary when you use the times given in the tables. These procedures prevent the formation of ice in some zones (wings, vertical and horizontal stabilizers, rudder) and makes it easier to remove the snow from the aircraft.

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Figure 17 De- and Anti-Icing (2)

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GROUND SERVICING EQUIPMENT

Introduction

Most large aircraft require some form of auxiliary power to start the engines, provide electricity while the aircraft is on the ground, or provide cabin heating or cooling. For this reason, various types of ground power units (GPUs) are available for supplying power when the engines are not running.

Some GPUs are mobile units that are driven to the aircraft while others are pulled behind a tug. Some newer airports have power and air outlets built into the tarmac.

Electrical Ground Power Units

The batteries used in most smaller aircraft are designed in such a way that they can not supply enough energy to for the engine starting. For this reason, most airports are equipped with battery carts and cables, which are used for such aircrafts. For large aircraft, a large self-propelled generator unit is used.

It is extremely important when installing a battery on a battery cart that its polarity matches the polarity of the aircraft. Reversed polarity can damage the alternator as well as the battery.

Most turbojet transport category aircraft carry an auxiliary power unit (APU). An APU is a small turbine engine that supplies compressed air for engine starting and cabin air conditioning, as well as electrical power for various aircraft systems. If the APU is not working, a ground unit is used for these purposes.

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Figure 18 Ground Power

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Hydraulic Power Units

Many aircraft have hydraulically retracted landing gear that must be periodically tested for operation. To do this, the aircraft is lifted off the hangar floor with jacks and a hydraulic power unit is connected to the aircraft's hydraulic system so the landing gear can be cycled through its retraction and extension cycles to verify that it operates properly.

These hydraulic power supplies connect into the aircraft hydraulic system with quick disconnect fittings. When the fitting is screwed onto the hydraulic power supply, it automatically opens so it can supply hydraulic pressure to the aircraft.

Before connecting a hydraulic power supply, ensure that all of the lines are clean so no dirt or contamination gets into the aircraft's system. Normally, these power supplies do not furnish fluid for the aircraft; rather, they use the fluid in the aircraft. Some of the fluid, however, remains in the pump and lines of the unit.

Because of the incompatibility of different types of hydraulic fluid, such as MIL H 5606 and SkydrolTM, a different hydraulic power unit must be used with each type of fluid. If the wrong type of hydraulic fluid is introduced into an aircraft's hydraulic system the entire aircraft hydraulic system would have to be purged and refilled with fresh, uncontaminated fluid. Should any of the aircraft's systems be operated with the wrong type of fluid in the system, all components would have to be cleaned, flushed, or possibly disassembled for seal replacement. This would be extremely expensive and may even require the services of a certified repair station.

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Figure 19 Hydraulic Power Unit

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Nitogen Servicing Trolley

The nitrogen trolley is designed for re-filling the tyres and the damper of the landing gear with nitrogen.

The nitrogen servicing trolley consists mainly out of a carriage with a tongue, a falling- and fixing breake, two nitrogen bottle receptacles and the corresponding nitrogen filling armatures and filling units.

The nitrogen servicing trolley is moved as a trailer with a suitable vehicle or by hand to the desired place. At the location the nitrogen servicing trolley is fixed by using the falling and the fixing break. The nitrogen servicing trolley is designed and manufactured according to the accepted guidelines and the European machinery directive.

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Figure 20 Nitrogen Servicing Trolley

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Manual Tyre Filler

- Selection of the right hose connection (e. g. shock strut, tyre, etc.).
- Connect the hose with the consumer.
- Open the bottle valves.
- Regulate the right working pressure with the pressure reducer.
- Fill the consumer.
- ATTENTION: When the work is completed always shut the valve of the bottle first!
- Disconnect the hose to the consumer (Indicated pressure of the pressure reducer falls).
- Turn back the pressure reducer and the adjusting screw.
- When disconnecting the high pressure hose the hose must be unloaded. Therefore the bottle valves have to be closed and the pressure relief valve has to be opened until the connection is without load.
- Afterwards shut down the pressure relief valve.

WARNING: To prevent accidents and injuries generally fix the end of the hose at the attachment depicted above. (Without an adapter at the hose end the hose would blast around and cause damages and injuries when the bottle valve is opened accidentally).

Handling

- After removing the dust cover at the tyre valve put the valve head over the valve, so that a close connection is created (the actual tyre pressure can be read at the manometer scale).
- For filling the lever has to pulled the whole way
- For relief, if necessary, the lever has to be pulled only the half way.
- For checking the actual pressure the lever has to be in idle position (starting position).
- Disconnect the valve head very fast from the tyre valve, to prevent a pressure loss.
- After accomplishment of the tyre inspection wind up the hose and put the equipment back into the designated box.

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Figure 21 Manual Filler

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Water Disinfecting Cart

The water disinfecting cart (WDC) consists out of a standardised carriage with a mounted disinfection device and two hose recoilers plus one double reservoir for the disinfectant. The double reservoir is designed for containing two chemical-resistant 25L canister.

The hoses on the hose recoilers are used for connecting the device to the local water supply and for supplying the aircraft with the disinfection mixture.

Via one additional inlet the dosing system can suck the disinfection concentrate and so creates an disinfection mixture. The device is designed for disinfectant with 50% hydrogen−peroxyd (e. g. Herlisil, www. herli. de) or alternatively for disinfectant with 13% free chlorine konzipiert.

