



NSW DEPARTMENT OF
PRIMARY INDUSTRIES



Queensland Government
Natural Resources and Mines

ESCAPE BREATHING APPARATUS FOR UNDERGROUND COAL MINING APPLICATIONS

Requirements for Registration and Monitoring Guidelines for Compressed Air Refill Stations

MDG 3006 MRT 9

This document replaces:
MDG 3006 MRT 4 (December 2001)
and
MDG 3006 MRT7 (December 2001)

Draft, 3rd December 2007

FOREWORD

This document contains the requirements for registering self rescue breathing apparatus for use in underground coal mines and includes procedures for the in-service testing of self-rescue breathing apparatus.

It is a review and combination of the former two Codes, namely;

- Code for Chemical Oxygen (KO₂) Self Contained Self Rescuers (MDG 3004 MRT 4) and,
- Code for maintaining, monitoring and testing the performance of escape breathing apparatus used in underground mines (MDG 3006 MRT 7 December 2001).

The performance criteria required for registration and the maintenance of registration by in-service testing of self rescue breathing apparatus has been identified by New South Wales and Queensland 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, 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.

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1 Scope and General

1.1 Scope

This document details the requirements for registration and maintaining registration of breathing apparatus to assist escape from the underground parts of a coal operation, including self rescuers. The document is a revision and combination of the Code for Chemical Oxygen (KO₂) self contained self rescuers (MDG 3004 MRT 4) and the Code for Maintaining, monitoring and testing the performance of escape breathing apparatus used in underground mines (MDG 3006 MRT 7).

There are three broad areas that this document covers;

- The requirements that breathing apparatus used for escape purposes must meet for registration.
- The ongoing monitoring required to maintain currency of registration.
- A guideline for maintenance and design of compressed air refill stations.

1.2 Referenced Documents

- MDG 1010 "Risk Management Handbook for the Mining Industry" (NSW Dept of Mineral Resources).
- MDG 1014 "Guide to Reviewing a Risk Assessment of Mine Equipment and Operations" (NSW Dept of Mineral Resources).
- MDG 3006 MRT4 "Code for Chemical Oxygen (KO₂) Self Contained Self Rescuers" (NSW Dept of Mineral Resources).
- AS/NZS 1716 "Respiratory Protective Devices" (Standards Australia).

1.3 Relationship with Regulations

The new Regulations to the NSW Coal Mine Health and Safety Act 2002 commenced on 22nd December 2006. In reference to escape equipment and self rescuers, the Regulation requires:

The operator of an underground mine must provide sufficient means of escape (including escape plan and adequately maintained self-rescuers) to allow safe egress of people from underground parts of the mine through conditions of reduced visibility and any irrespirable or irritant atmospheres that are likely to be encountered.

In providing and maintaining self rescuers, regard must be had to any relevant guidelines applied to the mine.

A person who is in the underground part of a coal operation must at all times have attached to him or her a type of self-rescuer that is registered under the Occupational Health and Safety Act 2000.

This document sets out the requirements for registration of breathing apparatus (including self rescuers) used to assist escape from the underground parts of a coal operation.

1.4 Relationship with AS/NZS 1716 Respiratory Protection Devices 2003.

Where possible the requirements for registration follow those required to comply with AS/NZS 1716, however where this is a conflict between this document and AS/NZS 1716, this document shall prevail.

1.5 Definitions

For the purposes of this Standard the definitions given in AS/NZS 1716 Respiratory Protection Devices apply. In addition the following definitions apply:

1.5.1 Body-worn

Refers to a unit which has at any time been issued to be worn by a person. Units which are frequently transported on a vehicle are to be regarded as equivalent to body-worn units for the purposes of registration.

1.5.2 BTPS

Body Temperature and Pressure Saturated (37°C, ambient pressure and saturated)

1.5.3 Cached

Refers to a unit which is stored underground, normally in a stationary and vibration-free location.

1.5.4 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.

