Advisory Circular

Subject: **Carriage of Portable Oxygen Concentrators for Passenger Use on Board Aircraft**

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1.0 INTRODUCTION

(1) This Advisory Circular (AC) is provided for information and guidance purposes. It may describe an example of an acceptable means, but not the only means of demonstrating compliance with regulations and standards. This AC on its own does not change, create, amend or permit deviations from regulatory requirements nor does it establish minimum standards.

1.1 Purpose

(1) The purpose of this AC is to provide air operators with recommended procedures for the carriage of portable oxygen concentrators on board aircraft.

1.2 Applicability

(1) This document is applicable to commercial air operators conducting operations pursuant to Subpart 703, 704 and 705 of the *Canadian Aviation Regulations* (CARs).

1.3 Description of Changes

(1) Not Applicable.

2.0 REFERENCES AND REQUIREMENTS

2.1 Reference Documents

(1) It is intended that the following reference materials be used in conjunction with this document:

(a) Part 2 of the *Transportation of Dangerous Goods Regulations* (TDGRs);

(b) Part 12 of the TDGRs;

(c) Section 1.1.3 of Part 1 of the International Civil Aviation Organization *Technical Instructions for the Safe Transport of Dangerous Goods by Air* (ICAO TIs);

(d) Section 1.1.2 of Part 8 of the ICAO TIs;

(e) Paragraph 148(5)(b) of the *Air Transportation Regulations – Terms and Conditions of Carriage of Persons: Services*;

(f) Section 551.500 of the CARs – *Restraint of Carry-on Baggage*;

(g) Section 602.08 of the CARs – *Portable Electronic Devices*;

(h) Section 602.86 of the CARs – *Carry-on Baggage, Equipment and Cargo*;

(i) Section 703.14 of the CARs – *Operating Instructions*;

(j) Subsection 703.38(3) of the CARs – *Passenger and Cabin Safety Procedures*;

(k) Section 704.12 of the CARs – *Operating Instructions*;

(l) Subsection 704.33(5) of the CARs – *Apron and Cabin Safety Procedures*;

(m) Section 705.17 of the CARs – *Operating Instructions*;

(n) Subsection 705.40(4) of the CARs – *Passenger and Cabin Safety Procedures*;

(o) Section 705.42 of the CARs – *Carry-on Baggage*;

(p) *Commercial and Business Aviation Advisory Circular* (CBAAC) 0106R, dated July 4th, 2001 – *Use of Portable Passenger Operated Electronic Devices Onboard Aircraft and Occurrence Reporting*;

(q) CBAAC 0257, dated December 11th, 2006 – *Carriage of Medical Oxygen Cylinders for Passenger Use On Board Aircraft*;

(r) CBAAC 0260, dated March 20th, 2007 – *Potential for In-flight Fires Due to Lithium Battery Failure*;

(s) Canadian Transportation Agency, Decision no. 720-AT-A-2005 – *Accessible transportation complaints by various complainants against Air Canada and one complaint against WestJet regarding persons who require that medical oxygen be available to them when travelling by air*;

(t) United States *Special Federal Aviation Regulation* (SFAR) 106 – *Use of Certain Portable Oxygen Concentrator Devices Onboard Aircraft*;

(u) United States Federal Aviation Administration (FAA) Advisory Circular (AC) 91-21.1B – *Use of Portable Electronic Devices Aboard Aircraft*;

(v) RTCA Inc., Section 21, Category M, of RTCA/DO-160E – *Environmental Conditions and Test Procedures for Airborne Equipment*;

(w) United Kingdom Civil Aviation Authority (CAA) Paper 2003/4 – *Dealing With In-Flight Lithium Battery Fires in Portable Electronic Devices*; and

(x) United States FAA Safety Alert for Operators (SAFO) 07002 – In-Flight Fires Caused by Lithium Ion and Lithium Battery Failures.

2.2 Cancelled Documents

(1) Not applicable.

2.3 Definitions and Abbreviations

(1) The following definitions and abbreviations are used in this document:

(a) **Medical Oxygen** means oxygen that has been prescribed by a physician for use by an individual.

