Australian Government
Civil Aviation Safety Authority

ADVISORY CIRCULAR

AC 21-39
Design and fitting of gaseous oxygen systems

v1.0 – November 2015

Audience

This Advisory Circular (AC) applies to:

- persons holding an Instrument of Appointment under Subpart 21.M or Approved Design Organisations under Subpart 21.J of the *Civil Aviation Safety Regulations (CASR)* for purposes of approval the design of new or modification of existing gaseous oxygen systems to be incorporated in an Australian aircraft.
- Certificate of Registration holders of aircraft having gaseous oxygen systems fitted or modified in their aircraft.

Purpose

The purpose of this AC is to provide guidance on a range of matters that need to be considered by the operator to ensure that gaseous oxygen systems fitted to an aircraft or the modification of existing systems will not be a potential threat to the safety of the aircraft while either on the ground or in flight.

For further information

For further information on this AC, contact Civil Aviation Safety Authority's (CASA’s) Airworthiness and Engineering Standards Branch (telephone 131 757).

Unless specified otherwise, all subregulations, regulations, divisions, subparts and parts referenced in this AC are references to the *Civil Aviation Safety Regulations 1998 (CASR)*.

Status

This version of the AC is approved by the Executive Manager, Standards Division.

Version	Date	Details
1.0	November 2015	Initial release

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1 Reference material

1.1 Acronyms

The acronyms and abbreviations used in this AC are listed in the table below.

Acronym	Description
AC	Advisory Circular
AS	Australian Standards
ASTM	American Society for Testing Materials
CAAP	Civil Aviation Advisory Publications
CAO	Civil Aviation Order
CAR 1988	*Civil Aviation Regulation 1988*
CASA	Civil Aviation Safety Authority
CASR 1998	*Civil Aviation Safety Regulations 1998*
EASA	European Aviation Safety Agency
FAA	Federal Aviation Administration (of the USA)
NZS	New Zealand Standards
OEM	Original Equipment Manufacturer
SAE	Society of Automotive Engineers
SAE AS	SAE: Aerospace Standard
SAE AIR	SAE: Aerospace Information Report
SAE ARP	SAE: Aerospace Recommended Practice

1.2 Definitions

Terms that have specific meaning within this AC are defined in the table below.

Term	Definition
Permission	An approval or exemption capable of being granted by CASA.
State	A country (in the international context).
Australian State	A State or Territory of Australia.

1.3 References

Regulations

Regulations are available on the ComLaw website http://www.comlaw.gov.au/Home

Document	Title
Division 2 of *the Civil Aviation Regulations 1988 (CAR)*	Maintenance for which the holder of certificate of registration responsible
Division 3 of CAR	Approved Systems of Maintenance
Division 4 of CAR	How Maintenance is to be carried out
Part 21	Certification and Airworthiness requirements for an aircraft and parts
Part 23	Airworthiness Standards for aeroplanes in the normal, utility, acrobatic or commuter category
Part 25	Airworthiness Standards for aeroplanes in the transport category
Part 42	Continuing Airworthiness requirements for aircraft and aeronautical products
Civil Aviation Order (CAO) 108.26	System Specification - Oxygen Systems
CAO 20.4	Provision and use of oxygen and protective breathing equipment

Advisory material

Document	Title
Federal Aviation Administration (FAA) AC 23-17C	Certification of Part 23 airplanes
FAA AC 25-22	Certification of Transport airplane Mechanical Systems
FAA AC 27-1B	Certification of normal category rotorcraft
FAA AC 29-2C	Certification of transport category rotorcraft
FAA AC 43.13-2B	Acceptable methods, techniques and practices – Aircraft alterations
AS 1777-2005	Aluminium cylinders for compressed gases - seamless 0.1 kg to 130 kg
AS 2030.1-2009	Verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases
AS 2030.5 – 2009	Gas Cylinders Part 5: Filling, inspection and testing of refillable cylinders
AS 2896-2011	Medical gas systems – Low pressure flexible connecting assemblies (hose assemblies)
AS 2902-2005	Medical gas systems – Low pressure flexible connecting assemblies (hose assemblies)
AS/NZS 3840.1-1998	Pressure regulators for use with medical gas – Pressure regulators and pressure regulators with flow-metering devices

