European Aviation Safety Agency

Deviation request #55 for an ETSO approval for CS-ETSO applicable to Crewmember Oxygen Mask (ETSO-2C78) and Oxygen Regulators, Demand (ETSO-C89) Consultation Paper

1. Introductory note

The hereby presented deviation requests shall be subject to public consultation, in accordance with EASA Management Board Decision No 7-2004[1] products certification procedure dated 30 March 2004, Article 3 (2.) of which states:

"2. Deviations from the applicable airworthiness codes, environmental protection certification specifications and/or acceptable means of compliance with Part 21, as well as important special conditions and equivalent safety findings, shall be submitted to the panel of experts and be subject to a public consultation of at least 3 weeks, except if they have been previously agreed and published in the Official Publication of the Agency. The final decision shall be published in the Official Publication of the Agency."

2. ETSO-2C78 - Crewmember Oxygen Mask
ETSO-C89 - Oxygen Regulators, Demand

ETSO-2C78#1 and ETSO-C89#7

Requirement: Leakage
ETSO- 2C78 Appendix 1 §3.3(a)

The total inward leakage rate, with the complete mask positioned on the face or on a suitable test stand in a manner which simulates normal use, must not exceed 0.10 LPM STPD at any negative differential pressure within the range of from zero to 1.5 KPa (6.0 inches of water).

ETSO-C89 FAA standard § 4.4 (a)

The inward leakage of air through the regulator at sea level must not exceed 0.1 LPM, STPD, with a suction pressure of 1.0 inches H2O applied to the outlet port, the oxygen supply inlet port sealed, and the diluter valve closed.

Industry: Industry requests authorization to deviate from the above mentioned paragraphs by using the TSO-C89a inward leakage requirement as called in the SAE standard AS8027 §3.2.2.2. for mask mounted regulator (type IV device).

The TSO-C89a standard takes into account the regulator being mask mounted (Type IV device). Its inward leakage requirement includes regulator, mask interface and valving. This requirement corresponds with MC40 series mask regulator design.

For the MC40, the regulator being mask-mounted to compose a single piece of equipment, the inward leakage on the mask can't be distinguished from the inward leakage of the regulator. So for the MC40, we propose to cumulate the mask and regulator inward leakage limits.

[1] Cf. EASA Web: http://www.easa.europa.eu/ws_prod/g/doc/About_EASA/Manag_Board/2004/mb_decision_0704.pdf

The TSO-C89a maximum mask-regulator inward leakage is 0.2 L/min STPD. That corresponds to the sum of the maximum mask inward leakage (0.1 L/min STPD) as in ETSO-2C78 § 3.3. (a) and the maximum regulator inward leakage (0.1 L/min STPD) as in ETSO-C89 § 4.4 (a).

For information, this test corresponds to the inward test performed on current ETSO/TSO already agreed INTERTECHNIQUE quick donning masks regulators. This deviation has already been accepted by JAA for mask regulator MLD20 Series and MRA Series [JTSO F.O.073 (22/12/1997) and JTSO F.O.007 (27/10/1999)].

EASA: We accept the deviation as an alternate means to meet the requirement because current SAE standard AS8027 is used as the basic technical standard for certification of crew oxygen regulators in the updated FAA TSO C89A. The TSO C89A includes the possibility for the oxygen regulator (type IV) to be integrated in the mask according to the last technological developments; it exempts such new design from some not feasible tests without lowering the equipment safety level.

ETSO-C89#8

Requirement: Proof pressure outlet procedure
ETSO-C89 FAA standard § 4.5 (b)

> *Straight demand and diluter demand regulators must comply with paragraphs 4.1 through 4.4 after a negative pressure of 29 inches H2O and a positive pressure of 12 inches H2O are applied to the outlet port for a period of 2 minutes. The diluter valve and the regulator inlet port must be closed during these two pressure tests.*

Industry: Industry requests authorization to deviate from the above mentioned paragraph by using the TSO-C89a outlet proof pressure procedure as called in the SAE standard AS8027 §3.2.1.2 & 3.2.1.3 for mask mounted regulator (type IV device).

The exhalation valve is a part of the regulator design. Therefore, if the outlet port is submitted to a **positive** pressure (about 0.7 mbar), the exhalation valve will open before reaching the 30 mbar requested for the test. It is not possible to apply a **positive** pressure of 30 mbar in MC40 series regulator and thus, it is not possible to perform this part of the test.