(b) **Oxygen, compressed (UN1072)** means a compressed gas in a cylinder at a pressure of 280 kPa or more as defined in paragraph 2.14(b) of the TDGRs.

(c) **Portable oxygen concentrator** means the medical device units approved pursuant to United States SFAR 106 – *Use of Certain Portable Oxygen Concentrator Devices Onboard Aircraft*, which include the following:

(i) AirSep Freestyle;

(ii) AirSep Lifestyle;

(iii) Inogen one;

(iv) SeQual Eclipse; and

(v) Respironics EverGo.

3.0 BACKGROUND

(1) Passengers who require medical oxygen are dependent upon the oxygen for medical reasons, are under a physician's care and require prescribed oxygen similar to a person requiring a prescribed drug.

(2) The CARs requirement to carry oxygen on an aircraft is for use during a decompression, for supplemental and first aid purposes. There are no operational regulations pertaining to passenger use of oxygen for medical reasons or prohibiting the use of medical oxygen.

(3) In the absence of any CARs addressing operational requirements, there are variances amongst individual Canadian air operator policies regarding the carriage and operation of medical oxygen equipment for passenger use.

(4) A number of concerns have been expressed by passengers who require the use of medical oxygen on board an aircraft:

(a) Passengers who require medical oxygen can experience difficulty in respiration due to such illnesses as chronic bronchitis, severe anaemia, chronic obstructive pulmonary disease, cardiac disease, emphysema, etc.

(b) It is important that the oxygen equipment be capable of providing a variable flow rate as the passenger prescription is established for the individual's medical condition. Air operator provided oxygen flow rates are generally a fixed flow rate of 2 or 4 litres per minute (LPM), versus the variable flow capability of the portable oxygen concentrator.

(c) Passengers requiring medical oxygen may encounter physical and physiological problems when their prescribed flow rate is not available on air operator provided oxygen equipment.

(d) Further respiratory difficulties may also be encountered due to the environmental change from ground level to the lower partial pressure of oxygen present at cabin pressure altitudes of up to 8,000 feet (2,400 metres).

(e) Many air operators do not provide a medical oxygen service for passengers and those that do provide the service often charge a fee.

(f) It can be difficult to coordinate the provision of a medical oxygen service between the air operator and an oxygen supplier to ensure that the service is available both on board the aircraft and while the passenger is on the ground at enroute stops. This can result in the passenger travelling without medical oxygen due to service-related problems.

(5) The Canadian Transportation Agency (the Agency), Accessible Transportation Directorate, continues to receive complaints from Canadian medical oxygen users regarding the lack of standardization amongst Canadian air operators related to the acceptance and use of medical oxygen on board aircraft. This lack of standardization may be seen as an obstacle to the mobility of persons who are dependent upon medical oxygen.

(6) The Agency has determined, through Decision no. 720-AT-A-2005 – *Accessible transportation complaints by various complainants against Air Canada and one complaint against WestJet regarding persons who require that medical oxygen be available to them when travelling by air*, that persons who may require medical oxygen when they travel by air do encounter obstacles to their mobility. The Agency has announced that it will conduct a review to determine whether or not those obstacles are "undue" under the *Canada Transportation Act* and, if so, what corrective measures may be appropriate to address them.

(7) In Canada, air operators are not required to permit the use of medical oxygen on board but may elect to either provide a medical oxygen service or permit the carriage of medical oxygen for passenger use. An air operator that does choose to permit the use of medical oxygen may accept it for carriage on board aircraft in two forms:

(a) Contained within a compressed oxygen cylinder (either supplied by the air operator or supplied by the passenger as described in CBAAC 0257 – *Carriage of Medical Oxygen Cylinders for Passenger Use On Board Aircraft*); and

(b) Provided by a portable oxygen concentrator.

(8) Unlike Oxygen, compressed (UN1072), which is classified as a dangerous good, portable oxygen concentrators do not contain oxygen.

(9) A portable oxygen concentrator is an electronic device used to provide oxygen at a substantially higher concentration (≈ 90%) than that of ambient air and is an alternative to using compressed oxygen cylinders. Portable oxygen concentrators do not have the safety concerns associated with the use of compressed oxygen cylinders on board aircraft, as there is no oxygen present in the device itself.