1.5.5 Change Over

The process of donning a fresh rescuer and removing a spent rescuer whilst in an irrespirable atmosphere.

1.5.6 Escape breathing apparatus

A device for emergency escape from a respiratory hazard.

1.5.7 Examination

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

1.5.8 Extended usage

The time between the rated duration and exhaustion of the chemical or collapse of the breathing bag when the apparatus is subjected to a breathing simulator test at a breathing rate of 35 litres per minute.

1.5.9 In-service

Refers to a unit that has been issued for use underground and has not been removed from service, and includes units which are body-worn or cached. Units which are frequently transported on a vehicle are to be regarded as equivalent to body-worn units for the purposes of registration.

1.5.10 Nominal duration

The duration in minutes nominated by the manufacturer for the apparatus to provide protection to the wearer.

1.5.11 Operator

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

1.5.12 Rated duration

The duration in minutes that the 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 shall not be greater than the nominal duration.

1.5.13 Recognised test authority

A test authority approved or otherwise recognised by the relevant Regulatory Authority for the purpose of examination and testing of breathing apparatus as required for registration.

1.5.14 NTP

Normal temperature and pressure i.e. 23°C and 101.3 kPa.

1.5.15 Stored

Refers to a unit which is held in stationary storage, has never been in service, and is not cached.

1.5.16 Supplier

An Australian manufacturer, or an Australian representative of a manufacturer, of escape breathing apparatus, who supplies this apparatus directly to users; or a mining organisation which imports escape breathing apparatus directly from a manufacturer.

1.5.17 Test report

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

1.6 Tolerances for Performance Testing

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

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

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

All gas concentrations are expressed by volume at NTP on a dry basis. Gas volumes are measured at BTPS unless otherwise specified.

1.7 Compliance Certificate

A certificate of compliance shall indicate:

- the date on which the examination was conducted;
- an unambiguous identification of the self-rescuers, represented by the sample(s) tested;
- the date of expiry of the certificate, when the self-rescuers will next be required to be examined, in accordance with the appropriate examination schedule (see Section 4.2).
- Except where specifically provided in this document, a certificate of compliance shall not be issued unless the equipment complies in all respects with the requirements for registration.

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 results will be covered by separate test reports. However only one certificate of compliance need be issued in relation to these units.

1.8 Monitoring Programmes

There are various levels of monitoring; some may be carried out at the work site by trained site personnel, while others may be carried out at the work 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 relevant Regulatory Authority 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) which 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 provided to a recognised test authority. In this scheme, the supplier plays a key role in maintaining records of the apparatus in service, monitoring its condition, arranging for periodic re-sampling and testing, and providing to the operator a copy of each certificate of compliance relevant to the apparatus in use by that operator.

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

1.9 Records

Comprehensive records for each apparatus shall be maintained by the operator and the supplier, including, but not limited to the following.

1.9.1 Records to be maintained by the operator

- Reference numbers - manufacturer's number, number allocated by the operator, transponder no. (where relevant)
- Brand and model of escape apparatus
- Date of manufacture
- Date of procurement
- Supplier
- Inspection history - manufacturer's recommended tests, and tests by recognised test authority
- Service and maintenance history, including refurbishment records
- Usage history (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

1.9.2 Records to be maintained by the supplier

- Name of operator
- Reference numbers - manufacturer's reference, transponder no. (where relevant), any other appropriate identification.
- Traceability (quality records)
- Date of manufacture
- Date of delivery
- History of service and maintenance carried out by the supplier, including refurbishment records
- Identification of escape apparatus permanently 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 apparatus with registration requirements.

2 Design Registration Requirements

2.1 Types of Apparatus

Escape breathing apparatus shall be classified in accordance with the following types:

- Self-contained chemical oxygen apparatus
- Carbon monoxide filter self-rescuers
- Self-contained compressed air apparatus
- Self-contained compressed oxygen apparatus

Where the classification of the apparatus is not clear the relevant Regulatory Authority shall be consulted concerning the appropriate registration requirements.

