



**NSW
Resources
Regulator**

TECHNICAL REFERENCE GUIDE

ESCAPE BREATHING APPARATUS FOR UNDERGROUND MINING APPLICATIONS

Standards for design and ongoing monitoring

Document control

Published by NSW Resources Regulator

Title: Technical reference guide: Escape breathing apparatus for underground mining applications
(Standards for design and ongoing monitoring)

First published: July 2015 (as MDG 3609)

Authorised by: Chief Inspector, NSW Resources Regulator

CM9 reference: DOC20/773589

AMENDMENT SCHEDULE

Date	Version	Amendment
April 2015	1	First published
October 2020	2	<p>This Technical reference guide replaces MDG 3609 (2015). Updated section 1.4 to include reference to clause 44(3) of the Work Health and Safety Regulation 2017. Amended Tables 6.1 and 6.2 to enable in-service testing to be carried out up until the manufacturer’s recommended service life. Updated definitions (section 1.7) of ‘recognised test authority’, ‘Regulator’ ‘Cached’, and ‘Extended usage’. Minor wording updates in response to stakeholder feedback to sections 1.11.1, 1.12, 2.2.3, and 7.1. Updated section 4.1 and Table 5.3 in response to stakeholder feedback to change the inhalation temperature performance criteria for new carbon monoxide filter self-rescuers to ≤55°C. Removed Appendix D Informative references due to out-dated information.</p>

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Disclaimer: The information contained in this publication is based on knowledge and understanding at the time of writing (May 2021). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of the Department of Regional NSW or the user’s independent advisor.

DOC20/773589

Foreword

This document sets out standards for the design and ongoing performance of breathing apparatus to assist escape (including self-rescuers) for use in underground mines and includes procedures for the in-service testing of self-rescue breathing apparatus.

The performance criteria required for the design, ongoing performance and the maintenance of registration by in-service testing of breathing apparatus (including self-rescuers) has been identified by NSW and Qld industry working groups.

An important premise of performance testing is that any failure in a sample of about 1% of breathing apparatus units signals a problem that requires further investigation.

This document represents a culmination of overseas escape strategies, testing and evaluation of self-rescue chemical oxygen apparatus, compressed air and oxygen breathing apparatus, as well as our own experiences with such apparatus.

The constructive evaluation and input provided by manufacturers and suppliers is gratefully acknowledged.

Garvin Burns
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1. Scope and general

1.1. Scope

This guide sets out standards for design, ongoing performance and maintenance of breathing apparatus to assist escape (including self-rescuers) from the underground parts of a mining operation.

There are two broad areas that this document covers:

- the design standards in Sections 2 to 4 for the design, testing and performance
- pre-release testing, ongoing monitoring of apparatus in service and general maintenance requirements in Sections 5 to 7.

Compliance with this standard does not negate the designer's work health and safety duties under section 22 of the *Work Health and Safety Act 2011*.

1.2. Application

This guide is applicable to the design of all breathing apparatus to assist escape (including self-rescuers) intended to be design registered under clause 177(5) of the Work Health and Safety (Mines and Petroleum Sites) Regulation 2014 (WHS (MPS) Regulation) and Part 5.3 of the Work Health and Safety Regulation 2017.

Note: Applications for registration are to be made using the appropriate form found on the NSW Resources Regulator's website.

1.3. Referenced documents

All references to the following standards in this guide is a reference to such standard, as amended from time:

- AS/NZS 1716:2012: *Respiratory protective devices*
- BS EN 13794:2002: *Respiratory protective devices. Self-contained closed-circuit breathing apparatus for escape. Requirements, testing, marking*

1.4. Relationship with NSW Regulation

Under clause 100 (1) of the WHS (MPS) Regulation, “the mine operator of an underground mine (other than an opal mine) must ensure that a person who is to go underground is provided with an appropriate self-rescuer if there is a risk of an irrespirable atmosphere at the underground mine (including during an emergency)”.

The maintenance of Personal Protective Equipment is required under clause 44 (3) (b) of the Work Health and Safety Regulation 2017.

1.5. Relationship with AS/NZS 1716:2012

In the event of any inconsistency with provisions of AS/NZS 1716:2012, this guide prevails.

1.6. Abbreviations

AS	Australian Standard
AS/NZS	Australian/New Zealand Standard
BS EN	British Standard European Standard
BTPS	Body temperature and pressure saturated (37°C, ambient pressure and saturated)
EN	European Standard
NTP	Normal temperature and pressure i.e. 23°C and 101.3 kPa
TRG	Technical reference guide produced by the NSW Resources Regulator and published on the Regulator’s website.
WHS (MPS) Regulation	Work Health and Safety (Mines and Petroleum Sites) Regulation 2014

1.7. Definitions

In this guide the definitions given in AS/NZS 1716:2012 apply.

In addition, the following definitions apply:

1.7.1. Body-worn

Body-worn refers to a unit that has at any time been issued to be worn by a person. Units which are stored on a vehicle are equivalent to body-worn units.

1.7.2. Breathing apparatus to assist escape (including self-rescuers)

Breathing apparatus to assist escape including self-rescuers is described as escape breathing apparatus in this guide and covers the following types of apparatus

- Chemical oxygen self-contained self-rescuers (chemical oxygen apparatus);
- Carbon monoxide filter self-rescuers also called Filter self-rescuers;
- Compressed air self-contained breathing apparatus (compressed air apparatus); and
- Compressed oxygen self-contained breathing apparatus (compressed oxygen apparatus).

