Leaflet D-40 Storage Conditions For Aeronautical Supplies

1 Introduction

This Leaflet gives guidance and advice on acceptable conditions of storage which may be used, in the absence of manufacturer's recommendations, for specific aeronautical materials and parts. Subject headings are as follows:

1.1 The correct handling of materials, especially the high strength aluminium alloys, is of extreme importance. Great care is necessary during loading and unloading and storage at the consignee's works to ensure that the material is not damaged by chafing, scratching, bruising or indentation, and that it is not excessively strained by bending, otherwise the mechanical properties of the material may be seriously affected. Heavy forgings, extrusions and castings should be carried and stored singly, ensuring that there is adequate support to maintain the material in its intended shape without strain.

2 General Storage Conditions

The conditions of storage of aircraft supplies are important. The premises should be clean, well ventilated (see paragraph 3.13) and maintained at an even dry temperature to minimise the effects of condensation. In many instances the manufacturer will specify the temperature and relative humidity in which the products should be stored. To ensure that these conditions are maintained within the specified range, instruments are used which measure the temperature and relative humidity of the store room.

2.1 Temperature and Relative Humidity

When required, the temperature and humidity should be checked at regular intervals by means of a hygrometer which measures the amount of humidity in the atmosphere. The wall-type of hygrometer is normally used and consists of wet and dry 'bulbs'; the dry bulb records the actual temperature, and a comparison between this reading and that registered by the wet bulb, when read in conjunction with a table, will indicate the percentage of relative humidity present in the atmosphere.

2.2 Protective Materials for Storage Purposes

2.2.1 Vapour Phase Inhibitor (VPI)

This is a method of protection against corrosion often used for stored articles made of ferrous metals.

a) VPI protects by its vapour, which entirely covers any article in an enclosed space. Direct contact of the solid VPI with the metal is not required. Although moisture and oxygen are necessary for corrosion to take place, VPI does not react with or remove either of them, but operates by inhibiting their corrosive action.

b) The method most commonly used is treated paper or board, the article to be protected being wrapped in paper which has been treated with VPI or, alternatively, enclosed in a box made of VPI treated board, or lined with treated paper.

NOTE: Protection of parts by the VPI process should only be used where it is approved by the manufacturer of the part.

2.2.2 Protective Oils, Fluids, Compounds

Where oils, fluids or compounds are used as a temporary protection on metal articles, it should be ascertained that the material and the method of application is approved by the manufacturer of the article. Where protective oils, fluids or compounds have been used, deterioration of such fluids or compounds by handling can be minimised by wrapping in a non-absorbent material (e.g. polythene, waxed paper), which will normally increase the life of such temporary protectives by inhibiting drying out. When parts or components are stored for long periods they should be inspected at intervals to ensure that the condition of the coating is satisfactory.

2.2.3 **Desiccants**

The desiccants most commonly used in the protection of stored parts or components are silica-gel and activated alumina. Because of their hygroscopic nature these desiccants are capable of absorbing moisture either inside a packaging container or a component, thereby preventing corrosion.

a) Desiccants should be inspected and/or renewed at specified periods or when an airtight container has been opened. It is important when inspecting or changing a desiccant that the prescribed method is used to avoid the entry of moisture into a dry container.

b) **Tell-Tale Desiccant**. This indicating type of desiccant is prepared with a chemical which changes colour according to its moisture content. The following table gives guidance on the relative humidity of the surrounding air.

Colour	**Surrounding Relative Humidity (%)**	**Moisture Content of Silica-Gel %**
Deep Blue	0·5	0·2
Blue	10	5·5
Pale Blue	20	7·5
Pinkish Blue	30	12·0
Bluish Pink	40	20·2
Pink	50	27·0

c) Silica-gel and activated alumina can be reactivated by a simple heat treatment process. The time and temperature required to effectively dry the desiccant should be verified with the manufacturer, but a general guide is 135ºC for at least 2 hours for silica-gel and 250ºC for 4 hours for activated alumina. The desiccant should then be placed in a sealed container until it has cooled, after which it should be completely reactivated.

2.3 **Racks and Bins**

Open racks allow a free circulation of air and are preferable when the nature of the stock permits their use. The painted metal type of bins is more suitable than the wooden type, since with the latter there is a risk of corrosion due to mould or dampness. Polyethylene, rigid PVC, corrugated plastics or cardboard bins may also be used. Many moulded plastics bins can also be fitted with removable dividers which will allow for the segregation of small parts whilst making economic use of the space.

2.4 **Rotation of Issue**

Methods of storage should be such that batches of materials or parts are issued in strict rotation, i.e. old stock should be issued before new stock. This is of particular importance for perishable goods, instruments and other components which have definite storage limiting periods.

2.5 **Storage Limiting Period**

The manufacturers of certain aircraft units impose storage limiting periods after which time they will not guarantee the efficient functioning of the equipment. On expiry of recommended storage periods the parts should be withdrawn from stores for checking or overhaul as recommended by the manufacturer. The effective storage

limiting periods of some equipment may be considerably reduced if suitable conditions of storage are not provided. Therefore, storage limiting periods quoted by manufacturers can only be applicable if the prescribed conditions of storage are in operation, and users should develop suitable limiting periods from their own experience.