2.2 Application for registration and modifications

2.2.1 Registration

To enable an apparatus to be assessed for registration in accordance with this standard, applicants are required to complete an application form and provide the following to the testing authority.

- a schematic drawing detailing the flow through the breathing circuit.
- dimensional drawings, specifications and tolerances for all components.
- a material list of the components, identifying the use of any light metal alloys.
- an Instruction manual in English with an identifying number, date of issue and details of the donning procedures.
- test report showing compliance to the relevant parts of this document.

Refer to the Department of Primary Industry website www.dpi.nsw.gov for an application form, GNC-005 Registration of Plant Design.

2.2.2 Application to modify an existing registration

If a manufacturer proposes to change a component of an already registered breathing apparatus type, an application and subsequent assessment by the testing authority will be required. If the proposed modification is approved, the registration will be amended to reflect the approved changes.

Refer to the Department of Primary Industry website www.dpi.nsw.gov for an application form, GNC-005 Registration of Plant Design.

2.3 General Requirements

2.3.1 Design and Construction

The design and construction shall:

- Permit the 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
- Give trouble free operation over the range of -5°C to 60°C (note: storage of the apparatus must not exceed temperatures specified by the manufacturer)
- Prevent leakage from the circuit to atmosphere except through a relief valve
- Allow parts of the apparatus to be effectively sealed from atmospheric air during storage
- Be such that the use of aluminium is limited to those applications that may be justified on the grounds of safety and health
- Be designed for easy removal when changing from one unit to another. For example neck straps with easy release clips.

2.3.2 Marking Requirements

The information listed below is to be clearly marked on each self rescue unit and if the unit is contained in a sealed carrying container, marking shall be on the outside of the container.

- The manufacturer and supplier shall be identified by name, trade mark or other means of identification
- Type of unit
- Rated duration
- Serial number
- Registration Number
- Month and year of manufacture
- Units to be stamped with a use by date for belt worn and cached units.
- A pictogram on the carrying container showing the donning procedure.

2.3.3 Instructions for use of the apparatus

On delivery, instructions for use shall accompany every apparatus. Instructions for use shall be written in plain, easy to understand English.

The instructions for use shall contain all information necessary for trained and qualified persons with respect to:

- Application limitation:
- Maximum surface temperature during use:

- Checks prior to use
- Donning and fitting
- Use
- Maintenance (preferably separately printed instructions)
- Inspection intervals:
- Storage
- Shelf-life
- Disposal after use
- Change over instructions

The instructions shall be unambiguous. If helpful, illustrations, part numbers, marking, etc. shall be added. The instructions for use should be complemented by an easy to understand picture (pictogram) on the carrying container showing the donning procedure.

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

- Integrity of the apparatus during carriage or transport
- Procedure of 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.

2.4 Requirements for Chemical Oxygen (KO₂) Self Contained Self Rescuers

The Chemical Oxygen (KO₂) self rescue unit is designed and constructed so that the wearer's exhaled breath passes via a mouthpiece or face piece into a circuit which contains chemical(s) which absorbs both carbon dioxide and humidity, and produces oxygen into a breathing bag where it is available for rebreathing. The gas flow may be of the pendulum or loop type and excess is ejected via a relief valve.

Ten sets of the apparatus are to be submitted for testing as per this section.

Chemical oxygen self contained self rescuers shall comply Australian Standard AS/NZS 1716:2003 Respiratory Protective Devices, in with the following exceptions;

- Units shall not exceed 55°C inhalation temperature at any time.
- Section 11.3.7 Rough Usage – Water Immersion. On completion of this test the unit shall be subjected to a carbon monoxide leakage test as per section

11.3.4. The performance of the unit shall be within 10% of the results obtained under section 11.3.4.

2.4.1 Training Units

Training Units:

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

A risk assessment should be performed before units that have passed their use by date are used for training purposes.