1.7.3. Cached

Refers to an escape breathing apparatus that has been stored underground in a cache.

Note: A *cache* is defined in clause 3 of the WHS (MPS) Regulation.

1.7.4. Certificate of compliance

Certificate issued by a recognised test authority verifying that the examined escape breathing apparatus of a particular model, made in a particular calendar year, complies with the relevant registration requirements.

1.7.5. Change over

Change over means the process of donning a fresh rescuer and removing a spent rescuer while in an irrespirable atmosphere.

1.7.6. Dust (in reference to filter self-rescuers)

Dust (in reference to filter self-rescuers) is residue in a filter self-rescuer casing due to breakdown of its chemical components.

1.7.7. Examination

Examination refers to an inspection to determine the condition of the breathing apparatus. This may involve visual inspection and/or testing to verify the performance of equipment.

1.7.8. Extended usage

Extended usage refers to the time between the rated duration and exhaustion of the chemical or collapse of the breathing bag when the breathing apparatus is subjected to a breathing simulator test at a breathing rate of 35 litres per minute (as per the requirements of AS/NZS 1716:2012 section 11.3.3).

1.7.9. In-service

In-service refers to a unit that has been issued for use underground and has not been removed from service, and includes units that are body-worn or cached. Units which are stored on mobile equipment are equivalent to body-worn units.

1.7.10. Must

Mandatory for compliance with this document.

1.7.11. Operator

A mine, rescue station, contractor or other organisation that uses escape breathing apparatus.

1.7.12. Rated duration

Rated duration means the duration in minutes that the breathing apparatus complies with the assessment criteria when subjected to testing on a breathing simulator at the prescribed breathing rate and CO₂ delivery rate.

The rated duration cannot be greater than the nominal duration.

1.7.13. Recognised test authority

A recognised test authority is a test facility which is unrelated to the designer, manufacturer or supplier and must be:

- a. the Department of Regional NSW, Mine Safety Technology Centre, Thornton NSW; or

- b. a facility in Australia that is accredited by the National Association of Testing Authorities (NATA) for performing the specific tests described in the standards referred to in any design order for breathing apparatus to assist escape (including self-rescuers) made by the regulator under clause 177(5) of the WHS (MPS) Regulation
- c. where a NATA-accredited facility is not available, a suitably qualified and experienced independent testing facility with regard to test equipment, equipment calibration, quality processes, work methods, past test experience and independent technical verification.

1.7.14. Regulator

The Regulator is as defined in the *Work Health and Safety (Mines and Petroleum Sites) Act 2013*.

1.7.15. Self-rescuer

Self-rescuer is a type of breathing apparatus that is normally worn on a person's belt and used to assist their escape in an emergency. They can also be stored in a cache.

1.7.16. Service life

Service life means the number of years from the date of manufacture after which a unit must be discarded. Manufacturers may state a different service life for a unit depending on its storage and handling (e.g. cached or body worn).

1.7.17. Stored

Stored refers to a unit that is held in stationary storage, has never been in service, and is not cached.

1.7.18. Supplier

Supplier means an Australian manufacturer, or an Australian representative of a manufacturer, of breathing apparatus, that supplies this apparatus directly to users. Or a mining organisation that imports escape breathing apparatus directly from a manufacturer.

1.7.19. Test report

A test report is a report provided by a recognised test authority giving results of examination and testing as specified in this TRG.

1.8. Tolerances for performance testing

Except for temperature limits, values that are not stated as maxima or minima must be subjected to a tolerance of $\pm 5\%$.

Unless otherwise specified, temperature limits in this guide must be subject to a tolerance of $\pm 1^\circ\text{C}$. Fast response 0.05mm diameter thermocouples must be used for these measurements.

Unless otherwise specified, the ambient temperature for testing must be $23 \pm 3^\circ\text{C}$.

Gas concentrations for performance limits are expressed by volume at NTP on a dry basis. Gas volumes are measured at BTPS unless otherwise specified.

1.9. Certificate of compliance

When issued, a certificate of compliance must indicate:

- A clearly visible identification of the self-rescuers represented by the sample(s) tested; and
- the date of expiry of the certificate in accordance with the appropriate examination schedule below.
- A certificate of compliance must not be issued unless the equipment complies in all respects with the requirements for registration, unless otherwise allowed in this guide.

Where several units of a particular make and model made in a particular calendar year, are tested at various times during the course of a year, the units will have several test reports. However, only one certificate of compliance needs be issued in relation to these units.

1.10. Monitoring programs

There are various levels of monitoring. Some may be carried out at the mine site by trained site personnel, while others may be carried out at the mine site or elsewhere by a technician authorised by the supplier.

There are three options with respect to the submission of samples:

- a. By a single user or mine
- b. By a user or group of users

A user or group of users may elect to submit a sample representing their combined number of rescuers. If this is done, the user or group of users must notify the Regulator in writing of the arrangement that is to be put in place, nominating the body (for example, a mine or mining

company or other organisation) that will accept responsibility for operating the monitoring scheme.

c. By the supplier or other provider

The supplier or other provider may be engaged to arrange for samples of apparatus in service at work sites to be given to a recognised test authority. In this scheme, the supplier plays a key role in maintaining records of the breathing apparatus in service, monitoring its condition, arranging for periodic resampling and testing and providing to the operator a copy of each certificate of compliance relevant to the breathing apparatus in use by that operator.

In this option, as above, the user or group of users must notify the Regulator in writing of the arrangement that is to be put in place, nominating the supplier or other provider who will be providing samples.