2.6 **Flammable Materials**

All materials of a flammable nature, such as dope, thinners, paint, etc., should be kept in a store isolated from the main buildings. The precautions to be taken vary with the quantity and volatility of the materials, and such stores should comply with the requirements of HM Inspector of Factories and the Area Fire Authority.

2.7 **Segregation of Stock**

Care should be taken to segregate materials which may have deleterious effects on other materials, e.g. carboys of acid should not be placed in a store where escaping fumes may affect raw materials or finished parts; phenolic plastics should be segregated from cadmium-plated steel parts to prevent corrosion of the steel parts; magnesium alloys should not be stored in the vicinity of flammable materials.

2.8 **Packaging of Stock**

Stock should normally be packaged from the following:

a) **Materials.** Plastics film, 'Jiffy' bags, lanolin grease impregnated cloth, plastics film lined paper envelopes, etc.

b) **Methods.** Oiling and placing in jars or plastics bags, individual packaging of seals, etc.

NOTE: Magnesium fittings should not normally be kept in sacks, as the materials used in making the sacks may cause corrosion of the fittings.

2.9 **Materials in Long Lengths**

It is particularly important that long lengths of material, such as extrusions, tubes, bars, etc., should generally be stored vertically, which tends to reduce problems caused by bow and handling damage. Care should also be taken when placing the material in the storage racks to prevent indentations and scratches, especially when handling the high strength aluminium alloys.

3 Storage Conditions For Specific Materials and Parts

This paragraph gives guidance on recommended methods of storage for various materials and parts.

3.1 **Ball and Roller Bearings**

Ball and roller bearings should be stored in their original wrappings in dry, clean conditions with sufficient heating to prevent condensation caused by significant temperature changes.

3.1.1 If the wrapping has become damaged or if it is removed for inspection of the bearings, the bearing (providing it does not incorporate rubber seals) should be soaked and swilled in white spirit to remove storage grease and/or dirt. It is permissible to oscillate or turn the races slowly to ensure thorough cleaning, but the bearings should not be spun in this unlubricated condition because the working surfaces may become damaged. A forced jet of white spirit may be used to advantage but an efficient filter should be provided in the cleaning system.

3.1.2 In certain cases it may be preferable to clean very small bearings with benzene, but if this fluid is used, consideration should be given to the fire hazard and possible toxic effects.

NOTES: 1) There are certain proprietary light white spirits which are suitable for use with very small bearings and which eliminate some of the dangers associated with the use of benzene.

2) Miniature steel balls and special high precision balls are immersed in instrument oil contained in plastics phials with screw-on caps.

3.1.3 After cleaning, the bearings should be inspected for signs of corrosion and then re-protected with a compound of mineral oil and lanolin and wrapped in greaseproof paper. Many miniature bearings, especially those used in instruments, are susceptible to brinelling. When such bearings have become suspect or contaminated they should be discarded.

NOTE: In many instances orders for bearings are endorsed with a requirement that special grease should be applied by the manufacturer. If this grease is removed for any reason, it is essential that grease of the correct specification is re-applied.

3.2 Aircraft Batteries

3.2.1 Lead-Acid Batteries

A charged battery which is to be stored for any length of time should be in the "fully charged" condition. Before storing, the electrolyte levels should be checked and the battery bench-charged in accordance with manufacturer's instructions. When fully charged, the battery should be stored in a cool, dry, well ventilated store on an acid-resistant tray. Batteries may also be stored in the dry, uncharged state. Additional points to note are as follows:

a) Every 4 to 6 weeks (depending on manufacturer's instructions) the battery should be removed from storage and fully recharged, i.e. until voltage and specific gravity readings cease to rise.

NOTE: Damage to the battery will occur if it is allowed to stand idle beyond the period for charging specified by the manufacturer.

b) Regardless of periodic check charges, the battery should be given a complete charge and capacity check immediately before being put into service.

c) For new batteries, a complete capacity test to the manufacturer's instructions should be made every 6 months, but if the battery has been in service this test should be made every 3 months.

d) Every 12 months, or earlier if a leak is suspected, an insulation resistance test should be carried out to the manufacturer's instructions.

e) If the conditions mentioned in the previous paragraphs are observed, a battery may remain in storage up to 18 months. A battery should not be allowed to stand in a discharged condition, and electrolyte temperatures should not exceed 48.8ºC.

NOTE: Trickle charging at low rates is not recommended as damage will occur if idle batteries are subjected to this form of charging.