Document	Title
AS 2473.3	Australian Standard ( )
ASTM MNL36	Safe Use of Oxygen and Oxygen Systems: Handbook for Design, Operation and Maintenance
SAE AIR 825/1	Introduction to Oxygen Equipment for Aircraft
SAE AIR 825/12	Oxygen System Integration and Performance Precautions
SAE AIR 825/13	Guide for Evaluating Combustion Hazards in Aircraft Oxygen Systems
SAE AIR 825/14	Basic System Design, Schematics Charts, Tables
SAE AS 861 Rev A	Minimum General Standards for Oxygen Systems
SAE AIR 1059 Rev B	Transfilling and Maintenance of Oxygen Cylinders
SAE ARP 1176	Oxygen System and Component Cleaning and Packaging
SAE AS 1248 Rev A	Minimum Standard for Gaseous Oxygen Pressure Reducers
SAE AIR 1392	Oxygen system maintenance guide
SAE ARP 1532	Aircraft oxygen system design, fabrication, test and installation
SAE ARP 4761	Guidelines and methods for conducting the safety assessment on civil airborne systems and equipment

2 Background

This Advisory Circular (AC) replaces Civil Aviation Advisory Publication (CAAP) 35-5. It provides guidance for the design and fitment, and modification of both required and non-required oxygen systems to aircraft.

Civil Aviation Order (CAO) 20.4 details the mandatory operational requirements for oxygen for all aircraft engaged in certain operations in Australia. In addition, type design requirements have also been published for Part 23, 25 and 29 aircraft by both the Federal Aviation Administration (FAA) and European Aviation Safety Authority (EASA).

CAO 108.26 is referenced by CAO 20.4 and provides the detail on the specifications and requirements Australian registered aircraft must meet when using supplemental oxygen and protective breathing equipment.

Any approval of the design and fitment of new, or modifications/repairs to existing, oxygen installations needs to consider the potential hazards associated with pressurised oxygen systems and should be based on the original equipment manufacturer (OEM) data and published practices.

> **Note:** Oxygen is neither explosive nor flammable. Flammable materials burn vigorously in an oxygen enriched atmosphere and, under certain circumstances, the enriched atmosphere can support combustion of materials that might otherwise be considered non-flammable. Extreme care must be taken with cleanliness of the system and in particular, oils or greases must not to be used.

The approval under Subpart 21.M must address either the original or a later more appropriate certification basis of the aircraft. The design must comply with all relevant design standards unless an equivalent level of safety can be achieved by an alternate standard. CASA may require the application of the latest standards in accordance with regulation 21.101.

> **Note:** The design of oxygen systems is a specialised function. The CASR 21.M Instrument of Appointment holder approving the installation must be conversant with the problems and dangers associated with design and use of gaseous oxygen systems.

3 Oxygen system components

3.1 Basic components

3.1.1 A gaseous oxygen system generally consists of the following components:

- pressurised cylinder storing the oxygen, generally high pressure, up to 3,000 psi
- gauges
- oxygen distribution lines (high pressure lines and low pressure lines)
- pressure reducers
- filters
- control valves
- fittings
- regulators
- face mask/cannula.

3.2 Cylinders

3.2.1 There are a number of different types of cylinders used in aircraft gaseous oxygen systems, steel, aluminium or composite. Steel cylinders can be divided into two categories, 3AA and 3HT cylinders. United States Department of Transport (DOT) 3AA 1800 (3AA) cylinders are standard industrial size steel cylinders found mostly in older airplanes. These are being replaced with 3HT high-tensile steel cylinders as they have a thinner wall than the 3AA cylinders, thereby affording a weight savings.

3.2.2 Aluminium and composite cylinders are lighter than either of the 3AA and 3HT steel cylinder types. The composite cylinders are typically aluminium-lined cylinders with a Kevlar™ overwrap.

3.2.3 Use of non-aviation cylinders may be used for non-required installations (e.g. aeromedical).

3.2.4 In accordance with health and safety legislation, all pressure vessels are required to be tested on a periodic basis. All aviation cylinders must be periodically tested in accordance with either:

- the system of maintenance approved for that aircraft
- the cylinder manufacturer's interval
- AS 2030.5 – 2009.

3.2.5 All non-required cylinders must be tested to AS 2030.5 – 2009, which details the time interval between tests appropriate for the cylinders construction. The test date is to be clearly marked on the cylinder. Cylinders that have exceeded the prescribed test period are prohibited from being re-filled and cannot be used until they have been re-tested.