1.11. Records

Comprehensive records for each breathing apparatus must be maintained by the operator and the supplier, including, but not limited to the following:

1.11.1. Records to be maintained by the operator

- Inventory of all apparatus
- Reference numbers – manufacturer’s number, number allocated by the operator, transponder number (where relevant)
- Brand and model of escape apparatus
- Date of manufacture
- Date of procurement
- Supplier
- Inspection history – manufacturer’s recommended tests and tests by a recognised test authority
- Service and maintenance history including refurbishment records
- History of use (employee or contractor, cached, stored, double-shift use etc.)
- Escape apparatus removed from service, and the reason for removal

- Date of removal from service
- Escape apparatus not located during routine maintenance inspections
- Escape apparatus used in any emergency
- A compliance certificate covering all units in service
- Risk assessment used to determine the type of escape apparatus selected.

1.11.2. Records to be maintained by the supplier

- Name of operator
- Reference numbers – manufacturer’s reference, transponder number (where relevant), any other appropriate identification
- Traceability (quality records)
- Date of manufacture
- Date of delivery
- History of any service and maintenance carried out by the supplier, including refurbishment records
- Identification of escape apparatus removed from service for testing, and the date of removal
- Details of the current quality assurance system used by the manufacturer
- Details of compliance of the breathing apparatus with registration requirements.

1.12. Training units

Training units must meet the requirements of the WHS (MPS) Regulation and should:

- be clearly marked and coloured, in such a way that they cannot inadvertently be mistaken as functional escape devices
- simulate breathing resistance, temperature increase, donning and changeover, and weight.
- be resistant to cleaning and disinfectant fluids.

Units that have exceeded their service life should not be worn for training purposes.

2. Design requirements

2.1. Types of breathing apparatus

Breathing apparatus must be classified in accordance with the following types:

- Chemical oxygen self-contained self-rescuers (chemical oxygen apparatus)
- Carbon monoxide filter self-rescuers
- Compressed air self-contained breathing apparatus (compressed air apparatus)
- Compressed oxygen self-contained breathing apparatus (compressed oxygen apparatus)

Where the classification of the apparatus is not clear the Regulator should be consulted concerning the appropriate registration requirements.

2.2. General requirements

2.2.1. Design and construction

The design and construction must:

- permit the breathing apparatus to be worn without undue discomfort and in such a manner that it is practicable for the wearer to escape and not unduly impede the wearer when walking or in a crouching position, crawling or manoeuvring in confined areas
- prevent leakage from the circuit to atmosphere except through a relief valve or exhalation valve on compressed air apparatus
- allow parts of the breathing apparatus to be effectively sealed from atmospheric air during storage
- ensure that the use of aluminium is limited to those applications that may be justified on the grounds of safety and health
- where a change-over is required, be designed for easy removal when changing from one unit to another. For example, have neck straps with quick release clips.

2.2.2. Marking requirements

The following information must be clearly marked on each self-rescuer:

- the manufacturer and supplier, which must be identified by name, trade mark or other means of identification
- rated duration
- serial number
- month and year of manufacture
- a pictogram on the carrying container showing the donning procedure

2.2.3. Instructions for use of breathing apparatus

On delivery, instructions for use accompany every apparatus (or a website link to download the instructions accompanies every apparatus). Instructions must be written in simple plain English.

The instructions must contain all information necessary for trained and qualified people with respect to:

- application limitation
- maximum surface temperature during use
- checks before use
- donning and fitting
- change over instructions
- use
- maintenance (preferably separately printed instructions)
- inspection intervals
- storage
- shelf-life
- service life (may be different for body worn or cached units)
- disposal after use

The instructions must be clear. If helpful, illustrations, part numbers, marking (and similar) can be added. The instructions for use should be complemented by an easy-to-understand pictogram on the carrying container showing the donning procedure.

Warning must be given against possible problems likely to be encountered, for example:

- integrity of the apparatus during carriage or transport
- during donning
- use of the apparatus in an explosive atmosphere
- danger of ignition if chemicals come into contact with combustible substances or water
- any other information the supplier may wish to provide to ensure that the apparatus is appropriate for use in underground coal mines.

3. Additional design requirements for chemical and compressed oxygen apparatus

3.1. Chemical oxygen apparatus

Chemical oxygen apparatus must comply with AS/NZS 1716:2012, as amended below:

- a. Units must not exceed 55°C inhalation temperature at any time
- b. The water leakage test in Appendix H6.3 of AS/NZS 1716:2012 is replaced with the leakage test Clause 7.5.1 of BS EN 13794:2002
- c. Clause 11.3.4 carbon monoxide leakage test is not required
- d. Clause 11.3.6 the high volume test is not required
- e. Clause 11.1 (c) must be the same as that specified by the manufacturer for storage conditions.

A minimum of 12 sets of the apparatus must be submitted to the testing authority for pre-registration testing.

3.2. Compressed oxygen apparatus

Compressed oxygen apparatus must comply with AS/NZS 1716:2012, as amended below:

- a. Units must not exceed 50°C inhalation temperature at any time
- b. The performance requirements for the unit must comply with clauses 11.3.1 to 11.3.3, 11.3.5 and 11.3.7 to 11.3.13 of AS/NZS 1716:2012
- c. The water leakage test in Appendix H6.3 is replaced with the leakage test in clause 7.5.2 of BS EN 13794:2002
- d. A leak tightness test of the casing must be conducted in accordance with clause 7.5.1 of BS EN 13794:2002
- e. Units with non-refillable gas cylinders are not required to comply with clauses 10.14 and 10.15 pressure gauge or cylinder colour coding per AS 4484-2004: *Gas cylinders for industrial, scientific, medical and refrigerant use – Labelling and colour coding*
- f. Appendix J Simulated Work Tests J4.6 must be used instead of J4.4. (Note: The tests described in J4.4 relate to rescue units.)