(10) Rather, portable oxygen concentrators function by filtering nitrogen from ambient air and delivering oxygen in concentrated form to the user. The simplest oxygen concentrator is capable of continuous delivery of oxygen and has internal functions consisting of two cylinders, filled with a zeolite material, which selectively absorb the nitrogen in the air.

(11) Portable oxygen concentrators are categorized as a medical portable electronic device (M-PED). In order to be acceptable for use on board aircraft, they should be designed and tested by the manufacturer in accordance with Section 21, Category M, of RTCA/DO-160E – *Environmental Conditions and Test Procedures for Airborne Equipment*. Portable oxygen concentrators that are certified by the manufacturer as falling within the emission levels contained in this document, in all modes of operation, may be used on board the aircraft without any further testing by the air operator.

(12) A portable oxygen concentrator that has not been certified by the manufacturer as falling within the emission levels contained in RTCA/DO-160E – *Environmental Conditions and Test Procedures for Airborne Equipment* should be evaluated by the air operator to determine that the unit does not cause interference with the electrical, navigation or communication equipment on board the air operator's aircraft.

(13) The United States permits passengers to use five different kinds of portable oxygen concentrator units on board commercial aircraft, with the approval of the aircraft operator. AirSep Corporation, Inogen Inc., Respironics, and SeQual Technologies manufacture these acceptable devices, which are identified in SFAR 106. It should be noted that the SFAR does not require an aircraft operator to allow passengers to use these devices on board. However, if an aircraft operator chooses to grant approval for a passenger to operate these devices on board an aircraft, then the conditions of the SFAR must be met.

4.0 SAFETY CONSIDERATIONS OF SPARE BATTERIES

(1) Portable oxygen concentrators typically operate using either rechargeable batteries or AC/DC electrical power via an external power cord. As it may be necessary for passengers to carry a number of spare batteries to provide power to the portable oxygen concentrator for the duration of the flight(s), certain precautions are necessary to address emerging safety issues associated with the carriage of batteries.

(2) Incident data and safety studies related to the potential hazard posed by battery abuse and short circuits during the transportation of batteries indicate that preventive measures are necessary to mitigate the potential risk of injury and on board fire posed by damaged batteries.

(3) Although the portable oxygen concentrator units themselves are not considered as dangerous goods, the lithium or lithium ion batteries often used to power these units are dangerous goods. Therefore, when transported as cargo or checked baggage with the battery installed, the portable oxygen concentrator would be fully regulated and may be transported in compliance with the packaging, marking, documentation and handling requirements specified in the TDGRs and ICAO TIs.

(4) When carried by passengers in the cabin of the aircraft, the portable oxygen concentrator units are not regulated by the provisions of the TDGRs and ICAO TIs. Rather, they are eligible for an exception related to the carriage of consumer electronic devices, where the device contains lithium or lithium ion cells or batteries.

(5) In accordance with the TDGRs, spare batteries shall be individually protected to prevent short circuits, may be carried as carry-on baggage only and shall not be transported as cargo or checked baggage. In addition, each spare battery must not exceed the following quantities:

(a) For lithium metal or lithium alloy batteries, a lithium content of not more than 2 grams; and

(b) For lithium ion batteries, an aggregate equivalent lithium content of not more than 8 grams.

(6) Lithium ion batteries with an aggregate equivalent lithium content of more than 8 grams but not more than 25 grams may be carried as carry-on baggage if they are individually protected to prevent short circuits and are limited to two spare batteries per person.

(7) Protection from short-circuits may be achieved with batteries incorporating recessed terminals, insulation of exposed terminals, or packaging that will prevent the terminals from contacting any metal objects.

5.0 PROCEDURES

(1) Passengers requiring the use of medical oxygen on board the aircraft may carry and use their own portable oxygen concentrator unit as described in this document provided the air operator approves and has established appropriate procedures.

