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**AIRWORTHINESS
CAUTION
HAZARDS ASSOCIATED WITH AIRCRAFT OXYGEN SYSTEMS**

1. PURPOSE

The purpose of this circular is to draw the attention of aircraft maintenance engineers and owners of civil aircraft to the hazards association with aircraft oxygen systems and to prescribe specific and general precautions to be observed when replacing such systems.

2. GENERAL

- 2.1. One of the main problems associated with oxygen is the hazard of fire. Fire is normally a rapid combination of fuel with the oxygen available in the air. Because the rate of chemical reaction is proportional to the concentration of the materials reacting, it is obvious why the fire risk increases with pure oxygen, in which the oxygen concentration is about five times that present in the air.
- 2.2. Fire prevention requires an understanding of the basic principles of combustion. No fire can start unless three ingredients are present simultaneously - oxygen, fuel and a source of ignition or an initiator. Anything that raises the temperature at some point in the fuel oxygen, oxygen is of necessity, present, possible initiator mechanisms are many and positive control of them is extremely difficult. Therefore, prevention of fuel accumulation is the most effective means of eliminating the hazard inside the system, in order words, use compatible materials and keep the system clean.
- 2.3. There is a good problem associated with oxygen and that is the high potential energy stored in a compressed gas. Any opening in the pressure wall of a pressurised gas system results in a violent eruption of gas through the hole. High or even explosive forces can result. For example, if a valve is broken off a high pressure cylinder, the container is immediately transformed into an unguided missile. It is essential that high-pressure containers be protected from mechanical damage so that they cannot be converted into shrapnel.

3. STORING OF OXYGEN CYLINDERS

- 3.1. Storage areas for oxygen cylinders must be properly ventilated to prevent oxygen from accumulating and creating a fire or explosive hazard.
- 3.2. Cylinders must be stored in a cool, dry place away from direct sunlight, open flames, steam pipes, inflammable substances, etc.
- 3.3. Empty cylinders must be stored separately and care must be taken to see that all valves are shut.
- 3.4. Insulate breathing oxygen cylinders from general purpose or welding oxygen cylinders.

- 3.5. Every cylinder containing breathing oxygen must be clearly marked to identify its contents.
- 3.6. Leaking oxygen cylinders must not be stored and steps must be taken immediately to have such cylinders repaired.
- 3.7. Breathing oxygen is generally received in high-pressure (15, 00 Mega Pascal (MPa) commercial) cylinders. The protective caps should be left on cylinders not in use to prevent damage to valves.
- 3.8. Breathing oxygen cylinders are colour -coded green and distinctly marked "Highflying oxygen".

4. CHARGING EQUIPMENT

- 4.1. Oxygen servicing carts and associated equipment provide a convenient means of recharging aircraft oxygen systems without removing supply cylinders from the aircraft. Only qualified operators who are thoroughly familiar with the equipment and procedures should attempt operation of such equipment.
- 4.2. Never interchange equipment with equipment intended or used for other gases. High-pressure commercial cylinders must be connected through a pressure regulator to service low-pressure aircraft oxygen systems.
- 4.3. Charging hoses must be kept clean and capped when not in use and must be clearly marked "For oxygen use only".

5. GENERAL PRECAUTIONS DURING CHARGING OPERATIONS

- 5.1. Do not permit aircraft servicing or maintenance operations which may inherently or accidentally introduce ignition sources or combustibles while charging oxygen systems. Possible ignition sources include fuelling, fuel and hydraulic system repairs and use of inflammable cleaning fluids, de-icing fluids etc. Do not operate electrical system switches or connect or disconnect ground power generators during the oxygen charging operation.
- 5.2. Prohibit open flames (including smoking within 15 meters of aircraft).
- 5.3. Electro statically ground the aircraft and also electro statically bond the oxygen charging equipment to aircraft.
- 5.4. The importance of cleanliness cannot be overstressed. Do not handle oxygen equipment with only hands or tools or perform charging operations wearing oily or greasy clothing. Keep protective caps on equipment as long as possible and replace them as soon as possible. If dust, dirt, grease or any other contaminant is found, it must be removed with a detergent or solvent approved for oxygen service. Bleed a small amount of oxygen through the hose before connecting to the fitting to eliminate foreign matter which may escape external inspection.
- 5.5. High-pressure valves should be barely "cracked open" and only after waiting five or more seconds should the valve be slowly opened to the fully open position. Sudden and fast discharge of oxygen into the aircraft system can cause dangerous heating, which can result in a fire or explosion.
- 5.6. Hammers, wrenches and other tools should not be used to force cylinder valves. If a cylinder valve cannot be hand operated, such valve must be removed and repaired or replaced.
- 5.7. Do not direct oxygen at the body or clothing because of the possibility of fire and personal injury.
- 5.8. Make certain that threaded fittings of cylinder valves and hoses correspond to each other. Fittings with worn or damaged threads should be replaced.
- 5.9. When the aircraft oxygen system does not have filler valves and it is necessary to remove the aircraft cylinders for recharging, close the cylinder valve and release all oxygen in the lines before attempting to remove the cylinder. It is vitally important that this discharge be as slow as possible because sudden release of oxygen can create a serious fire hazard. Before removing the cylinders from aircraft, cap cylinder valve outlets and plug all distribution lines.

6. GENERAL MAINTENANCE REQUIREMENTS

- 6.1. Copper tubing used a supply cylinders will work-harden in time because of vibration and bending during servicing operations, Copper tubing should therefore be removed periodically, annealed (to prevent cracking) and then cleaned and reinstalled.
- 6.2. Because of the explosive nature of an oxygen-grease-oil mixture none of the standard thread lubricants should be used on oxygen fittings. Only lubricants and thread compounds specifically approved for oxygen service at the relevant pressures and temperatures must be used.
- 6.3. Oxygen distribution lines with the aircraft should be inspected frequently to determine that the tubing has not been scratched or damaged during maintenance. Even slight damage may lead to failure.

7. GENERAL OPERATIONAL REQUIREMENTS

All operators of oxygen-equipped aircraft are encouraged to open the high-pressure valves of the aircraft oxygen system and to leave them open at all times except when routine maintenance or replacement is necessary. If the opening of such valves is overlooked and an immediate need for opening arises at cruising altitude, the probable rapid opening of this high-pressure valve could create a hazard, such as a ruptured line, fitting or regulator, allowing pure oxygen to escape and combine with combustible material, which could cause a fire or explosion.