A minimum of 12 sets of the apparatus must be submitted to the testing authority for pre-registration testing.

4. Additional design requirements for filter self-rescuers and compressed air apparatus

4.1. Carbon monoxide filter self-rescuers (FSRs)

Filter self-rescuers must comply with AS/NZS 1716:2012, as amended below:

- a. Exhalation resistance must not exceed 300 Pa.
- b. Inhalation temperature must not exceed 55°C during simulated breathing tests specified in section 7.3.10.3 of AS/NZS 1716:2012.

4.2. Requirements for compressed air apparatus

Compressed air apparatus must comply with AS/NZS 1716:2012.

5. Examination and testing of new units before issue to operators

This section applies to:

- self-contained chemical oxygen apparatus
- carbon monoxide filter self-rescuers
- compressed oxygen apparatus

This section does not apply to compressed air apparatus.

5.1. Supplier to submit samples

A supplier must not issue registered chemical oxygen apparatus or carbon monoxide filter self-rescuers or compressed oxygen apparatus to the mining industry until a certificate of compliance for the approved/certified rated duration, relevant to those units, has been obtained from a recognised test authority.

If a supplier intends to sell units of a particular model made in a particular year, and does not already have a certificate of compliance for these units, the supplier must submit at least 1% to a test authority for examination and testing. The test authority must issue a test report and may issue a certificate of compliance to the supplier.

Once the supplier has a certificate of compliance for that model, made in that year, the supplier may continue to supply to the mining industry units of that model, made in that year, provided that the number of units tested does not fall below 1% of the units supplied to the mining industry. The supplier may need to submit further units for test to maintain this ratio.

Provided the results of further samples continue to be satisfactory, the same certificate of compliance continues to cover further supplies of that model made in that year. Where possible, samples should be representative of the period of manufacture.

5.2. Test authority to examine and test samples

The test authority should subject the samples to a visual examination, any compliance tests as specified by the manufacturer, and any other checks which the test authority considers necessary. Example forms are in Appendix A (for chemical oxygen apparatus and compressed oxygen apparatus) or Appendix B (for carbon monoxide filter self-rescuers).

If these examinations are satisfactory, the test authority should conduct relevant tests using the test method and breathing rate shown in Table 5.1.

Table 5.1: Testing procedures for each self-rescuer type

RESCUER TYPE	CERTIFICATE OF COMPLIANCE REQUIRED FOR UNITS BEFORE RELEASE?	BREATHING RATE FOR LABORATORY TEST AT BTPS	LABORATORY TEST PROCEDURE (BEFORE RELEASE AND RE-TESTING)
Chemical Oxygen	Yes	35L/min	AS/NZS 1716, Appendix R4a
Carbon Monoxide filter	Yes	35L/min	AS/NZS 1716, Appendix E 5.1
Compressed air	No	(none required)	(none required)
Compressed Oxygen	Yes	35L/min	AS/NZS 1716, Appendix R4a)

The test authority should assess the test results against the criteria for new apparatus for the rated duration, as given in Tables 5.2 – 5.4.

Table 5.2: Performance criteria for new chemical oxygen apparatus

PARAMETERS	UNITS	RATED DURATION ≤ 30 MINUTES	RATED DURATION > 30 MINUTES
Inhaled CO ₂ during rated duration	%	≤3.0	≤3.0
Average CO ₂ during rated duration	%	≤1.5	≤1.5
Inhalation/exhalation resistance	kPa	≤1.0	≤0.75
Sum of inhalation and exhalation resistances	kPa	≤1.6	≤1.3
Inhalation temperature	°C	≤55	≤55

Table 5.3: Performance criteria for new carbon monoxide filter self-rescuers

PARAMETERS	UNITS	RATED DURATION ≤ 60 MINUTES	RATED DURATION > 60 MINUTES
Inhaled CO during rated duration	ppm	≤400	≤400
Average CO during rated duration	ppm	≤200	≤130‡
Inhalation resistance	Pa	≤900	≤900
Exhalation resistance	Pa	≤300	≤300
Inhalation temperature	°C	≤55	≤55

‡ These values relate to a 90-minute duration. They would need to be modified for longer or shorter durations, so as not to exceed a total of 400mL of carbon monoxide for new apparatus, and not more than 600mL for in-service units.

Table 5.4: Performance criteria for new compressed oxygen apparatus

PARAMETERS	UNITS	DURATION ≤30 MINUTES	DURATION >30 MINUTES
Inhaled CO ₂ during rated duration	%	≤1.5	≤1.5
Average CO ₂ during rated duration	%	-	-
Inhalation/exhalation resistance	kPa	≤0.5	≤0.5
Total of resistances	kPa	-	-
Inhalation temperature *	°C	≤50	≤50

* Note: Because the inhaled gas is humid, lower temperature limits apply to this type of apparatus than to those types which supply dry inhaled gas.