3.2.6 Re-filling cylinders installed in an aircraft is a maintenance action and should only be done by or under supervision of an appropriately qualified Licensed Aircraft Maintenance Engineer (LAME) in accordance with approved data or by suitably endorsed aircrew. No oxygen cylinder should be charged beyond its maximum rated capacity.

3.2.7 Portable and non-required cylinders should not be re-filled on the aircraft. They should to be removed and either exchanged or re-filled by an appropriately authorised refilling station. Cross filling of portable cylinders is not supported and may be in breach of local health and safety legislation.

3.2.8 Cylinders located where they may be damaged by baggage or stored materials should be protected by guards or covers.

3.2.9 The operator needs to consider emergency landing conditions when mounting the cylinders. The inertia loads are to meet the requirements of the certification basis of the aircraft.

3.3 Oxygen distribution lines

3.3.1 Type design for transport category aircraft prohibits the location of oxygen equipment and lines in designated fire areas. In addition, the equipment and lines need to be protected from any heat generated in these areas.

3.3.2 Oxygen lines and equipment should be installed, where possible, at a distance from electrical power lines or electrical equipment so that power line or electrical equipment failure precludes contact with oxygen lines and equipment. All oxygen lines should be adequately supported to avoid excessive vibration and to prevent deterioration by friction.

3.3.3 Piping, tubing, and fittings should be suitable for the intended oxygen service. The design should be based on the pressure and temperature of the oxygen system and the pressure and temperature limitations of the materials selected. Lines should be copper or nickel alloys such as Monel for high and low pressure and may include stainless steel for low pressure. This design concept is strongly recommended for oxygen systems in all other categories of aircraft.

3.3.4 All lines need to be cleaned prior to installation in accordance with Chapter 6 of FAA AC 43.13-2B. Care should be taken to ensure that all surfaces coming into contact with oxygen are free of oils, grease and particulate contaminants such as talc or dust.

3.3.5 High pressure

3.3.5.1 Oxygen lines from the cylinders to the regulator, if remote from the cylinder, are subject to high pressure and must be designed to withstand full cylinder pressure. High pressure lines should be made from copper or nickel alloys (i.e. Monel). The maximum length of the pipe must ensure that high pressure runs are kept as close as possible to the source.

3.3.5.2 The lines should be formed to reduce repeated plastic deformation, such as when replacing oxygen cylinders. Line diameters should be limited to a size that is adequate to carry the flow at the minimum cylinder operating pressure. All pipes should be pressure tested to twice the system’s operating pressure on a test bench or as per OEM data prior to installation in an aircraft.

3.3.5.3 The pipes should be thoroughly cleaned after testing to remove all traces of oil and grease.

Note: Flexible hoses or pipes should not be used in any part of the high pressure system.

3.3.6 Low pressure

3.3.6.1 Low pressure lines that are hidden from view during normal operation should be solid metal lines that are approved by the manufacturer for oxygen use and should meet Australian Standard (AS) 2902-2005.

3.3.6.2 Low pressure flexible hoses should only be used where the line is visible at all times during normal operation and not exposed to continuous pressure. Flexible hoses are typically made of non-metallic materials that degrade over time due to material and installation environment. Instructions for continuing airworthiness should include how flexible hoses should be inspected to maintain their continued airworthiness and the frequency of those inspections.

3.3.6.3 All pipes should be pressure tested, either on a test bench or in-situ, using dry air or nitrogen, to at least twice the system's operating pressure with nil leakage over a one hour period. Care must be taken to account for the fittings with low pressure that may be affected by high pressure in the case of a system failure, where high pressure oxygen escapes into the low pressure system (e.g. failure of the regulator). Protection against high pressure in the low pressure pipes can be provided by a line pressure safety valve (refer to section 3.6).

3.3.6.4 Hoses with nipples may be used where the end fitting is a purely cylindrical type and is swaged over hose and nipple using a press.

3.4 Pressure reducers

3.4.1 High pressure oxygen cylinders may have a storage pressure of up to 20,000 kPa (3,000 psi). The pressure reducer automatically reduces this high inlet pressure to a steady lower downstream pressure, regardless of changing flow rate and/or varying inlet pressure. If the design incorporates a pressure reducer, it should be located as close to the storage cylinder as possible to minimise the length of high pressure plumbing.

3.4.2 On some lower pressure systems, the pressure reducer may be incorporated into the regulator.

3.5 Filters

3.5.1 The operator should consider the use of sintered filters to all entry points to regulators/pressure reducers and high pressure valves (other than the cylinder valve).