This design characteristic is taken into account by the AS8027 standard with the type IV regulator (mask mounted) which corresponds to MC40 regulator design. Only the 72 mbar **negative** pressure is applied on the outlet port of type IV devices to perform the outlet proof pressure.

EASA: We accept the deviation as an alternate means to meet the requirement because current SAE standard AS8027 is used as the basic technical standard for certification of crew oxygen regulators in the updated FAA TSO C89A. The TSO C89A includes the possibility for the oxygen regulator (type IV) to be integrated in the mask according to the last technological developments; it exempts such new design from some not feasible tests without lowering the equipment safety level.

ETSO-2C78#2 and ETSO-C89#9

Requirement: Inspiratory resistance
ETSO- 2C78 Appendix 1 §3.4(a)

The inspiratory resistance of the mask and oxygen supply tube including the oxygen supply connector when inserted in an appropriate mating fitting must not exceed the following negative differential pressures at the corresponding oxygen flow rates:

Differential Pressure KPa (inches H_2O)	*Flow Rate (LPM)*
0.15 (0.6)	*20*
0.37 (1.5)	*70*
0.62 (2.5)	*100*

ETSO-C89 FAA standard § 4.1 (a)

Demand regulators must supply the following oxygen or oxygen-air flows at not more than the specified outlet pressures. These characteristics must be displayed at all altitudes, with the oxygen supply pressure at al1 values within the design inlet pressure range, and with the diluter valve open and closed.

MAXIMUM OUTLET FLOW, LPM, ATPD:		*SUCTION PRESSURE, INCHES OF WATER*
20	----------	*0.40*
70	----------	*0.80*
100	----------	*1.00*

Industry: The regulator being mask-mounted and thus integrating the entire inspiratory circuit (valves and ducts), we propose to perform the inspiratory resistance test on the regulator only and cumulated the maximum mask inspiratory resistance (ETSO C78 § 3.4 (a)) and the maximum regulator inspiratory resistance (ETSO C89 § 4.1 (a)).

The maximum mask-regulator inspiratory resistance considered for the test is defined as follows:

Flow (L/min STPD)	Suction pressure in inches H_2O (mbar)		
	ETSO-2C78 § 3.4 (a)	ETSO-C89 § 4.1 (a)	TSO-C89a § 3.2.3 (type IV)
20	0.6 (1.50)	0.4 (1.0)	1.0 (2.5)
70	1.5 (3.75)	0.8 (2.0)	2.3 (5.7)
100	2.5 (6.25)	1.0 (2.5)	3.5 (8.7)

For information, this deviation has already been accepted by JAA for mask regulator MLD20 Series and MRA Series [JTSO F.O.073 (22/12/1997) and JTSO F.O.007 (27/10/1999)].

EASA: We accept the deviation as an alternate means to meet the requirement because current SAE standard AS8027 is used as the basic technical standard for certification of crew oxygen masks and regulators and their installation on FAA part 25 aircraft. in the updated FAA TSO C89A. It includes the possibilities that the oxygen regulator can be integrated in the mask (type IV) according to the last technological developments. It exempts for such new design some not feasible tests without lowering the equipment safety level.

ETSO-C89#10

Requirement: Outlet and Overall leakage
ETSO-C89 FAA standard § 4.4 (c) [outlet leakage]

> *The regulator outlet leakage must not exceed 0.01 LPM, STPD, with the regulator outlet port open and any oxygen supply pressure within the specified operating range applied at the regulator inlet port.*

ETSO-C89 FAA standard § 4.4 (d) [overall leakage]

> *The regulator overall leakage must not exceed 0.01 LPM, STPD, with the regulator outlet port sealed and the regulator inlet port pressurized to a value equal to the maximum specified oxygen supply pressure.*

Industry: The exhalation valve being part of the regulator, the regulator outlet leakage (ETSO-C89 §4.4 (c)) and the regulator overall leakage (ETSO-C89 4.4 (d)) cannot be measured separately. As detailed in Figures 1 and 2, the outlet leakage becomes an overall leakage as soon as the outlet port is plugged or restricted.

We propose to perform only one regulator leakage test and cumulate the maximum outlet leakage (0.01 L/min STPD as per TSO-C89 § 4.4. (c)) and the maximum overall leakage (0.01 L/min STPD as per TSO-C89 § 4.4 (d)). Though, the maximum regulator leakage considered for the test is 0.02 L/min STPD.

For information, this deviation has already been accepted by FAA for mask regulator MF20 Series [TSO document ref: GE/vk/12/04/Intertechnique (04/12/1998)].