3.2.2 Silver-Zinc Batteries and Silver-Cadmium Batteries

These batteries should be stored in clean, dry, cool and well ventilated surrounds, not exposed to direct sunlight or stored near radiators.

a) New batteries will normally be supplied in the dry condition with the electrolyte contained in polythene ampoules. If possible, new batteries should be stored in their original packaging together with the related ampoules of electrolyte. For storage periods of more than 2 years, special instructions should be requested from the manufacturers.

b) Filled and formed batteries required for use at very short notice may be stored in the charged condition. Manufacturers normally recommend that such batteries should be discharged and recharged every 4 to 6 weeks. The manufacturer's schedule of maintenance should be applied to batteries stored in the charged condition.

c) Batteries to be stored out of use for protracted periods, should be discharged at the 40-hour rate until the voltage level measured while discharging, falls below the equivalent of 0·8 volt per cell.

d) Before storing batteries, the electrolyte level should be adjusted to near the maximum specified by topping up, using a potassium hydroxide solution of 1.300 sg.

e) The need for care in handling potassium hydroxide, because of its caustic content, is stressed.

After topping up or filling, the top of the batteries should be cleaned and the connections and terminals lightly smeared with white petroleum jelly. In no circumstances should sulphuric acid or acid contaminated utensils be used in close proximity to silver-zinc or silver-cadmium batteries.

3.2.3 **Nickel-Cadmium Batteries**

This type of battery can be stored for long periods without damage, in any state of charge, provided the storage place is clean and dry and the battery is correctly filled.

a) For the battery to be ready for use in the shortest possible time, it should be fully charged, correctly topped up and then discharged at normal rate for a period of 1 hour before storage.

b) The battery should be cleaned and dried and the terminals and connectors lightly smeared with pure mineral jelly.

c) The battery should be inspected at intervals of 6 to 9 months and topped up if necessary.

d) Before going into service, the battery should be given a double charge and capacity check as recommended by the manufacturer of the particular type of battery.

e) The battery should be stored on a shelf or rack, protected from dirt or dust, and where metallic objects such as bolts, hand-tools, etc., cannot drop onto the battery or touch the cell sides.

NOTE: The above refers to pocket plate nickel-cadmium cells and not to sintered plate nickel-cadmium cells, for which reference should be made to the manufacturer's instructions.

3.2.4 **Precautions**

It should be noted that sulphuric acid will destroy alkaline batteries; therefore, utensils which have been used for this acid should not be used with such batteries. It is also important to avoid any contamination from the fumes of lead-acid types of batteries. (See Leaflet 24-10).

3.3 Braided Rubber Cord

Braided rubber cord should be stored in a cool, dark place with an even temperature preferably not exceeding 18ºC with relative humidity of approximately 65%. The cord should not come in contact with any radiant heat, grease, oil, water, organic solvents or corrosive materials.

NOTE: Storage at elevated temperatures may cause permanent deterioration of the rubber, and prolonged storage at low temperatures will cause temporary stiffening of the rubber.

3.3.1 Storage Limiting Period

Braided rubber cord has a storage limiting period of 4 years if stored in good conditions. Cord which has been issued from stores within the 4 year period from the date of manufacture may remain in service until the expiry of 5 years from that date.

a) The date of manufacture of cordage can be determined by the colour of the threads in the cotton outer casing; French Blue 1986; Night Black 1987; Nato Green 1988; Service Brown 1989 and Canary Yellow 1990. After 1990 the colours are repeated in the same sequence for a further 5 years and subsequently until further notice.

b) The number of coloured threads indicate the quarter of the year in which the cord was manufactured, e.g. one thread indicates the cord was made between 1st January and 31st March, two threads 1st April and 30th June inclusive.

NOTE: Further details are given in British Standard Specification (Aerospace Series) 2F 70 and 2F 71, Light Duty Braided Rubber Cord for Aeronautical Purposes.

3.4 Compressed Gas Cylinders

Stores which are used for storage of compressed gas cylinders should be well ventilated. The cylinders should not be exposed to the direct rays of the sun and no covering should be used which is in direct contact with the cylinders. Cylinders should not be laid on damp ground or exposed to any conditions liable to cause corrosion. Gas storage cylinders should normally be fitted with a transportation/storage cap over the shut-off valve to help prevent handling damage and contamination of parts which could cause a risk of explosion or fire. Portable gas cylinders (e.g. therapeutic oxygen, fire extinguishers) should be stored on racks and, where appropriate, control heads and gauges should be protected against impact.

3.4.1 No heating is required in stores where compressed gas cylinders are kept, unless specified by the manufacturer.

3.4.2 Lighting for stores containing combustible gas cylinders (i.e. acetylene) should be flameproof, or installed outside the building, lighting the interior through fixed windows.

3.4.3 Store rooms should be manufactured of fireproof materials and the cylinders so placed to be easily removable in the event of fire. The store should be at a distance from corrosive influences, e.g. battery charging rooms.

3.4.4 Full and empty cylinders should be stored in separate rooms, and appropriate notices displayed to prevent confusion.

3.4.5 Oxygen and combustible gases such as acetylene should not be stored together. Acetylene cylinders should be stored in the upright position.

3.4.6 Oxygen cylinders are generally rounded at the bottom, thereby making it unsafe to store in an upright position without suitable support. If cylinders are stacked horizontally special wedges should be used to prevent the cylinders rolling, and the stack of cylinders should not be more than four high.