3.5.2 The use of filters is to limit the introduction of particles and to capture particles generated during service. Guidance for use of filters in oxygen systems includes the following:

3.5.2.1 Location: The operator should consider the use of filters at sites of oxygen entry into a system, downstream of points where particles are likely to be generated and at points where the presence of particles produces the greatest risk. Place filters in locations where they can be removed and inspected. It is important to place filters where there is no possibility of back flow that could cause the particulate captured by the filter to be blown back out of the filter. Examples of appropriate filter placement include:

- o gas supply points
- o disconnect points
- o upstream valves, regulators, and other high-velocity-producing components.

3.5.2.2 Size: The operator should use the finest filtration for a system that meets system flow requirements. This ensures that the filtration level corresponds to the system cleanliness level to lessen the likelihood of clogging the filter. For smaller higher-pressure applications, filters commonly range from 2-50 µm.

3.5.2.3 Strength: Filter elements should not be fragile or prone to breakage. If complete blockage is possible, the elements should be able to withstand the full differential pressure that may be generated.

3.5.2.4 Maintenance: Filters should have an ongoing maintenance program that is adequate to limit the hazard associated with flammable debris collected on a filter element.

3.5.2.5 Materials: Use burn-resistant materials such as nickel, bronze or Monel for filter elements because they typically have high surface-area/volume ratios. The use of materials with relatively low combustion resistance, such as stainless steel mesh, is not recommended.

3.6 Control valves

3.6.1 The material and physical design of valves should be carefully selected while considering both normal and unusual operating conditions. Avoid rotating valve stems and sealing configurations that require rotation on assembly, rotation of seals, and rotation against seats. Rotating valve stems and seals can gall and generate particulate that may migrate into the flow stream.

3.6.2 A slow opening shutoff valve must be attached to each cylinder in accordance with AS 2896 - 2011. Rapid opening and the subsequent sudden and fast discharge of oxygen into the system can cause dangerous heating, which could result in fire or explosion of combustibles within the system. Locate the shutoff valve on or close as practicable to the cylinder to prevent loss of oxygen due to pressure leakage in the system.

3.6.3 For emergency medical systems, the shutoff valve should be accessible to a crew member at all times during normal operation. If the mounting of the cylinders is such that the shutoff valves are inaccessible to the aircraft crew or medical team members, an excess flow check valve followed by a line pressure safety valve is an acceptable alternative. This valve should be set to lift at 30% above nominal working pressure to protect the pressure reducers/regulators and lines against high pressure in the event of a partial failure of the reducer/regulator. These should be installed as close as possible to the cylinder and vented overboard.

3.6.4 Design of flow valve settings should be supported by tests demonstrating that the maximum flow will not result in nuisance trips and reliable trips will occur during a malfunction condition.

3.7 Fittings

3.7.1 All fittings used in oxygen systems must be manufactured from materials that are compatible for use with oxygen such as copper, Monel and Inconel, in accordance with AS 2896-2011. Fittings should not be made of mild steel or materials that are prone to corrosion when in contact with another material. All fittings should be cleaned prior to installation, in accordance with AS 2896-2011 or Chapter 6 to FAA AC 43.13-2B.

3.7.2 High pressure

3.7.2.1 Inter-cylinder connections should be made with regular flared or flareless tube fittings with stainless steel.

3.7.2.2 Fittings that are of the same material as the lines are recommended whereas mild steel or aluminium alloy fittings with stainless steel lines are discouraged.

3.7.3 Low pressure

3.7.3.1 Fittings for metallic low pressure lines may be regular flared or flareless, similar to high pressure lines. Universal fittings or friction nipples in conjunction with hose clamps should not be used in pressurised oxygen systems.

3.7.4 Outlets

3.7.4.1 All outlets should be of an automatic shutoff type, with a flow limiting restrictor in the socket or plug fitting.