The amount of supplied disinfectant is proportional to the supplied water amount.

The conveyed quantity of fluid is ca. 2500l/h at a pressure of 6bar. A systemcutter prevents the pollution of the local water system with disinfectant mixture.

The device contains a eye rinse bottle to provide first-aid immediately when accidents with the used chemicals are happening.

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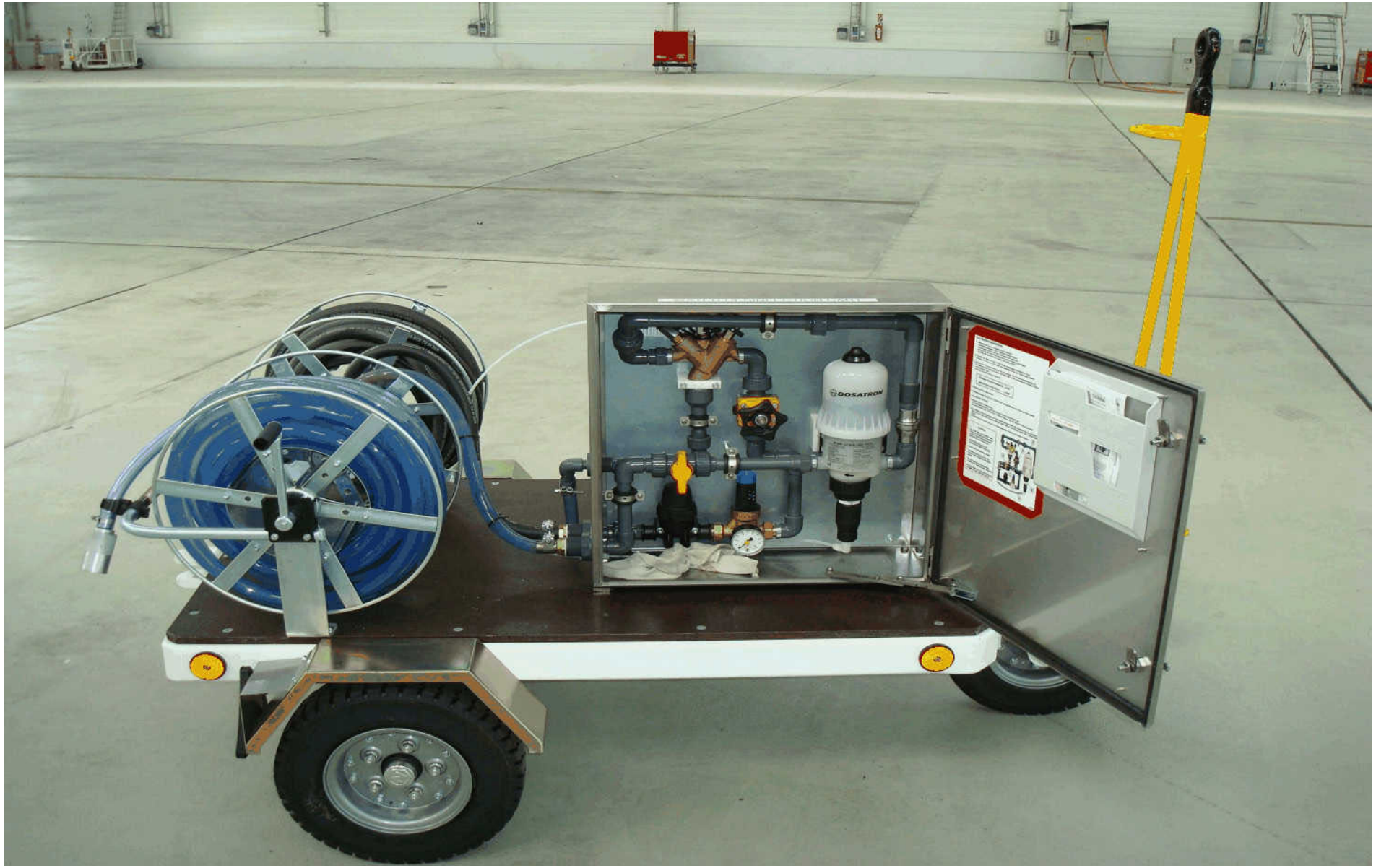


Figure 22 Water Disinfecting Cart

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Pneumatic Servicing Equipment

Trolleys used for the replenishment of an aircraft's air, nitrogen and gaseous oxygen systems are all very similar and to avoid any possible confusion are clearly marked, not only on the actual cylinders, but also on the charging compartment.

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Oxygen Trolley



Figure 23 Air Servicing Equipment

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EFFECTS OF ENVIRONMENTAL CONDITIONS ON THE AIRCRAFT

Depending on the environmental condition it may occur that the aircraft must be treated especially.

Like we have seen in the aircraft storage section it is necessary to fill the aircraft with appropriate fuel amount when the weather condition is very stormy. The nose of the aircraft has to be turned into the wind direction and the chocks have to be equipped with ribbons.

During heavy storms it is also necessary to use the shelter of buildings.

When frost may occur it has to be taken special care of the water system, this has also been described in the aircraft storage section.

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Figure 24 Environmental Conditions

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