3.4.7 Breathing oxygen and welding oxygen should be segregated and properly labelled to avoid confusion. In some cases welding oxygen may be used for testing oxygen components not installed in the aircraft, but welding oxygen should not be used in aircraft oxygen systems.

3.4.8 **Precautions**

If cylinders are exposed to heat, the gas pressure will increase and the cylinder walls may be weakened, causing a dangerous condition. Cylinders should be stored at some distance from sources of heat such as furnaces, stoves, boilers, radiators, etc.

a) Oil or grease will ignite in the presence of oxygen, and if the latter is under pressure an explosion may result. Cylinders should be kept away from sources of contamination, such as oil barrels, overhead shafting, hydraulic components or any container or component that may contain oil or grease.

b) Smoking, exposed lights or fires should not be allowed in any room where compressed gases are stored, and oily or greasy clothes or hands should be avoided when handling the cylinders.

c) Grit, dirt, oil and water should be prevented from entering the cylinder valves.

d) When returning any cylinder that may have been accidentally damaged or overheated, the supplier should be notified so that any necessary action may be taken before refilling.

3.5 **Electrical Cables**

Where electrical cables are stored in large reels it is necessary that the axis of the reels are in a horizontal position. If stored with the axis vertical there is a possibility that the cable in the lowest side of the reel will become crushed.

3.6 **Fabric**

Fabric and fabric covering materials (e.g. strips and thread) should be stored in dry conditions at a temperature of about 21°C away from direct sunlight. Discolouration, such as iron mould, is sufficient to cause rejection of the material and this may be caused by unsuitable storage conditions. Most synthetic fibre fabrics should be stored away from heat sources. Rubber proofed fabrics should be stored away from plasticised materials such as PVC as it is known, in some cases, for plasticisers to leach from some plastics and have an adverse affect on rubbers.

3.7 **Forgings, Castings and Extrusions**

All large forgings, castings and extrusions should be carefully and separately stored on racks to avoid superficial damage.

NOTE: The high strength aluminium alloys are susceptible to stress corrosion when in the solution treated condition, and it is important that parts so treated should be coated with a temporary protective such as lanolin.

3.7.1 Aluminium alloy forgings which are anodised normally need no protection in a heated store. Finished details should be protected in accordance with DEF STAN 03–2.

3.7.2 Aluminium alloy castings in store should not be contained in sacks or absorbent packages. It is not normally necessary to protect castings before machining, but finished details should be protected as for forgings in paragraph 3.7.1.

3.7.3 Aluminium alloy extrusions should be protected in store with a lanolin and mineral oil solution (DEF STAN 80–34) and as finished details with DEF STAN 03–2 as in paragraph 3.7.1.

3.8 Instruments

The smaller types of instruments are usually delivered in plastic envelopes and these should be used during storage to minimise the possible effects of condensation. The transit containers of the larger instruments contain bags of silica-gel (paragraph 2.2.3) to absorb moisture which may enter. The gel should be examined periodically, and if its colour has changed from blue to pink it should be removed, dried out and replaced, or renewed. It is essential that all instruments should be stored in a dry, even temperature, and that the storage limiting period recommended by the manufacturer is not exceeded.

NOTE: Whenever possible instruments should be kept in transit or similar cushioned containers until required for fitment to an aircraft.

3.8.1 In the absence of any specific recommendation by the manufacturer the storage limiting period for instruments should not exceed 3 years, and on completion of this time the item should be re-certified in accordance with the relevant Overhaul Manual. Additionally, any equipment containing gyro assemblies should be exercised and gyro wheels run for a period of 24 hours at the completion of periods not exceeding each 12 months of storage.

3.9 Oil Coolers and Radiators

Oil coolers and radiators are normally filled with an inhibiting fluid during storage; the fluid used should be in accordance with the manufacturer's instructions. The components should not be stored on the floor, but placed on raised wooden supports to permit a free circulation of air and minimise the possibility of damage to the matrices.

3.10 Paints and Dopes

For the storage of paint and related materials (i.e. all low flash point materials) it may be necessary to obtain a licence to comply with the requirements of the Petroleum Act. Paints should be kept in a dry store at a controlled temperature between 7º and 23ºC.

3.10.1 Paint containers should be marked with the date of receipt so that the oldest batches may be used first, as pigments tend to 'settle out' when paint is stored. A simple method of avoiding settlement is to invert containers at regular intervals, e.g. once a month.

3.10.2 Toxicity of Solvents

If paints are handled or mixed in a confined space it is important to ensure adequate ventilation during such operations as the fumes from volatile liquids are harmful if inhaled in sufficient concentration.

NOTE: A point frequently overlooked in ventilating a paint store is that most solvents are heavier than air, so that ventilation is more efficient downwards than upwards.

3.10.3 Provided paints and dopes are suitably stored in their original sealed containers, the storage limiting period is normally 12 months in the United Kingdom, but this may vary elsewhere; for example, in tropical conditions the period is normally 6 months.