3.8 Regulators

3.8.1 The oxygen pressure regulator's primary function is to match the flow of gas through the regulator to the demand for gas placed upon the system. If the load flow decreases, then the regulator flow must also decrease. If the load flow increases, then the regulator flow must increase in order to keep the controlled pressure from decreasing due to a shortage of gas in the pressure system. There are two types of regulators:

- Continuous flow oxygen regulators: These regulators attach to the top of the oxygen tank and have a dial that allows the adjustment their litre flow. These oxygen regulators only provide continuous flow settings.
- Demand regulator: This type can be further divided into pressure demand and diluter demand type regulators. Diluter-demand and pressure-demand masks supply oxygen only when the user inhales:
  - Diluter-demand system: as the altitude increases, ambient pressure (and therefore the partial pressure of ambient oxygen) decreases, the oxygen flow increases such that the partial pressure of oxygen is roughly constant. Diluter-demand oxygen systems can be used up to 40,000 ft.
  - Pressure-demand system: the oxygen in the mask is above ambient pressure, permitting breathing above 40,000 ft but as the pressure inside the mask is greater than the pressure around the user’s torso, inhalation is easy, but exhalation requires more effort.

3.8.2 The proposed regulator should be suitable for use with oxygen and should be located as close as physically possible to the oxygen cylinder to avoid long high pressure lines and minimises the use of fittings. If non-aviation regulators are used, the operator should give careful consideration to any manufacturer's environmental qualifications, and particular attention should be given to the manufacturer's vibration, altitude and temperature tolerances of the regulator.

3.8.3 Non-aviation regulators should meet AS/ NZS[1] 3840.1 - 1998 or similar standard.

Note: Regulators that are not manufactured to an approved standard should be carefully assessed for their operational reliability and suitability.

3.8.4 Regulators that have in-built relief valves should have the relief port vented overboard using suitable metal pipe.

3.9 Pressure relief devices

3.9.1.1 Oxygen cylinder valves and high-pressure systems should be provided with a relief valve should the desired pressure be exceeded.

3.9.2 The valve should be ported to an indicating or blowout disk. This should be located in a visible place, such as the fuselage skin, where it can be seen during walk-around inspection.

3.9.3 Relief valves should be functionally tested to verify that design requirements are satisfied, including testing in both static and dynamic states.

3.10 Oxygen masks

3.10.1 Face masks or cannulas should be of a type suitable for the intended purpose and as required by regulations (refer to CAO 108.26 for more information).

3.10.2 Aviation-style masks may not be suited to medical use. Medical approved oxygen rated masks are acceptable.

3.11 Filler connection

3.11.1 A filler connection, if provided, should be located outside the fuselage skin or protected by an access door on the fuselage. It should:

- be of the slow acting type
- have a large vented area around the filling nipple
- be mounted in a manner that would minimise leaking oxygen from entering the aircraft
- be placarded.

3.11.2 Any mounting point should also take into consideration the location of fuel, oil and hydraulic sources and lightning strike zones.

[1] NZS is New Zealand Standard

3.12 Earthing and bonding

3.12.1 All metallic components of the oxygen system should be protected against catastrophic effects from lightning and static electricity. This can be achieved by securely bonding all the components to the airframe.

3.12.2 The operator should consider the effects of lightning if the cylinders or metal plumbing are located behind composite structure or access panels.

3.13 Thread compound

3.13.1 If anti-seize or thread compound is used, the product should conform to military material MIL-T-5542B specification or equivalent that is clearly labelled as compatible for use with oxygen systems.

3.13.2 Thread compound should not be used on aluminium alloy flared fittings that have straight threads. Proper flaring and tightening of this type of fitting should be sufficient to prevent leaking.

3.13.3 All male tapered pipe threads should be treated with anti-seize and sealing compound (MIL-T-5542B, or tetrafluoroethylene tape MIL-T-27730), or equivalent. The compound should be used in accordance with the manufacturer’s recommendations. Apply compound carefully and sparingly to the first three male threads from the end of the fitting. Compound should not be used on coupling sleeves or on the outside of the tube flares.

3.14 Placards

3.14.1 Appropriate and durable placards should be provided with any installed system warning of the dangers associated with the use of oxygen. Emphasis should include any precautions, such as no smoking and use no oils or greases.