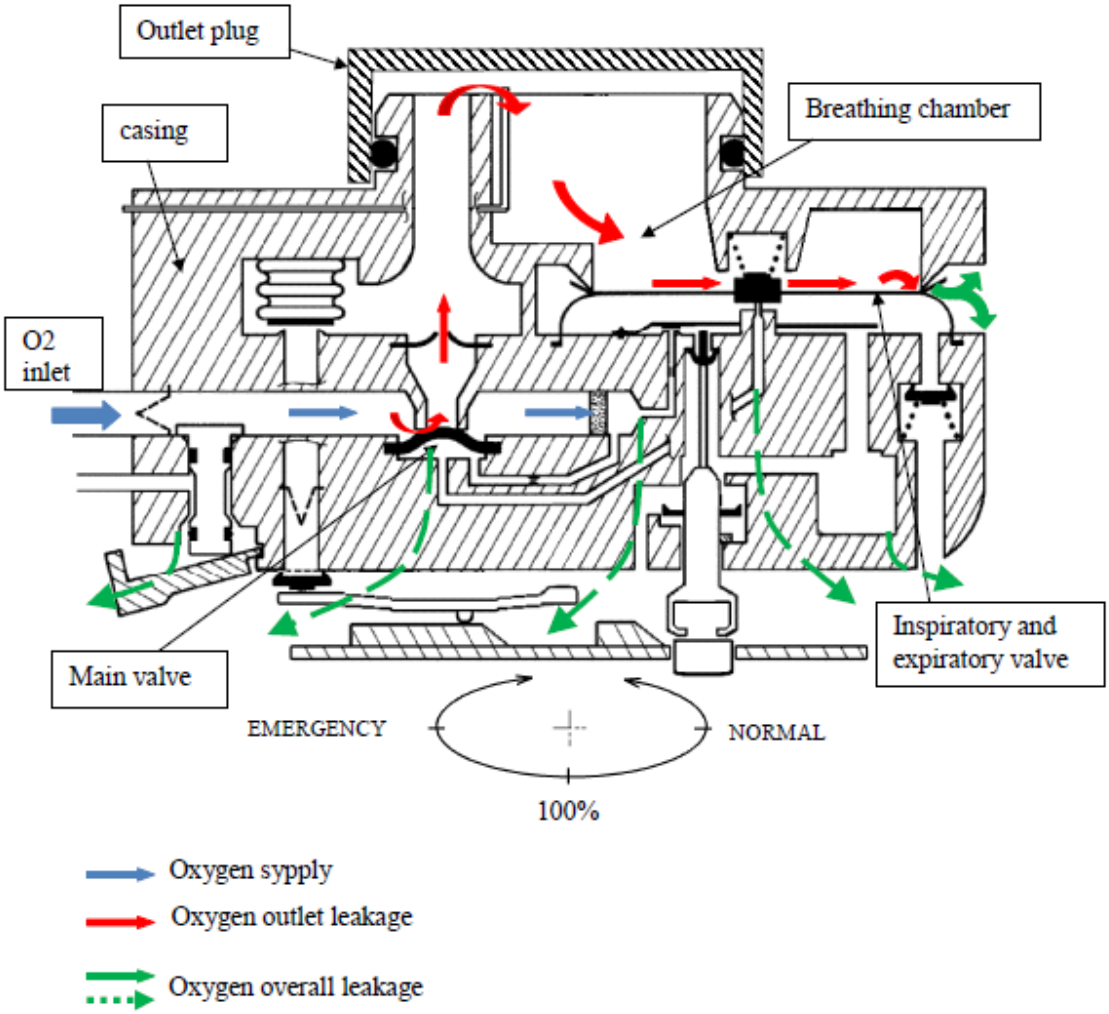

FIGURE 1: REGULATOR OVERALL LEAKAGE

Due to expiratory valve, it is not possible to identify and measure separately outlet leakage and overall leakage.

To perform the overall leakage, the regulator outlet is plugged. If the regulator has an outlet leakage, the only possibility is a leak from the oxygen supply inlet to the regulator outlet between the main valve and the casing. With the outlet plug, the leak will increase the pressure in the breathing chamber and will be considered as expiration by the expiratory valve.

The expiratory valve will open under the breathing pressure chamber increase (around 0.7 mbar) and the outlet leakage becomes a part of the regulator overall leakage.

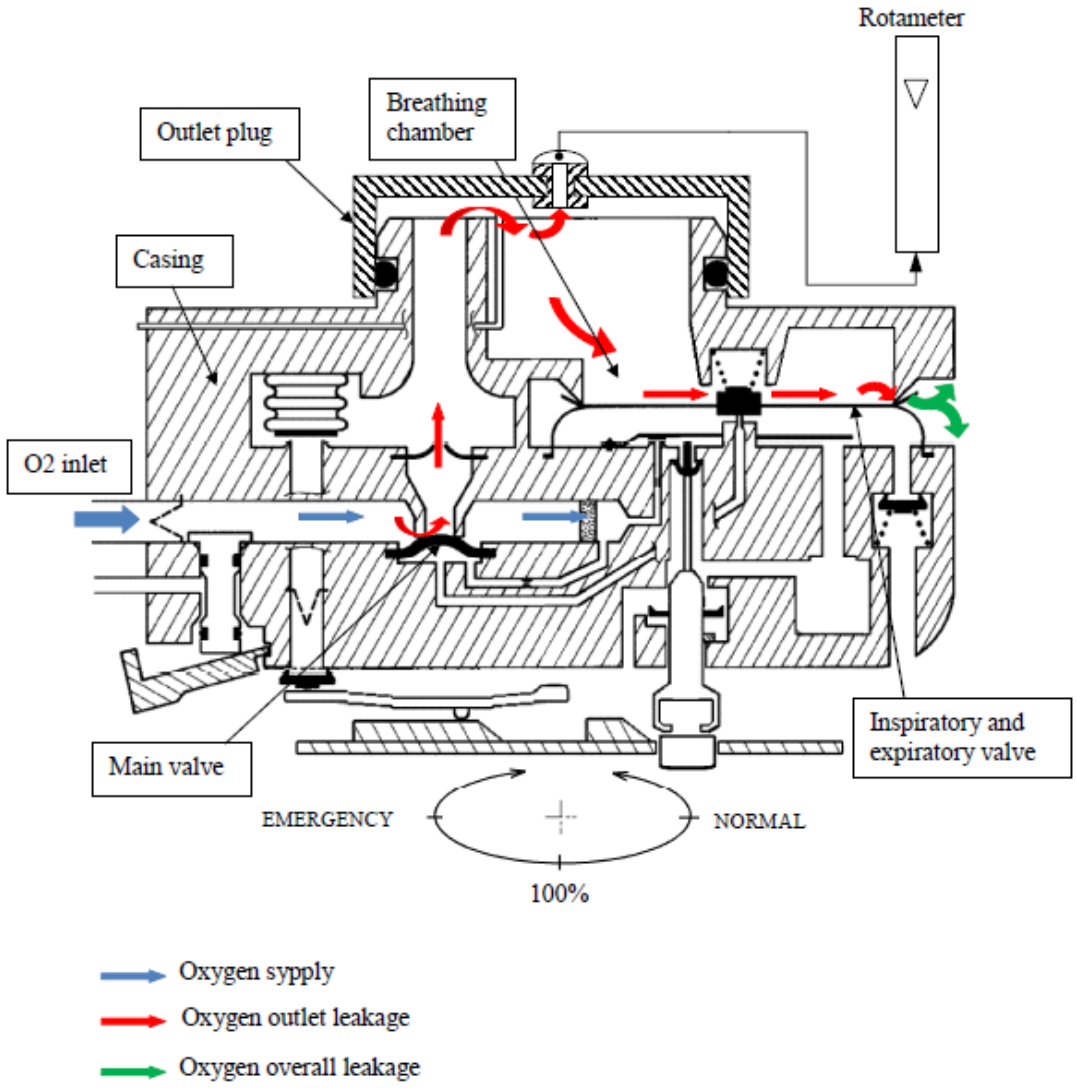

FIGURE 2: REGULATOR OUTLET LEAKAGE

Due to expiratory valve, it is not possible to identify and measure separately outlet leakage and overall leakage.

To perform the outlet leakage, the regulator outlet is restricted and the leakage measured with a rotameter. If the regulator has an outlet leakage, the only possibility is a leak from the oxygen supply inlet to the regulator outlet between the main valve and the casing. With the outlet restriction, the leak will increase the pressure in the breathing chamber and will be considered as expiration by the expiratory valve.

The expiratory valve will open under the breathing pressure chamber increase (around 0.7 mbar) and the outlet leakage becomes an overall leakage not measured by the rotameter.

EASA: We agree to the deviation because in the new generation crew oxygen mask regulator design, being the regulator integrated with the mask, the exhalation valve is part of the regulator itself, therefore the regulator outlet and overall leakage cannot be measured separately as explained in the industry position.