3.11 Pipes

Rigid pipes should be adequately supported during storage to prevent distortion. Flexible pipes should, unless otherwise stated by the manufacturer, be suitably wrapped, for example, in a sealed plastics sleeve before being stored in a darkened room, maintained at a temperature of approximately 15ºC. In hot climates, flexible pipes should be stored in cool places where air circulates freely, since high temperatures tend to accelerate surface hardening of the outer cover.

3.11.1 Flexible pipes should be stored in a completely unstressed condition and, where possible, should be suspended vertically (see also paragraph 3.13.14).

3.11.2 The ends of all pipes should be blanked, using a type of blank which does not allow it to be left in position when the pipes are fitted. The use of rags or paper for this purpose is prohibited. The blanks should not be removed until just prior to fitting the pipe.

3.11.3 Chloride based materials, such as Neoprene and glass fibre tape should not be used for the wrapping of Stainless Steel and Titanium pipes. Chloride based materials break down with heat (temperatures above 150ºC) to produce corrosive salts which will attack Stainless Steel and Titanium components resulting in premature failure. In addition it is also possible that smears of chloride material may be left on components which have been touched by PVC (Plasticised Polyvinyl Chloride) sheeting while covered over by, or packed in, such material.

3.12 Pyrotechnics

Pyrotechnics should be stored in a dry, well ventilated building and kept at constant room temperature. The building should conform to the local by-laws laid down by the Local Authority.

3.12.1 At the periods specified by the manufacturer, pyrotechnics should be examined for any signs of damp or other external damage.

3.12.2 With paper-cased items, such as signal cartridges, the effect of damp is usually indicated by softening or bulging of the outer case and evidence of staining.

3.12.3 With metal-cased items, the effects of damp may often be indicated by traces of corrosion or tarnishing of the case and/or staining of the instructions label.

3.12.4 All pyrotechnics gradually deteriorate in time, although such deterioration will vary with factors such as quality or type of composition, degree of protection afforded by the containers, etc. For this reason a proportion of the items should be proof-tested at regular intervals as specified by the manufacturer; the items will also have a maximum serviceable life, regardless of proof testing, which should not be exceeded.

NOTE: The most likely effect of storage deterioration is a loss of brightness and range.

3.13 Rubber Parts and Components Containing Rubber

The following storage conditions are generally acceptable for a wide range of components containing rubber in their manufacture or parts made of rubber. In many cases manufacturers make special recommendations and these should also be observed. (Further information can also be found in BS 3F 68 and 3F 69).

3.13.1 Temperatures

The storage temperature should be controlled between 10º and 21ºC and sources of heat should be at least 3 feet from the stored article (unless screened) to minimise exposure to radiant heat. Some special rubber materials (e.g. neoprene) may withstand a wider range of temperature satisfactorily, i.e. –12º to 26ºC, but before any rubber part is exposed to these temperatures the manufacturer's recommendations should be verified. This particularly applies to any special precautions necessary when thawing parts which have been subjected to the lower temperatures.

3.13.2 Humidity

The relative humidity in the store room should be about 75%. Very moist or very dry conditions should be avoided.

3.13.3 **Light**

Rubber parts should not be exposed to direct daylight or sunlight. Unless the articles are packed in opaque containers, store room windows or skylights should be screened or covered with a suitable transparent red or amber coating. Store rooms should be kept as dark as practicable. Use of artificial light which has a high ultra-violet level should be avoided.

3.13.4 **Oxygen**

Isolation from atmospheric oxygen greatly increases the storage limiting period of rubber parts. Where possible, parts should be packed in airtight containers or wrappings using talc or french chalk. Where parts are packed in airtight tins, the tins should be lined with wax paper or polythene to avoid direct contact with the metal.

3.13.5 **Ozone**

Exposure to air containing ozone even in minute quantities should be avoided.

Storage rooms should not contain any apparatus liable to generate ozone, such as high voltage electrical equipment, electric motors or other plant which may give rise to electrical sparks. Free access to outdoor air, which in temperate climates always contains ozone, should be avoided. Still indoor air is normally ozone-free because wall and ceiling coverings and organic materials rapidly destroy ozone.

3.13.6 **Deformation**

Rubber parts should be stored in a 'relaxed' position free from compression or distortion, with the least possible deformation. Deformation greatly aggravates the action of ozone and also leads to permanent changes in shape and dimensions. Articles received prepacked in a strain-free condition can, with advantage, be stored in their original packing, as long as they are clearly identified and labelled.

3.13.7 **Contamination**

Rubber parts should not come in contact with liquids or vapour concentrations during storage even though they may be subsequently used in contact with a similar fluid. Contact with copper, brass or corroded iron or steel, or with any compounds of manganese, should be avoided.

NOTE: If deterioration of seals is suspected, it can usually be verified by stretching the seals to 20% of their internal diameter. If cracks are visible under x10 magnification, the seals should be rejected.

3.13.8 **Hydraulic and Pneumatic System Components**

Hydraulic and pneumatic components generally have a nominal 7 year shelf life which may usually be extended for periods of 2 years by inspections.

NOTE: The maximum service life of seals is usually to be found in the approval Maintenance Schedule.