3.14.2 The following information should be placarded adjacent to the oxygen cylinders or filler connection:

MEDICAL OXYGEN SYSTEM

NO SMOKING

TURN OXYGEN ON SLOWLY

CAP OFF OXYGEN LINES WHEN NOT IN USE

KEEP THIS AREA FREE OF OILS, GREASE, DIRT

AND HYDROCARBONS

3.14.3 If the system has removable oxygen cylinders the following should be added:

OXYGEN CYLINDERS ARE NOT TO BE FILLED IN-SITU

INSTALLERS ARE TO TAKE CARE WHEN

INSTALLING OXYGEN CYLINDERS SO THAT

SURROUNDING EQUIPMENT AND AIRCRAFT

ARE NOT DAMAGED

3.14.4 Any oxygen outlet and valves located in the cabin should have at least the following placards adjacent to the fittings:

OXYGEN

NO SMOKING

4 Continuing airworthiness

4.1 General

4.1.1 All oxygen system equipment, including regulators, oxygen outlets and valves, should be maintained in accordance with manufacturer’s instructions and by personnel qualified to maintain oxygen equipment. If the manufacturer of the oxygen equipment does not have specific maintenance requirements, the maintenance requirements should be established by qualified oxygen maintenance personnel and a suitably experienced CASR 21M authorised person as part of the continuing airworthiness program.

4.1.2 Oxygen cylinders and valves should be hydrostatically tested every ten years in accordance with AS 2030.1 - 2009 or as required by the aircraft's approved maintenance program. Any repair or maintenance on the installed system should be performed by maintenance personnel and recorded in the aircraft documentation, including the recharging or replacement of the oxygen cylinders. SAE AIR 1392 details acceptable methods of system maintenance.

Note: Cylinders and other components once removed from the aircraft may have minor routine maintenance performed by suitably qualified medical support staff.

4.1.3 A maintenance schedule should also be developed and should include periodic maintenance requirements, cleaning and precautions on the use of oxygen.

4.2 Cleanliness

4.2.1 Thorough cleaning is the most fundamental fire safety measure that can be applied to oxygen systems. The presence of contaminants in otherwise robust oxygen systems can lead to catastrophic fires. To reduce the hazard of ignition, components used in oxygen systems should always be reasonably clean before initial assembly to ensure the removal of contaminants, such as particulates, hydrocarbon oils and grease, which could potentially cause mechanical malfunction, system failures, fires, or explosions.

4.2.2 No single cleaning procedure will meet all cleanliness requirements. Visual cleanliness is not a sufficient criterion when dealing with oxygen systems because of the hazards associated with contaminants that cannot be detected with the naked eye. Visual inspection should be preceded by a verified cleaning process or other methods that are able to quantify the amount of contaminants present. Effective cleaning will:

- remove particulates, films, greases, oils, and other unwanted matter, which are more easily ignited than bulk materials
- prevent loose scale, rust and dirt from clogging the flow passages and interfering with component function
- reduce the concentration of finely divided contaminants, which are more easily ignited than bulk material.

4.2.3 White light inspection test may be used to detect the presence of contaminants such as oil, greases, preservatives, moisture, corrosion products and other foreign matter. Black (ultraviolet) light inspection may also be used to detect oils and grease when they are not detectable by white light. Many, but not all, common organic oils or grease will fluoresce in presence of black light.

4.2.4 When a component is removed from an oxygen system, it should be inspected to determine its cleanliness. This provides an opportunity to determine the cleanliness of the system and to establish cleaning intervals and levels. For example, when a filter is removed it should be back flushed, and the trapped debris should be analysed. Based on the results of the analysis, appropriate action can be taken.

5 Documentation

5.1 General

5.1.1 A flight manual supplement should be included for any system permanently fitted to an aircraft. This supplement should detail any precautions necessary for the safe use and operation of the oxygen system, including all precautions and warnings associated with the use of oxygen.

Note: Warnings to flight crew and operators should include advice that high pressure lines should be pressurised prior to loading portable equipment onto an aircraft.

5.1.2 When developing procedures, the operator should take into consideration State laws on the refilling of oxygen cylinders. This should include who may fill cylinders and where they may be filled.

6 Certification

6.1 General

6.1.1 The design and construction of an oxygen system permanently fitted to an aircraft constitutes a modification to the aircraft. A Subpart 21.J design organisation or Subpart 21M authorised person must approve all aspects of the design of the system. This includes the mounting brackets and all components used with the oxygen system. The equipment and systems must be installed to ensure adequate performance and functions under any foreseeable operating conditions. The design must maintain and continue to meet the certification basis of the aircraft.

6.1.2 A Functional Hazard Assessment, performed in accordance with SAE ARP 4761, is usually required to show continued compliance with the design standard and that there is no hazard or interference to the safe operation of the aircraft.

6.1.3 Oxygen installations are potentially hazardous and complex. The operator should consider applying for a Supplemental Type Certificate for the design and installation of gaseous oxygen equipment.