2.5 Compressed Oxygen Self Contained Self Rescuers

Compressed oxygen self contained self rescuers shall comply with Australian Standard AS/NZS 1716:2003 Respiratory Protective Devices, with the following exceptions;

- For escape units, Appendix J Simulated Work Tests J4.6 shall be used in place of J4.4. (Note: The tests described in J4.4 relate to rescue units.)

2.6 Carbon Monoxide Filter Self Rescuers (FSR's)

Filter self rescuers shall comply with Australian Standard AS/NZS 1716:2003 Respiratory Protective Devices, with the following exceptions;

Exhalation resistance must not exceed 300 Pa.

2.7 Compressed Air Self Contained Breathing Apparatus

Compressed air breathing apparatus shall comply with Australian Standard AS/NZS 1716:2003 Respiratory Protective Devices.

3 Examination and Testing of Units Prior to Release to Operators

This requirement:

- applies to chemical oxygen apparatus;
- applies to carbon monoxide filter self-rescuers
- does not apply to compressed air apparatus;
- applies to compressed oxygen apparatus.

3.1 Supplier to submit samples

A supplier shall not release 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.

Note: where a manufacturer has an acceptable quality assurance system covering the manufacture and testing of apparatus, a test report from the manufacturer may be accepted in place of the sampling and testing required in this section. This will only be possible where the manufacturer tests to the protocols in this document, and has demonstrated that their results are equivalent to those of the Department of Primary Industries'. In this case the test authority may issue a Certificate of Compliance based on the manufacturer's test report.

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, 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 are to be representative of the period of manufacture.

3.2 Test authority to examine and test samples

The test authority shall 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, to complete the appropriate information required on the form 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 is to conduct relevant tests using the test method and breathing rate shown in Table 3.1.

Table 3.1: Testing Procedures for Each Self Rescuer Type

| Rescuer Type | Certificate of Compliance required for units before release? | Breathing rate for laboratory test BTPS | Laboratory test procedure (prior to 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 shall assess the test results against the criteria for new apparatus for the rated duration, as given in Table 3.2 to Table 3.4.

Table 3.2: Performance Criteria for New Chemical Oxygen Self-Rescuers

| Parameters | Units | Rated duration | Rated duration |
|---|-------|----------------|----------------|
| | | ≤ 30 minutes | > 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 3.3: 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 | ≤90 | ≤90 |

* This limit is applied when the apparatus is tested with 1.5% carbon monoxide. The test is conducted only on new apparatus. 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 3.4: 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.

Prior to issuing a certificate of compliance the test authority shall 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 require discussions with the supplier and further investigations before issuing the certificate.

3.3 Procedure after results of examination and test are assessed

The test authority shall 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 4 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 shall issue to the supplier a certificate of compliance covering the period to the next required examination.

Section 4.2 details the re-sampling schedules for the various types of apparatus. The supplier shall 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 in the state where the units are to be supplied.

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 of the units tested in the re-sampling pass, the test authority may issue a certificate of compliance. In the event of a failure in the further sample, the test authority shall 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 shall inform the regulator.

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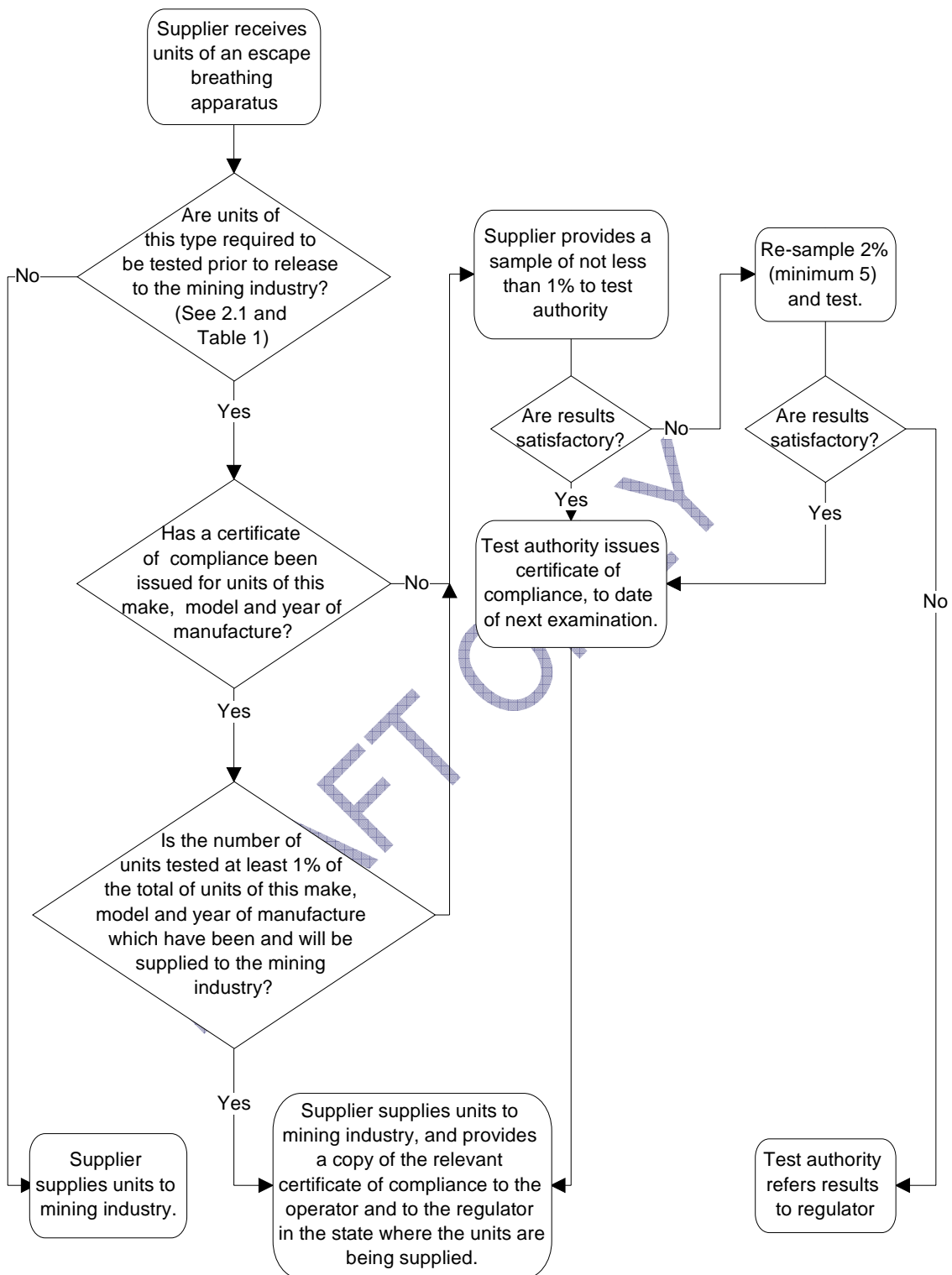


Figure 3.1: Flowchart of the process for units prior to release to operators

4 Examination and Testing of Self-rescue units in service

4.1 In-service Testing Procedure

This requirement:

- Applies to chemical oxygen apparatus;
- Applies to carbon monoxide filter self-rescuers
- Does not apply to compressed air apparatus;
- Applies to compressed oxygen apparatus .

4.2 Mine / Owner to submit samples

It is the responsibility of the mine or owner of the breathing apparatus, (or, where an alternative scheme provided for in Section 1.8 is in place, of the responsible body), to arrange for samples of units in service to be submitted to a recognised test authority for prescribed testing.

The due dates at which apparatus are to be re-tested are shown in Table 4.1 for CO filter self rescuers and Table 4.2 for chemical oxygen and compressed oxygen self rescuers. The numbers of samples to be submitted is given in Table 4.3.

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

Where possible, samples are to be selected such that:

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

With each unit submitted to the recognised test authority, the relevant information required in 1.9.1 and 1.9.2 is to be submitted. The test authority reserves the right to query and/or reject unrepresentative samples.

Table 4.1: Re-testing Schedule for In-Service CO Filter Rescue Units

| Year of Service | Due Date for Testing |
|-----------------|--------------------------------|
| 1 | No Test |
| 2 | No Test |
| 3 | No Test |
| 4 | February |
| 5 | May |
| 6 | August |
| 7 | November |
| 8 | Remove in month of manufacture |

Table 4.2: Re-testing Schedule for In-Service Chemical Oxygen and Compressed Oxygen Rescue Units

| Month Due | Lifespan of Unit (Years) | | | | | |
|-----------|--------------------------|----------|----------|----------|----------|----------|
| | 5 | 6 | 7 | 8 | 9 | 10 |
| Jan | | | | | | |
| Feb | | | | 2nd Year | | 2nd Year |
| Mar | | | 2nd Year | | 2nd Year | |
| Apr | | | | | | 4th Year |
| May | | | | 4th Year | 4th Year | |
| Jun | 2nd Year | 2nd Year | | | | 6th Year |
| Jul | | | 4th Year | | 6th Year | |
| Aug | | | | 6th Year | | 7th Year |
| Sep | | | | | 7th Year | |
| Oct | | | | | | 8th Year |
| Nov | 4th Year | 4th Year | 6th Year | 7th Year | 8th Year | 9th Year |
| Dec | | | | | | |

Table 4.3: 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 Self Rescuers |
|--|--------------------------------------|---|
| 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% |

4.3 Test authority to examine and test samples

The test authority shall 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, to complete the appropriate information required on the form in APPENDIX A (for chemical oxygen apparatus or compressed oxygen escape 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 3.1. The test authority shall assess the test results against the criteria for in-service apparatus for the approved/certified rated duration. Performance criteria are shown in Table 4.4, Table 4.5, and Table 4.6 for chemical oxygen, carbon monoxide filter, and compressed oxygen apparatus respectively.

Table 4.4: Performance Criteria for In-Service Chemical Oxygen Self-Rescuers

| Parameters | Units | Rated duration | Rated duration |
|--|-------|----------------|----------------|
| | | ≤ 30 minutes | > 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 4.5: Performance Criteria for In-Service CO filter self-rescuers

| Parameters | Units | Rated duration | Rated duration |
|----------------------------------|-------|----------------|----------------|
| | | ≤ 60 minutes | > 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 |

* 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 4.6: Performance Criteria for In-Service Compressed Oxygen Apparatus

| Parameters | Units | Duration ≤30 | Duration >30 |
|---|-------|--------------|--------------|
| | | minutes | 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.

4.4 Procedure after results of examination and test are assessed

The test authority shall 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 4.3, the test authority shall 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, on the basis of service history, a manufacturer may agree to support an apparatus beyond its initially recommended service life.

The extension which the certificate of compliance grants to the service of the apparatus will normally be that which is specified Table 4.1 and Table 4.2. 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 re-sampling.

The supplier shall provide a copy of the certificate to each operator holding apparatus of that model made in the relevant calendar year, and to the regulator in the state where the units are being held.

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 of the units tested in the re-sampling pass, the test authority may issue a Certificate of Compliance. In the event of a failure in the further sample, the test authority shall 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 shall inform the regulator.