3.13.9 In many instances, hydraulic components are stored filled with hydraulic fluid which may leak slightly from the component; it is therefore important to ensure that fluid will not come into contact with other stored items.

3.13.10 If the stored component is filled with a fluid other than that used in the aircraft system (e.g. DTD 5540B is a hydraulic component storage fluid only) the component should be clearly labelled to ensure the removal of all traces of storage fluid prior to installation in the hydraulic system.

3.13.11 To avoid adhesion and to exercise the seals, it is in some cases recommended that the component be operated several times at three-monthly intervals. If the seals are square or rectangular, special care should be used in the initial operation as experience has shown that there is a tendency for seal stiction on its bearing surface and, if the part incorporating the seal is moved rapidly, the seal may tend to rotate and be damaged. This applies also where spring-loaded seals are concerned; growth of the rubber may result in damage to the sealing lip.

3.13.12 **Tyres**

Tyres should be stored vertically in special racks embodying support tubes, so that each tyre is supported at two points. Two-thirds of the tyre should be above the support tubes and one-third below. By this method the weight of the tyre is taken by the tread and distortion is reduced to a minimum. The tyres should be turned to a new position every 2 or 3 months. Where tyres are delivered in bituminised hessian wrappers, the wrappers should be left on during storage.

3.13.13 **Inner Tubes**

Inner tubes should be stored in the cartons in which they were received, but where this is not possible the tubes should be lightly inflated and stored inside covers of appropriate sizes to prevent damage. Tubes should not be secured in a fixed position (such as a tight roll) by rubber bands or tapes as this may cause the rubber to crack.

3.13.14 **Storage of Rubber Hose and Hose Assemblies**

Unless otherwise specified by the manufacturer, rubber hoses should be inspected and tested every 2 years; they should also be inspected and tested immediately prior to installation.

a) **Storage Conditions**. Hose and hose assemblies should be stored uncoiled and supported to relieve stresses. Air should circulate freely about the hoses unless they are contained in plastics envelopes. Temperatures in the store should be controlled as detailed in paragraph 3.13.1.

NOTE: Care should be taken to ensure that the plastics envelopes selected are compatible with the hose material, since some, including PVC, can have a deleterious effect on rubber.

b) **Sealing Blanks**. The correct sealing blanks should always be fitted to items in store. Plugs and caps conforming with AGS specifications are suitable but, where standard blanks cannot be fitted, the blanks used must be so designed that they cannot enter the pipe or be left in position when the assembly is coupled up. It is also important that the material used for blanking purposes will not 'pick-up' or leave small particles inside a coupling after long periods of storage. Tape, rag or paper should not be used.

c) **Bore Protection**. In some special cases, to prevent deterioration of the bore or inner lining of the hose, it may have to be stored filled with the liquid which it is intended to contain in service and instructions concerning this procedure are normally attached to the assembly. If a hose assembly is enclosed in an airtight plastics envelope, this should not be removed until the hose assembly is to be fitted. If this envelope becomes damaged during handling, it should be resealed or renewed after any desiccant inside has been checked for condition.

d) **Markings on Hose**. Various methods are employed to mark the date of manufacture on hoses. It is sometimes stencilled on the external surface, or impressed on a tab or band secured to the hose. In instances where the external surface is of cotton braid, some of the 'picks' are woven in black and some in colour which indicates the month and year of manufacture, as required by the appropriate Specification.

3.13.15 Cleaning

Any cleaning of rubber parts and components containing rubber, after storage, should be done with water, soap solution or methylated spirits. If synthetic detergents are used, care should be taken to select those that are not harmful to rubber. Petrol (or other petroleum spirit), benzene, turpentine, etc., should not be used, nor may cleaning be carried out with sharp or abrasive objects such as wire brushes or emery cloth. Disinfectants should not be used. After cleaning, articles should be rinsed in water and dried at a distance from any direct heat.

3.14 Sheet, Bar and Tube Metal

It is recommended that sheet material should be stored on edge in racks; care being necessary to prevent the bending of single sheets. Flat stacking is not recommended (unless suction pads are used to lift the sheets) since sheets are almost invariably slid from the stack, often resulting in detrimental scratches on the sheet removed and on the adjacent sheet. Where vertical storage is employed, the material should be kept clear of the floor to prevent possible damage by scraping, splashing from disinfectants used for floor cleaning (which may cause corrosion) and the possibility of edge corrosion, which can occur with light alloy materials when in contact with composition floors. Temporary protectives, such as grease, paper or plastics coating, should be left in position until the material is required for use. If the temporary protective becomes damaged or partially removed, it should be restored without delay, and a periodic inspection of stock should be made.

3.14.1 There may be some merit in storing the sheet material in the transit cases. After the initial checking of the sheets, the case should be closed to eliminate dust/dirt which can cause surface scratching during handling operations.

3.14.2 Metal bars should be stored in racks either horizontally or vertically, well supported along the length when stored horizontally to prevent bending under weight. Metal tubing is normally stored in racks, well supported, the smaller diameter tubing being wired along the length, in bundles, to prevent damage.

