



AEROSPACE RECOMMENDED PRACTICE

ARP6390™

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Superseding AIR1390

Location of Crew and Passenger Oxygen Masks, Portable Oxygen System, and
Protective Breathing Equipment

RATIONALE

This ARP document supports interior and oxygen systems aircraft certification. Airlines, aircraft modification centers and facilities, original equipment manufacturers (OEMs) and regulatory authorities may utilize this document to support interior and oxygen systems certification activities regarding the locations of oxygen masks, portable oxygen systems and protective breathing equipment. This ARP will account for aircraft layouts and anthropometric data to ensure that reasonable and acceptable concepts are addressed.

INTRODUCTION

The purpose of this document is to provide basic guidelines for use by aircraft interior designers so that oxygen masks connected to oxygen supply systems are made available for use by passengers and crew members. Oxygen masks, portable oxygen cylinders, and protective breathing equipment should be readily accessible if the necessity arises for use of supplemental oxygen during flight operations.

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1. SCOPE

Various emergency situations may require the dispensing of oxygen to all occupants of aircraft during flight. During an emergency event, depending on the aircraft operational flight capability, all cabin occupants must be serviced by a mask presentation system connected to an operational oxygen source.

Several regulations specify the functional characteristics and requirements of the oxygen systems for aircraft in support of different missions. These should be referred to for the exact functional performance requirements. It is not the intent of this document to ensure conformance with these regulations, but only to recommend general concepts for the location of the oxygen masks and oxygen system outlets for proper accessibility by the aircraft occupants, whether cabin occupants or crew members. Different requirements may apply when the mission of the pressurized aircraft or the operational altitude of the aircraft is not in excess of FL250. When the aircraft is operating above FL100, oxygen masks, either distributed to each cabin occupant or stowed and readily accessible, must be available in the event of a pressurization failure. Oxygen masks must also be connected to an operational source, available and within easy reach of each seated flight deck crew member and observer.

For unpressurized aircraft, during flight operations above FL125, oxygen masks connected to an operational oxygen source must be available to all occupants.

This document defines the accessibility requirements that should be considered in the placement of oxygen masks for presentation to the user and the connections for such oxygen masks to the operational oxygen systems. This is of interest when designing the interior of the aircraft, placing the seats in relationship to such outlets and mask connections, or placing oxygen mask outlets in relation to the seats. The accessibility requirements contained in this document are applicable to installation and arrangement of such equipment in different locations in the aircraft as shown on typical examples of installation areas as shown in Figures 3 through 15.

Furthermore, this document does not discuss operational needs with respect to oxygen supply duration, nor the detail design of portable oxygen system or protective breathing equipment. Please refer to other SAE documents for such information. Portable Oxygen System and Protective Breathing Equipment are to be installed to meet the requirements of 25.1447(c) and 25.1439. Also, if portable oxygen equipment is installed, they need to meet the requirements of 14 CFR Part 25, Section 25.1443(d)& (e).

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AS452	Oxygen Mask Assembly, Demand and Pressure Breathing, Crew
AIR822	Oxygen Systems for General Aviation
AIR825	Oxygen Equipment for Aircraft
AIR847	Oxygen Equipment for Commercial Transport Aircraft Which Fly Above 45,000 Ft
AS861	Minimum General Standards for Oxygen Systems
AIR1069	Crew Oxygen Requirements Up to a Maximum Altitude of 45,000 Ft.

AS1224	Continuous Flow Aviation Oxygen Masks (For Non-Transport Category Aircraft)
ARP4287	Supplemental Oxygen Devices with Automatic or Manual Presentation
AS8031	Personal Protective Devices for Toxic and Irritating Atmospheres Air Transport Flight Deck (Sedentary) Crewmembers
AS8047	Performance Standard for Cabin Crew Portable Protective Breathing Equipment for Use During Aircraft Emergencies

2.1.2 ISO Publications

Available from American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, Tel: 212-642-4900, www.ansi.org.

ISO7250-1	Basic human body measurements for technological design-Body measurement definitions and landmarks.
ISO7250-2	Basic human body measurements for technological design-Statistical summaries of body measurements from national populations.

2.1.3 NASA Publications

Available from NASA, Documentation, Marshall Space Flight Center, AL 35812, www.nas.nasa.gov.