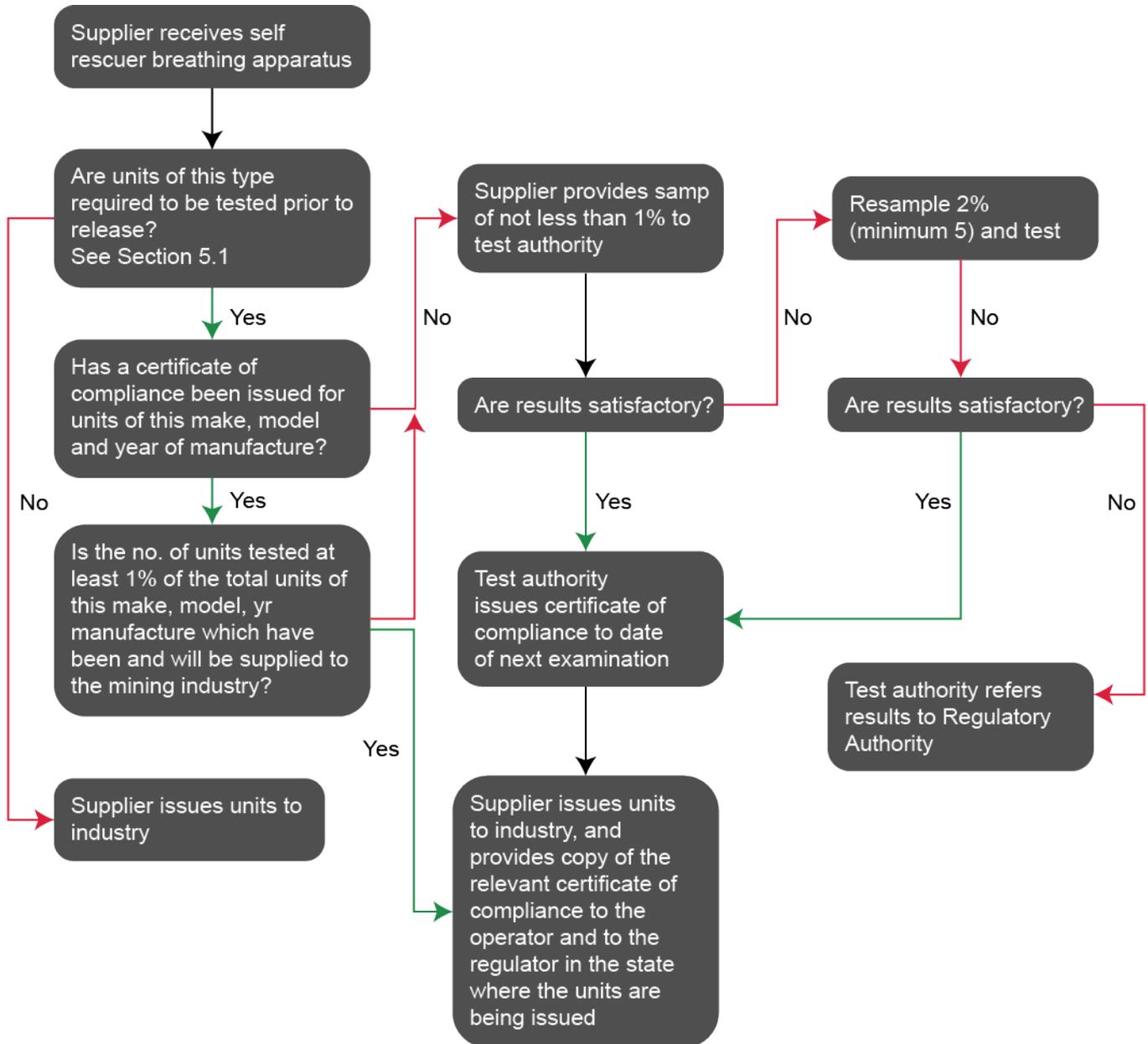
Before issuing a certificate of compliance the test authority should compare the performance of the tested units with the test data on which the registration was based. If the apparatus complies with the requirements, but there is a deterioration of more than 15% in any of the criteria from the type testing, the test authority may discuss the results with the supplier and may require further investigations before issuing the certificate.

5.3. Procedure after results of examination and test are assessed

The test authority should issue a test report to the supplier. If all apparatus in a sample of not less than 1% satisfy the examinations, tests, and assessments described in section 5 and a certificate of compliance has not previously been issued in relation to units of that model made in the particular calendar year, the test authority should issue to the supplier a certificate of compliance covering the period to the next required examination.

Section 5 details the resampling schedules for the various types of apparatus. The supplier should provide a copy of the compliance certificate to each operator receiving apparatus of that model made in the relevant calendar year, and to the Regulator.

Figure 5.1: Flowchart of the process for units before issue to operators



If any of the test results do not comply with the relevant criteria, further sampling may be required. This may take the form of a further 2% sample, with a minimum of five units. If all the units tested in the resampling pass, the test authority may issue a certificate of compliance. In the event of a failure in the further sample, the test authority must inform the supplier and refer the results to the Regulator to direct appropriate action. If any examination by a test authority reveals defects which may point to a widespread problem, the test authority must inform the Regulator.

6. Examination and testing of self-rescue units in service

6.1. In-service testing procedure

This requirement applies to:

- self-contained chemical apparatus
- carbon monoxide filter self-rescuers
- compressed oxygen apparatus

This section does not apply to compressed air apparatus.

6.2. Mine/owner to submit samples

The mine or owner of the breathing apparatus, (or, where an alternative scheme provided for in section 1.10 is in place, the responsible body), must arrange for samples of units in service to be submitted to a recognised test authority for prescribed testing.

The retesting schedule for CO filter self-rescuers is given in Table 6.1.

The retesting schedule for chemical oxygen and compressed oxygen apparatus is given in Table 6.2.