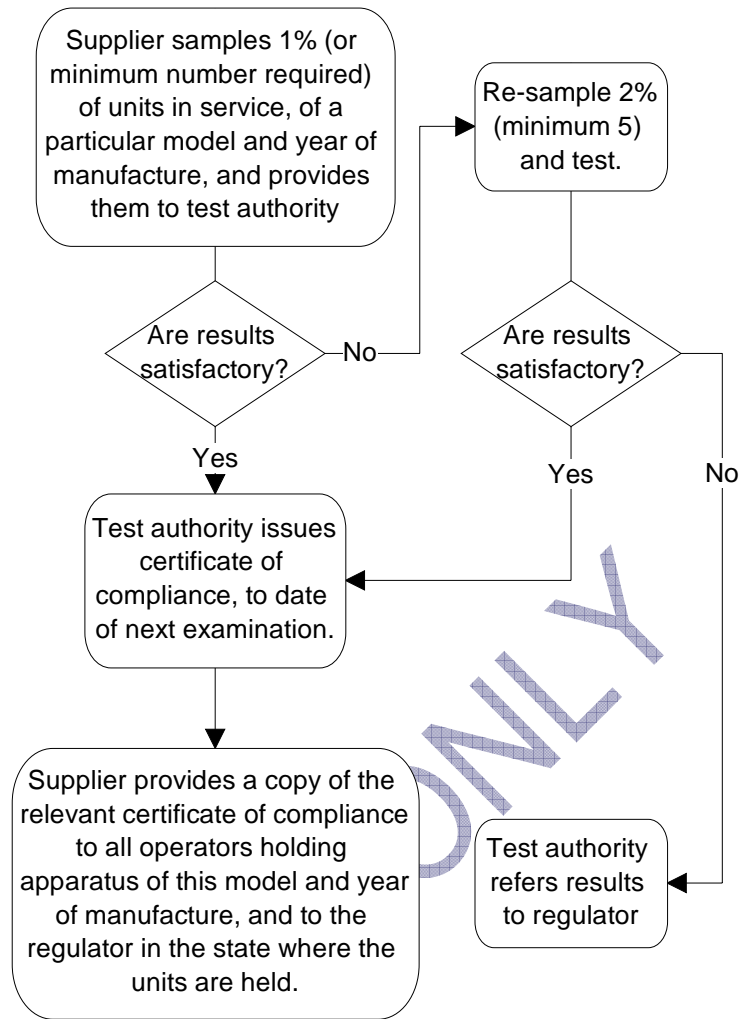


Figure 4.1: Flowchart of the Process for Self-Rescuers In Service

5 General maintenance requirements of apparatus in-service

The operator, in consultation with the supplier and an appropriate representative of the employees, should draw up a risk-based scheme for regular maintenance and checks on the apparatus. This should take account of the manner in which the apparatus is used and stored. The risk assessment should be conducted in accordance with MDG 1010, and any review should be conducted in accordance with MDG 1014, or other formal risk assessment and review criteria. The scheme should be documented for inclusion in the underground emergency system for the mine.

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 are to be repaired only by the manufacturer or authorised agent. The manufacturer or authorised agent is to certify the integrity of any repaired apparatus prior to it being returned to service.

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5.1 Specific suggestions for maintenance of apparatus

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

- Apparatus which 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.
- It may be desirable to have the frequent checks repeated at less frequent intervals by a single nominated person, to ensure that consistent standards are being maintained, and that progressive deterioration is detected.
- 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 (cleaned and) accurately weighed monthly. Any apparatus that shows an increase in weight of twelve (12) grams or more above the weight indicated on the unit shall 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 etc.).
- Cylinder pressures must be checked frequently to ensure that they are fully charged (minimum pressure 80% or other value defined by the escape strategy).
- Cylinders with rubber protective boots may suffer corrosion under the boot (see MSHA report on fire extinguishers). 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.

6 Compressed Air Refill Stations

To contain guidelines on

- Compressed Air Refill Stations
- Design
- Operation
- Maintenance

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APPENDIX A Worksheet For The Examination Of Chemical Oxygen and Compressed Oxygen Self-Rescuers.

Testing organisation:

| | | | |
|-------------------|---|----------------------------|---|
| Make & model | : | Date of test | : |
| Unit serial no. | : | Supplier | : |
| Date manufactured | : | From mine | : |
| Weight of rescuer | : | Exhalation CO ₂ | : |
| Rated duration | : | Dead space | : |
| 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 (Prior to 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.