NOTE: Floor cleaning fluids containing chlorides should not be allowed to contact metallic materials, particularly austenetic steel as a brittle fracture may eventually result.

3.15 Sparking Plugs

The plugs should be treated with light oil or other suitable corrosion inhibitor. The inhibitor should not come into contact with the plug screen, but the electrode end of the plug may be filled with oil and then emptied prior to fitting the caps. Plugs receiving this treatment should be washed out with tricloroethylene or carbon tetrachloride before use. Protector caps should be screwed on both ends of the plugs to prevent the ingress of moisture or foreign matter. The plugs should be stored in a warm dry place, preferably in a heated cupboard, as an additional precaution against the ingress of moisture.

3.16 Survival Equipment

Survival equipment should be stored in a room which can be maintained at a temperature between 15° and 21°C, and which is free from strong light and any concentration of ozone.

3.16.1 Preparation for Storage

The manufacturer's instructions should be carefully followed when preparing survival equipment for storage. These instructions normally include: ensuring that the component is completely deflated; removing easily detachable components; fitting protection blanks or pads to inflation valves and other connections; dusting the component with french chalk and folding it loosely; wrapping in waterproof paper; and placing it on a shelf above the floor.

3.16.2 A tie-on label should be attached to the wrapping stating:

a) The type, serial number and part number of the equipment;

b) Date of inspection and inflation tests;

c) Date of overhaul;

d) Date of component overhaul;

e) Date of next inspection and/or test.

NOTE: The components should be stored with the equipment but it is preferable that any CO_2 cylinders be fitted with a transit cap and stored separately.

3.16.3 Under no circumstances should life-jackets or liferafts be stored one on top of the other without a separation of corrugated paper or similar shock absorbing material.

a) In the case of liferafts, not more than three should be stored on top of each other.

b) In the case of life-jackets, up to ten may be stored on top of each other.

c) Owing to the light texture of life-jackets, it is important that they should be handled with care to avoid damage.

3.16.4 **Storage Limiting Period**

The period is normally 6 months if packed and stored in accordance with the manufacturer's instructions. At the end of this period survival equipment should normally be:

a) Opened up and inspected before further storage;

b) Inspected, tested and overhauled prior to being operationally packed for stowage in aircraft.

3.16.5 Liferafts and life-jackets not operationally packed and placed in storage for more than 10 days after the last test should be re-tested before installation in an aircraft.

3.17 **Tanks (Flexible)**

The precautions to be taken during storage will depend on the type of tank and the packaging method (if any) used. Some manufacturers of flexible tanks specify that the tanks should be coated with a special preparation if they are to remain empty for more than 2 or 3 days, and that this preparation should be removed before the tanks are put into service.

3.17.1 Manufacturers also specify a 'long term' or 'short term' storage procedure contingent upon special requirements.

3.17.2 'Short term' storage is the period between transport of the tanks from the manufacturer's works and delivery for immediate installation by the aircraft firm.

3.17.3 'Long term' storage covers the period during which the tanks are held following receipt by the aircraft firm before installation, or shipment to locations at home or abroad, involving an extended period of storage prior to installation.

3.17.4 Flexible tanks can be divided into two categories for packaging and storage purposes:

a) Tanks that can be folded, e.g. those not fitted with rigid internal members, heavy coverings or fittings which would preclude satisfactory folding.

b) Tanks with heavy protective coverings, or fitted with rigid internal members, anti-surge valves, gauge units, etc.

3.17.5 Folding and Packing

When packing a tank for storage purposes it is important to fold it in such a way that no strain or creasing is imposed on the folded areas, and in many instances folding diagrams are provided. All openings should be sealed with the specified blanks and corrugated cardboard interposed between the folds.

a) After folding, the tank should be encased in an airtight wrapping, such as a polythene bag, and sealed.

b) The tank in its airtight envelope should then be placed in a cardboard box which should also be sealed.

c) Flexible tanks which are unsuitable for folding because of internal or external fittings, etc., are often packed in an air-inflated state suitably supported in sealed cases. This method of packing is used only for short term storage. For long term storage of this type of tank, the manufacturer's instructions should be followed which will vary with the shape and type of tank concerned.

3.17.6 Storage Conditions

Generally, flexible tanks should be stored in the original airtight containers supplied by the manufacturer and if this is not possible a similar airtight storage container should be used. The manufacturer's instructions should be observed closely. The tanks should be stored in cool, dry, draught-proof conditions, at a temperature not exceeding 25ºC and preferably below 15ºC.

3.18 Tanks (Rigid)

Rigid tanks should be carefully cleaned and any moisture dried out before storage. All apertures should be sealed with closely-fitting blanks. A silica-gel cartridge attached to a blank and placed inside the tank assists in preventing internal condensation and subsequent corrosion.

3.19 Timber

Plywood panels should be stored flat, away from all sources of heat or damp. Other timber sections should be stacked with spacers between each section to permit the free circulation of air. The timber should be checked periodically for moisture content. (See Leaflet 51-30.)