Chemical oxygen apparatus should be removed from service at the end of the manufacturer's recommended service life, which may be less than 10 years for some models.

The numbers of units to be submitted for various types of rescuers are given in Table 6.3.

Resampling of each model is based on the calendar year of manufacture, across approved/certified units in service, and must be carried out in advance of the expiry date of the certificate of compliance relevant to those units.

Where possible, samples must be selected such that:

- over time, a wide range of locations are included
- at each location, samples are weighted towards those uses that are most likely to cause degradation of the apparatus
- dates of manufacture are spread across the calendar year of manufacture.

The relevant information specified in sections 1.11.1 and 1.11.2 is to be submitted with each unit submitted to the recognised test authority. The test authority reserves the right to query and/or reject unrepresentative samples.

Table 6.1: Retesting schedule for in-service CO filter rescue units

AGE OF UNIT (YEARS)	TEST SCHEDULE
1	No test
2	No test
3	No test
4 or greater	Test required each year
Manufacturer's recommended service life	Remove in month of manufacture

Table 6.2: Retesting schedule for in-service chemical oxygen and compressed oxygen apparatus

AGE OF UNIT (YEARS SINCE MANUFACTURE)	TEST SCHEDULE
1	No test
2	Test required
3	No test
4	Test required
5	No test
6 or greater	Test required each year
Manufacturer's recommended service life	Remove in month of manufacture

Table 6.3: Number of units to be submitted for in-service testing

NUMBER OF RESCUERS IN-SERVICE OF A GIVEN YEAR OF MANUFACTURE	CARBON MONOXIDE FILTER SELF-RESCUERS	CHEMICAL OXYGEN AND COMPRESSED OXYGEN APPARATUS
1-10	1	1
11-20	2	2
21-200	3	2
201-300	3	at least 1%
301+	at least 1%	at least 1%

6.3. Test authority to examine and test results

The test authority should subject the samples to a visual examination, any compliance tests as specified by the manufacturer, and any other checks that the test authority considers necessary. Example forms are in Appendix A (for chemical oxygen apparatus or compressed oxygen apparatus) or Appendix B (for carbon monoxide filter self-rescuers).

If these examinations are satisfactory, the test authority is to conduct relevant tests using the test method and breathing rate shown in Table 5.1. The test authority should assess the test results against the criteria for in-service apparatus for the approved/certified rated duration. Performance criteria are shown in Table 6.4, Table 6.5 and Table 6.6 for chemical oxygen, carbon monoxide filter, and compressed oxygen apparatus respectively.

Table 6.4: Performance criteria for in-service chemical oxygen apparatus

PARAMETERS	UNITS	RATED DURATION ≤ 30 MINUTES	RATED DURATION > 30 MINUTES
Inhaled CO ₂ during rated duration	%	≤3.0	≤3.0
Average CO ₂ during rated duration	%	≤2.0	≤2.0
Inhalation/exhalation resistance	kPa	≤1.5	≤1.2
Sum of inhalation and exhalation resistances	kPa	≤2.4	≤2.0
Inhalation temperature	°C	≤55	≤55
Average inhalation temperature during rated duration	°C	≤55	-

Table 6.5: Performance criteria for in-service CO filter self-rescuers

PARAMETERS	UNITS	RATED DURATION ≤ 60 MINUTES	RATED DURATION > 60 MINUTES
Inhaled CO during rated duration	ppm	≤400	≤400
Average CO during rated duration	ppm	≤290	≤200‡
Inhalation resistance	Pa	≤900	≤900
Exhalation resistance	Pa	≤300	≤300
* Inhalation temperature	°C	90	90
Dust	g	<2	<2

* Because the inhaled gas is dry, higher temperatures are allowed than for types of apparatus which supply humid inhaled gas.

‡ These values relate to a 90-minute duration. They would need to be modified for longer or shorter durations, so as not to exceed a total of 400mL of carbon monoxide for new apparatus, and not more than 600mL for in-service units.

Table 6.6: Performance criteria for in-service compressed oxygen apparatus

PARAMETERS	UNITS	DURATION ≤30 MINUTES	DURATION >30 MINUTES
Inhaled CO ₂ during rated duration	%	≤3.0	≤3.0
Average CO ₂ during rated duration	%	≤2.0	≤2.0
Inhalation/exhalation resistance	kPa	≤1.5	≤1.2
Total of resistances	kPa	≤2.4	≤2.0
Inhalation temperature *	°C	≤50	≤50

* Note: Because the inhaled gas is humid, lower temperature limits apply to this type of apparatus than to those types which supply dry inhaled gas.

6.4. Procedure after results of examination and test are assessed

The test authority should issue a test report to the supplier.

If all apparatus in a sample of not less than 1% satisfy the examinations, tests, and assessments described in Section 6, the test authority should issue to the supplier a certificate of compliance covering the period to the next required examination.