NASAS REF	NASA Reference Publication, Anthropometry for designers <u>Volume 1 of Anthropometric Source Book, Volume 1024 of NASA reference publication.</u>
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2.1.4 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

FAA REGULATIONS

14 CFR § 25.1439	Protective breathing equipment
14 CFR § 25.1443	Minimum mass flow of supplemental oxygen
14 CFR § 25.1447	Equipment standards for oxygen dispensing units.
14 CFR § 121.329	Supplemental oxygen for sustenance: Turbine engine powered airplanes.
14 CFR § 121.331	Supplemental oxygen requirements for pressurized cabin airplanes: Reciprocating engine powered airplanes.
14 CFR § 121.333	Supplemental oxygen for emergency descent and for first aid; turbine engine powered airplanes with pressurized cabins.
14 CFR Part 25	Airworthiness Standards, Transport Category Aircraft
14 CFR Part 121	Certification and Operations: Domestic, Flag and Supplemental Air Carriers and Commercial Operators of Large Aircraft
14 CFR Part 91	General Operating and Flight Rules
14 CFR Part 23	Airworthiness Standards: Normal, Utility and Acrobatic Category Airplanes
14 CFR Part 135	Operating Requirements: Commuter and on Demand Operations and Rules Governing Persons on Board Such Aircraft

FAA Policy Memo No. ANM-03-111-07 - Policy Statement on Testing of Flightcrew Oxygen Masks for Transport Category Airplanes

AC 25.17A Transport Airplane Cabin Interior Crashworthiness Handbook

FAA TECHNICAL STANDARD ORDER

TSO-C64a Oxygen Mask Assembly, Continuous Flow, Passenger (For Air Carrier Aircraft)
TSO-C78a Crew Member Demand Oxygen Masks
TSO-C89a Oxygen Regulators, Demand
TSO-C99 Protective Breathing Equipment
TSO-C103 Oxygen Mask Assembly, Continuous Flow (For Non-Transport Category Aircraft)
TSO-C116a Crewmember Portable Protective Breathing Equipment

2.1.5 EASA Publications

Available from European Aviation Safety Agency, Postfach 10 12 53, D-50452 Cologne, Germany, Tel: +49-221-8999-000, www.easa.eu.

REGULATIONS

CS 25.1443 Minimum mass flow of supplemental oxygen
CS 25.1447 Equipment standards for oxygen dispensing units
CS25 1439 Protective breathing equipment
AMC 25.1447 (c) Equipment Standards for Oxygen Dispensing Units

TECHNICAL STANDARD ORDER

ETSO-C64a Oxygen Mask Assembly, Continuous Flow, Passenger (For Air Carrier Aircraft)
ETSO-C78 Crew Member Demand Oxygen Masks
ETSO-C89 Oxygen Regulators, Demand
ETSO-C99 Protective Breathing Equipment
ETSO-C103 Oxygen Mask Assembly, Continuous Flow (For Non-Transport Category Aircraft)
ETSO-C116 Crewmember Portable Protective Breathing Equipment

2.2 Abbreviations and Definitions

AMC: Acceptable Means of Compliance

CRP: The Reference Point located at the intersection of seat and Bracket (Cushion Reference Point)

CS: Certification Specification (European Certification Requirements)

EASA: European Aviation Safety Agency

ETSO: European Technical Standard Order

FAA: Federal Aviation Administration

FFQDM: Full Face Quick Donning Mask

FL: Flight Level

QDM: Quick Donning Mask

TSO: Technical Standard Order

3. FLIGHT DECK

3.1 Flight Deck Crew Oxygen Mask Access Requirements

3.1.1 Pressurized Aircraft Operating Above 25000 Feet

For flight crew on duty when a loss of cabin pressure occurs, the donning of the crew mask and obtaining immediate access to supplemental oxygen is essential and should be the first step, prior to any other emergency procedures.

It is necessary that pilots and first officers have easy access to a Quick Donning Mask (QDM) connected to an always pressurized and ready to be used oxygen source that supplies oxygen regulated as a function of the cabin pressure altitude requirements to maintain the operational well-being of the crew. It is required that the crew member be able to grasp an oxygen mask of "rapid donning" design from the "ready" position with one hand and easily place the mask in proper and secure position on their face. They shall be breathing oxygen, and able to communicate within a maximum time period of five seconds from the time an indication of a pressurization failure has occurred. Due to regulation requirements, the successful passing of the 5 seconds crew oxygen mask donning test is a must.

Before conducting what is called the 5 second donning test, the flight deck of the airplane must be in the production configuration including seats, control columns, and any equipment that surrounds the pilot. A minimum of five donning attempts will be accomplished from each flight crewmember station, and the average time for each donning test must be five seconds or less as detailed in the FAA Policy Memo No. ANM-03-111-07.

Since crew member seats are sometimes provided with adjustment in three directions: (1) up and down, (2) side to side, (3) forward and reverse, the area location for ready donning, or what is termed to be the "ready" position, is extremely important and is restricted. This area is defined in Figure 3 for the left hand side of a crew member (opposite for the right hand side of a crew member). Figure 3 illustrates the typical crew mask reach lengths that have been evaluated as acceptable for an average-percentile tall subject to reach a stowed oxygen mask from a seated and belted position using the opposing hand from the stowed mask location. The perimeters of the defined arcs are determined to be the maximum reach distances of the subject's hand opposite from the stowed oxygen mask location. The reference points, as shown, are defined as the typical anthropomorphic vertical, lateral, and longitudinal pivot locations of the subject's arms relative to their torso in a seated configuration. The crew member should be keenly aware of the location of his/her mask and experienced in obtaining it with the proper hand-hold so that donning the mask is a "reflex". For additional flight deck occupants, requirements may be applicable as addressed in the FAA Policy Memo No. ANM-03-111-07.

3.1.2 Protective Breathing Equipment

Protective Breathing Equipment (PBE), in the form of a Full Face Quick Donning Mask (FFQDM), or the combination of an orinasal crew mask plus smoke goggles, or a Smoke Hood, must be readily accessible to the flight crew. Smoke hoods are designed to TSO-C116 and it is the airplane manufacturer's responsibility to ensure such equipment meets the applicable airplane requirements when installed. These parts are needed and installed to ensure the requirements of 14CFR Part 25, Section 25.1439, and 14CFR Part 121, Section 121.337 are met.

Protective Breathing Equipment, also known as smoke hoods, are used by the crew when fighting a fire. The hood is worn over the head to protect the crew member's eyes from smoke and to provide oxygen. It is important to note that there are different types of PBEs, the sedentary PBE which is used by the crew while flying the airplane, and the portable PBE which is provided so that a crew member can use it to freely move around the airplane. The second type of PBEs is needed so that the crew can investigate the sources of smoke as well as attempting to extinguish a cabin fire that may be discovered.

3.1.3 Pressurized Aircraft Operating Up to and Including 25000 Feet

Operations of pressurized aircraft between FL100 and FL250 are less critical as far as the urgency for oxygen is concerned. In some cases, a different type of oxygen system for crew members is utilized if the limitation of the aircraft flight altitude is based on FL250. It is, however, necessary that oxygen be provided. An oxygen dispensing unit and an operational plug-in for the unit must be within easy reach of either pilot while seated in their respective positions. The dispensing unit must be stowed within reach so that the crew member can attach the mask and don it conveniently without moving from his/her seated position.

Recommended locations for the mask have not been provided as there are a considerable number of such locations around the crew member seat. It is recommended, however, that the outlet be accessible as defined in 3.1.1. The same requirements will exist for any observer within the flight operations area.

3.1.4 Unpressurized Aircraft

When the mission of an unpressurized cabin airplane is between 10000 feet and 12000 feet, oxygen must be provided and used by each crew member on flight deck duty and must be provided for other crew members for any period beyond 30 minutes of flight at these levels. Above 12000 feet, oxygen must be provided for, and used by, each crew member on flight deck duty, and must be provided for all other crew members. For this reason, it is only essential that oxygen outlets be situated convenient to the crew member in a similar location as is defined in 3.1.1 of the document.

3.2 Quick Donning Mask and Hose Stowage

As the proper stowage of the crew oxygen mask and hose is important in order to ensure that the mask can be donned within the mandated five-second period, it is necessary for clear instructions describing the proper stowage to be outlined. Since oxygen systems may be used daily depending on the type of operation, it is essential that each stowage of the mask is done correctly and that packing procedures are applied. Knowledge of proper mask stowage can be just as important as the actual donning of the mask, since one is dependent on the other.

If proper stowage procedures are not followed, it is possible for the hose to become entangled. One common example of this is the harness becoming trapped in the facemask, thus forcing the use of a second hand in order to release it and properly don the mask. An illustration of the harness entangled in the mask is shown in Figure 1 below.

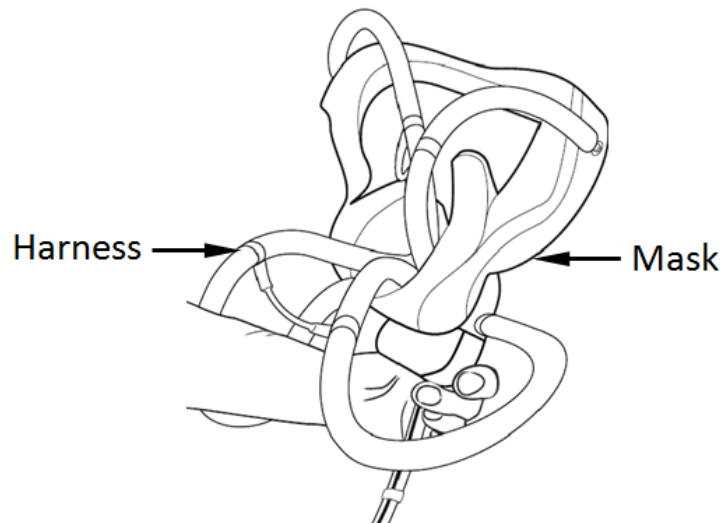


Figure 1 - Illustration of harness entangled in the mask

Improper stowage of the oxygen hose can also be problematic. If the oxygen hose is twisted when coiling it into the stowage box, it can reduce the operational length of the hose when extended as show in Figure 2 below.