3.20 Transparent Acrylic Panels

Acrylic sheets should be stored on edge, with the protective paper left in position as this will help to prevent particles of grit, etc., becoming embedded in the surfaces of the sheets. When this is not possible, the sheets should be stored on solid shelves, and soft packing, such as cotton wool, should be placed between each sheet. The pile of sheets should be kept to a minimum and not exceed 12 sheets.

3.20.1 Curved panels should be stored singly with their edges supported by stops to prevent 'spreading'. There are several proprietary lacquers available for the protection of acrylic panels and shapings during handling and storage, including those complying with specifications DTD 900/5592.

3.20.2 Protective paper may also be used and, to prevent deterioration of the adhesive between the protective paper and the sheet, store rooms should be well ventilated, cool and dry. The material should not be placed near steam pipes or radiators as hot conditions will cause the adhesive to harden and make the subsequent removal of the paper difficult.

3.20.3 Material in storage should not be exposed to strong sunlight, particularly when the light shines through a glass window. This could cause a 'lens' formation resulting in local overheating to the detriment of the material.

3.20.4 Acrylic materials should not be stored with certain other materials because of the adverse effects which may arise from the vapours given off. A typical list of these materials is as follows:

Acetone	Dopes
Ammonia Vapour	Ethyl Alcohol
Amyl Acetate	Glacial Acetic Acid
Aviation Gasoline	Methyl Alcohol
Aviation Turbine Fuel	Nicotine
Benzene	Rust Remover
Butyl Acetate	Skydrol 500, and similar (Phosphate Ester) fluids
Carbon Tetrachloride	Synthetic Finishes
Cellulose Paints	Thinners
Cresol	Trichloroethylene
Deoxidine Materials	

3.20.5 When sheets are handled or moved they should be lifted off (not drawn from) the adjacent sheet. The vulnerability of transparent plastics to surface damage by scratching and bruising should be impressed on all personnel handling the material.

3.21 Windscreen Assemblies

All types of windscreen panels should be carefully protected from scratches, abrasions or other damage as small scratches or abrasions may considerably weaken the panels and impair their optical qualities. The manufacturer's recommendations relating to packaging or protective wrapping for storage purposes should be carefully followed.

3.21.1 Glass Panels and Windscreen Assemblies

All types of glass panels should be carefully protected from scratches, abrasions or other external damage.

3.21.2 Sandwich Type Windows

Sandwich type windows should be stored vertically in dry conditions, each window having its own desiccant cartridge attached, which should be inspected and renewed at specified periods. Spare windows are usually despatched with desiccant cartridges attached and these should not be removed until the window is to be connected to the aircraft desiccation system.

a) Windows in transit should be allowed to 'breathe', this being particularly important when windows are transported by air, as considerable atmospheric pressure variations may be encountered.

b) In addition to desiccant breathing cartridges, some manufacturers build into each window airspace another desiccator which consists of small discs of activated alumina strung on wire and encased in a cylindrical fabric stocking. Normally the desiccator does not require renewing.

3.21.3 **Electrically Heated Windscreens**

Extreme care is necessary in handling and storing windscreens. It is generally recommended that windscreens are stored in the manufacturer's packing, which usually consists of protecting both surfaces with adhesive polythene, wrapping in acid-free paper and cellulose wadding and storing in reinforced cartons.

a) The panels should be stored separately in their cartons on racks, away from any strong light at a controlled temperature of approximately 10º to 21ºC in well ventilated conditions.

b) It is important that during handling or storage the thick glass laminate is kept uppermost to prevent delamination and that the polythene film is not removed until the panel is fitted to the aircraft.

3.22 **Wire Rope**

Wire rope should be stored in dry, reasonably well ventilated and temperature controlled conditions to prevent condensation. Wire ropes should not be stored where they might be exposed to the corrosive influence of acid fumes, steam or other corrosive agents, and should never be placed on a stone or concrete floor.

3.22.1 Wire rope in store should be inspected periodically for signs of corrosion or other damage. Where a wire rope dressing has been used, this should be renewed when necessary.

3.22.2 Wire rope should be wound on a reel, the diameter of which will be specified by the manufacturer according to the size and type of rope (usually 40 to 50 times the diameter of the rope).

3.22.3 If reels are made locally, it is important that oak, chestnut or western red cedar are not used in their manufacture as these timbers may corrode the wire rope. The inside of the reel should be lined with waterproof paper.

3.22.4 When unwinding wire rope, a spindle should be placed through the centre of the reel and fixed so that the reel is free to rotate and the free end of the cable can be pulled out in direct line with the reel. The cable should not be unwound by paying off loose coils, or by pulling the wire away from a stationery reel laid on its side. When cut-off lengths of wire rope are hand coiled, the coils should be of a diameter not less than 50 times the diameter of the wire rope concerned, with a minimum of 152 mm (6 in) diameter. When hand coils are unwound, the coil should be rotated so that the wire rope is paid out in a straight line. If the wire rope forms a loop on itself, this indicates a localisation of turn and should be eliminated by taking the turn out and not by pulling straight.

3.22.5 Before cutting the cable to length, it should be bound either side of the proposed cut to prevent loss of tension from the woven strands.