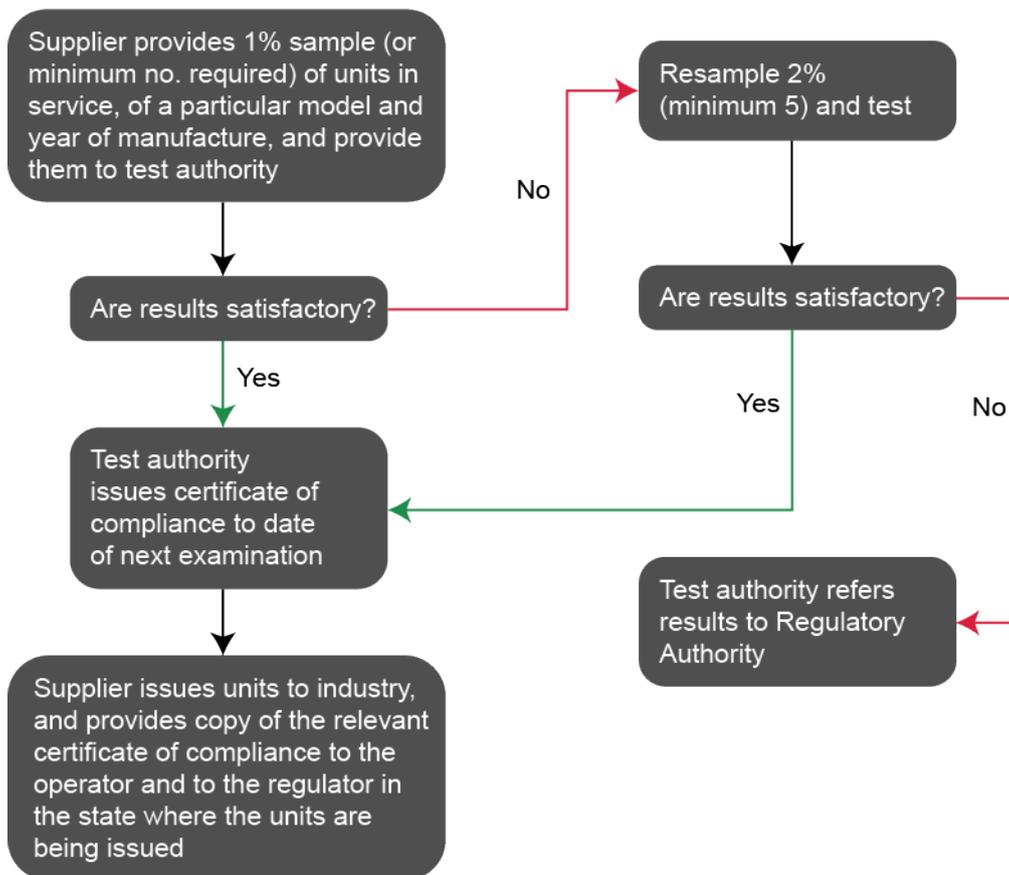
The extended service granted to a unit must not exceed the service life agreed by the manufacturer. However, based on service history, a manufacturer may agree to support an apparatus beyond its initially recommended service life.

The extension that the certificate of compliance grants to the service of the apparatus will be that which is specified in Table 6.1 and Table 6.2. However, the test authority may issue a certificate of compliance with a lesser extension, if it determines that the apparatus is deteriorating at such a rate that it may exceed the prescribed limits before the next scheduled resampling.

The supplier must provide a copy of the certificate to each operator holding apparatus of that model made in the relevant calendar year, and to the Regulator.

If any of the test results do not comply with the relevant criteria, further sampling may be required. This may take the form of a further 2% sample, with a minimum of five units, of which two units must be from the same operator as the previously failed unit(s). If all the units tested in the resampling pass, the test authority may issue a certificate of compliance. In the event of a failure in the further sample, the test authority should inform the supplier and refer the results to the Regulator to direct appropriate action. If any examination by a test authority reveals defects that may point to a widespread problem, the test authority should inform the Regulator.

Figure 6.1: Flowchart of the process for self-rescuers in service



7. General maintenance requirements of apparatus in-service

The operator, in consultation with the supplier and an appropriate representative of the workers, should implement a risk-based scheme for regular maintenance and checks on the apparatus. This should take account of the way the apparatus is used and stored. A risk assessment should be conducted that involves a comprehensive, systematic investigation and analysis of all aspects of risk to health and safety associated with the apparatus. The scheme should be documented for inclusion in the underground emergency system for the mine and be reviewed regularly.

The scheme should implement the supplier's recommendations for maintaining the apparatus, and must define the frequency, responsibility, location and details of the required maintenance and checks, and clear criteria for deciding whether a particular apparatus is to be accepted, examined further, or rejected.

Damaged units must be repaired only by the manufacturer or authorised agent. The manufacturer or authorised agent must certify the integrity of any repaired apparatus before being returned to service.

7.1. Specific suggestions for maintenance of apparatus

In drawing up a scheme for regular checks on breathing apparatus, the operator should consider the following:

- Apparatus that is body-worn, handled frequently, or subjected to rough usage, should be checked visually, possibly on a daily basis by the user. The checks should verify that:
 - the apparatus is free of external damage
 - the seal is intact and has not been tampered with
 - the case does not have a significant dent (according to manufacturer's recommendations)
 - the apparatus has no visible puncture, and
 - the moisture indicator (where fitted) has not changed colour, in accordance with the manufacturer's recommendations.
- All units should be maintained in a clean condition, as ingrained dirt may affect seals and disguise damage.

- Carbon monoxide filter self-rescuers must be accurately weighed in a clean condition on a monthly basis. Any apparatus that shows an increase in weight of 12 grams or more above the weight indicated on the unit must be immediately withdrawn from service. (This may indicate that the unit has absorbed moisture.)
- Cylinders used for compressed gases, and refilling devices, must comply with statutory requirements and any relevant Australian Standard (such as for periodic pressure testing, internal examination).
- Cylinder pressures must be checked frequently to ensure that they are fully charged (minimum pressure 90% or other value defined by the escape strategy).
- Cylinders with rubber protective boots may suffer corrosion under the boot. Checks should be made where appropriate.
- All cylinder refilling devices must be subjected to the checks and tests detailed in the manufacturer's maintenance schedule, to ensure that they are free of visible external damage and meet the manufacturer's test requirements.
- Any required protection on aluminium and light alloys must be intact.
- Detergents and cleaning agents should not be used unless recommended by the supplier.