(2) The air operator procedures should normally include the following:

(a) An evaluation to determine that the portable oxygen concentrator does not cause interference with the electrical, navigation or communication equipment on board the air operator's aircraft;

(b) Where applicable, confirmation of medical clearance with the air operator's medical advisor, in consultation with the passenger's licensed physician or other licensed health professional such as a respiratory therapist;

(c) The boarding, stowage and restraint of medical oxygen equipment conforms with the following:

(i) The portable oxygen concentrator and any accessories are stowed under a passenger seat equipped with a forward and sideward means of restraint, or in another approved stowage location, during movement on the surface, take off, landing and at other times carry-on baggage is required to be stowed;

(ii) The oxygen equipment does not exceed the maximum weight restrictions approved for the area where the equipment is required to be stowed; and

(iii) Where applicable, the air operator's carry-on baggage control program, required pursuant to section 705.42 of the CARs, contains provisions for oxygen equipment and accessories that are provided by the passenger and such equipment is within the parameters for the approved carry-on baggage control program;

(d) The passenger requiring medical oxygen is seated in a location:

(i) Where the oxygen equipment will not restrict access to, or use of, any emergency/safety equipment, or access to any aisle or exit; and

(ii) That in the event of an emergency landing requiring evacuation, access to an aisle would not be obstructed by the hose of the portable oxygen concentrator;

(e) The pilot-in-command is advised prior to flight that medical oxygen will be in use during the flight; and

(f) The passenger is provided with an individual pre-flight safety briefing that includes the following:

(i) In the event of an on-board fire, the passenger and portable oxygen concentrator should be moved to a location away from the fire; and

(ii) In the event of an emergency requiring an evacuation, the oxygen equipment should be left on board the aircraft.

(3) Prior to travelling, the air operator should inform passengers requiring the use of a portable oxygen concentrator while on board the aircraft of their responsibilities as follows:

(a) The passenger should ensure that the unit is in good condition, free from contamination (such as oil and grease) and has no visible signs of damage or abuse.

(b) The passenger should have the cognitive and sensory capacity to detect any alarm indications associated with the operation of their portable oxygen concentrator and be capable of responding to problems with the operation of the unit;

(c) The passenger should ensure that they have sufficient battery power to provide an adequate supply of oxygen for the duration of their travel time. Factors to take into consideration to determine the adequacy of oxygen supply are whether oxygen is medically necessary for all or a portion of the travel time, the duration of the flight (including connecting flights), the duration of time spent on the ground (prior to departure, during enroute stops and following arrival at destination) as well as an appropriate reserve in case of unforeseen operational circumstances; and

(d) The passenger must ensure that spare batteries for the portable oxygen concentrator are carried as carry-on baggage only and are individually packaged to protect them from damage or short-circuit.

(4) The air operator should publish established procedures in its company operations manual, flight attendant manual and any other appropriate location that will provide information to persons who require such information for the performance of their duties.

6.0 DOCUMENTATION

(1) Passengers requiring the use of medical oxygen should be requested to provide documentation signed by a licensed physician or other licensed health professional such as a respiratory therapist, that indicates the maximum quantity of oxygen required for the flight(s).

(2) In order to conform with the United States regulatory requirement specified in SFAR 106, it is recommended that air operators request the medical oxygen user to provide a written statement, which should be kept in that person's possession, signed by a licensed physician that:

(a) States whether the user of the device has the physical and cognitive ability to see, hear and understand the device's aural and visual cautions and warnings and is able, without assistance, to take the appropriate action in response to those cautions and warnings;

(b) States whether or not oxygen use is medically necessary for all or a portion of the duration of the trip; and

(c) Specifies the maximum flow rate corresponding to the pressure in the cabin of the aircraft under normal operating conditions.

7.0 CONCLUSION

(1) Air operators should take the content of this Advisory Circular into account when developing or amending procedures related to the carriage and use of portable oxygen concentrators for the provision of medical oxygen on board their aircraft.

8.0 CONTACT OFFICE

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Suggestions for amendment to this document are invited and should be submitted via the Transport Canada Civil Aviation Issues Reporting System (CAIRS) at the following Internet address:

http://www.tc.gc.ca/CivilAviation/QualityAssurance/QA/cairs.htm

or by e-mail at: CAIRS_NCR@tc.gc.ca

Original Signed By

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