Testing Organisation: _____

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 shall be subjected to the simulated escape test and subjectively assessed according to the following questionnaire, none of the wearers shall 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. How would you describe the quality of the written and illustrated operating instructions supplied with the apparatus?

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

Comment:

.....
.....

2. How would you describe the ease of donning the apparatus?

- Simple
- Difficult
- Very difficult

Comment:

.....
.....

3. How would you describe the comfort of the apparatus while wearing on your belt?

- Comfortable
- Uncomfortable
- Very uncomfortable

Comment:

.....
.....

4. How would you describe the comfort of the apparatus harness after donning?

- Comfortable
- Uncomfortable
- Very uncomfortable

Comment:

.....
.....

5. How would you describe changeover from one apparatus to another during use?

- Good
- Fair
- Difficult

Comment:

.....
.....

6. How would you describe the temperature of the inhaled atmosphere from the apparatus?

- Comfortable
- Tolerable
- Very hot

Comment:

.....
.....

7. How would you describe the resistance to breathing while wearing the apparatus?

- Comfortable
- Tolerable
- Hard

Comment:

.....
.....

8. How would you describe the taste of the inhaled atmosphere from the apparatus?

- Pleasant
- Tolerable
- Unpleasant

Comment:

.....
.....

9. How would you describe the comfort of the nose clip?

- Effective
- Not effective

Comment:

.....
.....

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10. How would you describe the effect of the surface temperature of the apparatus?

- Warm
- Tolerable
- Very hot

Comment:

.....
.....

11. How would you describe the effectiveness of the goggles (where supplied)?

- Effective
- Tolerable
- Ineffective

Comment:

.....
.....

OVERALL ASSESSMENT OF THE APPARATUS

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

SIGNATURE OF WEARER:.....

DATE:

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APPENDIX D Informative References

The preparation of this document has used the following standards as references:

- AS/NZS 1716: 1994 Respiratory Protective Devices
- BS EN 401: 1993 Respiratory protective devices for self rescue Chemical Oxygen (KO₂) escape apparatus
- SABS Draft Document Body Worn Escape Type Breathing Apparatus

Sources of Criteria Used in this document.

Chemical oxygen self-rescuers

New apparatus:

- MDG 3006, which was based on:
- BS/EN401: 1993 Respiratory Protective Devices for Self-Rescue – Self-Contained Closed Circuit Breathing Apparatus – Chemical Oxygen (KO₂) Escape Apparatus – Requirements, Testing, Marking
- South African Standard - SABS private specification on SCSR , 839 (CKM) 1989

In-service apparatus:

Carbon dioxide limits were derived using the following information:

- South African service limits - CSIR Mining Technology: Report No: ES&H - 98 - 0337
- Personal communication re MSHA and NIOSH criteria.
- Discussions with Mr John Pennefather (Scientific Officer, RAN Submarine and Underwater Medicine Unit)
- Discussions with experts associated with the manufacture and supply of escape breathing apparatus, concerning physiology stressor limits.
- Report by Dr Ian Lambert for Dartbrook Colliery, concerning health considerations in carbon dioxide exposures.
- Published literature (various) concerning exposure to carbon dioxide.

Breathing resistance limits (inhalation and exhalation)

These were derived from discussions with the suppliers and from information from the US, to establish a maximum of 1.5kPa. This allowed a 50% increase in the limit for in-service apparatus up to 30 minutes' duration. The same increase was allowed for other resistance limits.

Carbon monoxide filter self-rescuers

Apparatus with duration up to 60 minutes:

For units with durations up to 60 minutes, the limits for both new and in-service apparatus are those which have been applied by the Department since these units were introduced into the mining industry. The average CO value replaces the previous measure of 'CO slip', a concept which was not well understood. The replacement values are equivalent.

Apparatus with duration greater than 60 minutes

To account for new apparatus and provide equivalent protection for the wearer, the maximum and average CO concentrations are lowered for longer duration apparatus to ensure that the total quantity of CO passing to the wearer does not increase.