Appendix A Worksheet for the examination of chemical oxygen and compressed oxygen self-rescuers

Testing organisation :		Date of test :	
Make and model :		Supplier :	
Unit serial no. :		From mine :	
Date manufactured :		Exhalation CO ₂ :	
Weight of rescuer :		Dead space :	
Rated duration :			
Lab. Reg. no. :			

1. LEAK TEST ON COMPLETE UNIT (SEALED)

Leak test			Start =	Finish =
			Change in pressure =	(Pa)
Leak test (water bath)			Change in weight =(g)

2. VISUAL INSPECTION OF COMPLETE UNIT (Prior to Breathing Simulator Test)

INSPECTION			COMMENTS
Tampering seal OK	YES	NO	
Clamping device OK	YES	NO	
Casing lid OK	YES	NO	
Belt loops OK	YES	NO	
Casing OK	YES	NO	
Casing seal OK	YES	NO	
Indicator window OK	YES	NO	
Indicator showing dry OK	YES	NO	

3. VISUAL INSPECTION OF INNER UNIT (Before breathing simulator test)

INSPECTION			COMMENTS
Mouthpiece OK	YES	NO	
Breathing tube OK	YES	NO	
Nose clip OK	YES	NO	
Breathing bag OK	YES	NO	
Pressure relief valve OK	YES	NO	
Head strap OK	YES	NO	
Neck strap OK	YES	NO	
Waist strap OK	YES	NO	
Starter mechanism OK	YES	NO	
Mouthpiece plug in place OK	YES	NO	

COMMENTS: _____

TESTED BY _____ DATE _____

Appendix B Worksheet for the examination of carbon monoxide filter self-rescuers

1. Filter self-rescuer details

Mine..... _____
 Manufacturer..... _____
 Model..... _____
 Serial number..... _____
 Date manufactured/reconditioned..... _____
 Registered weight..... _____

2. Visual examination of external casing

External casing in good condition Y/N _____
 Seal on opening lever is correct and in place Y/N _____
 Locking assembly is fitted and in place Y/N _____

3. Weight

Measured weight of filter self-rescuer _____

4. Opening efficiency

The opening seal breaks easily Y/N _____
 The locking assembly releases easily Y/N _____
 The top cover is removed easily Y/N _____
 The 'O' ring seal is present Y/N _____
 The rescuer is easily removed from casing Y/N _____

5. Contamination

Weight of dust contamination _____

6. Examination of rubber components

Mouthpiece is present and intact Y/N _____
 Mouthpiece rubber is pliable not perished Y/N _____
 Mouthpiece withstands tugging and flexing Y/N _____
 Chinrest withstands slight flexing Y/N _____
 The rubber is soft (not hard) Y/N _____
 The rubber is strong (not weak) Y/N _____

7. Examination of headstraps

Headstraps are not perished Y/N _____
 Headstraps are firmly attached Y/N _____

8. Examination of nose clip

Spring functions correctly Y/N _____
 The rubber is soft (not hard) Y/N _____
 The rubber is strong (not weak) Y/N _____

INTERNAL SERIAL NUMBER..... _____

Set aside for breathing simulator test by _____

Signed _____

Date _____

Appendix C Wearer assessment of self-contained self-rescuers

The apparatus should be subjected to the simulated escape test and subjectively assessed according to the following questionnaire, none of the wearers should experience any undue discomfort caused by the operational imperfections.

APPARATUS TYPE:

SERIAL NUMBER:

LOCATION OF TEST:

DATE OF TEST:

NAME OF WEARER:

AMBIENT CONDITIONS:

DURATION OF APPARATUS:.....

REASON TEST STOPPED:

WEARER'S ASSESSMENT

1. Describe the quality of the written and illustrated instructions supplied with the apparatus?

- Clear and concise
- Some difficulty understanding them
- Very difficult to understand

Comment:

2. Explain the ease of donning the apparatus?

- Simple
- Difficult
- Very difficult

Comment:

3. Determine the feeling of the apparatus while wearing it on your belt?

- Comfortable
- Uncomfortable
- Very uncomfortable

Comment:

4. Describe the comfort level of the apparatus harness after donning?

- Comfortable
- Uncomfortable
- Very uncomfortable

Comment:
.....

5. Describe the ease of changeover from one apparatus to another during use?

- Good
- Fair
- Difficult

Comment:
.....

6. Describe the temperature of the inhaled atmosphere from the apparatus?

- Comfortable
- Tolerable
- Very hot

Comment:
.....

7. What is the resistance to breathing while wearing the apparatus?

- Comfortable
- Tolerable
- Hard

Comment:
.....

8. Describe the taste of the inhaled atmosphere from the apparatus?

- Pleasant
- Tolerable
- Unpleasant

Comment:
.....

9. What is the comfort level of the nose clip?

- Effective
- Not effective

Comment:
.....

10. What is the effect of the surface temperature of the apparatus?

- Warm
- Tolerable
- Very hot

Comment:

11. What is the effectiveness of the goggles (where supplied)?

- Effective
- Tolerable
- Ineffective

Comment:

OVERALL ASSESSMENT OF THE APPARATUS

.....
.....
.....
.....

SIGNATURE OF WEARER:.....

DATE: