

Health and safety of underground workforce of paramount importance to the SA mining industry

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BACKGROUND

Underground mines are divided into ventilating districts. This means that two or more workings use the same ventilation air to cool and provide workers with breathable air. In the event of fire or explosion, noxious fumes generated in one section of the mine will therefore affect both the incident site, and any working section in the direction of the air flow, situated within the same ventilating district.

After the Kinross tragedy of September 1986, in which 177 employees lost their lives in the aftermath of an underground fire, belt-worn Self-Contained Self-Rescuers (SCSRs) were deployed into the South African mining industry.

SCSRs provide the wearer with a supply of breathable oxygen. Together with refuge bays, defined escape routes and mine rescue teams, SCSR form an integral part of a mine's escape and rescue strategy. Presently more than 160 000 SCSR are deployed in the South African mining industry.

THE WORKINGS OF SELF-CONTAINED SELF-RESCUERS

During the use of chemical-based Self-Contained Self-Rescuers, the oxygen required for breathing is supplied by a solid chemical substance, potassium super oxide (KO₂). This chemical reacts with the carbon dioxide and moisture from the exhaled air. These two components of the exhaled air are absorbed by the KO₂, which then releases the chemically-bound oxygen in KO₂.

The simplified chemical reaction formulas are:



Potassium super oxide is both an oxygen source and a carbon dioxide absorber. Alternating between inhalation and exhalation, breathing air flows to and fro from the breathing bag, through the chemical canister and breathing tube, and then returns.

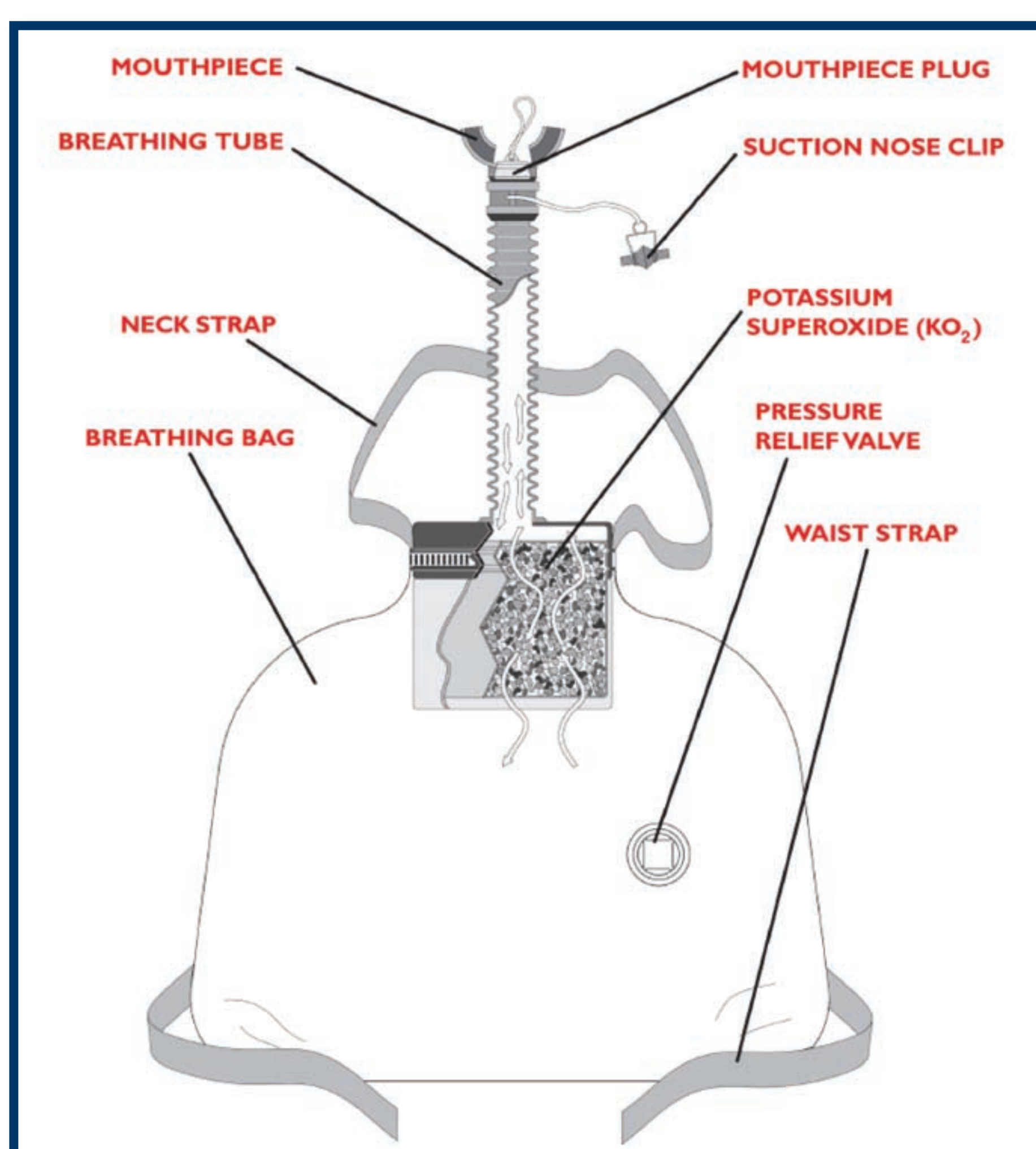


Figure 1. Diagrammatic view of one type of Self-Contained Self-Rescuer

All SCSR deployed in the SA mining industry use the chemical potassium superoxide to generate oxygen. As the chemical is sealed within a container designed to withstand harsh underground conditions, it is extremely difficult to ensure that the SCSR will perform as required in an emergency. This concern resulted in the introduction of a mandatory monitoring programme.

A 1% sample of all SCSR units deployed in mines is selected annually for functional performance assessment; and CSIR Consulting and Analytical Services is the only accredited testing authority in South Africa to perform this monitoring function and is recognised as an international benchmark.

The monitoring programme was established in 1996 at the direction of the Chief Inspector of Mines and is controlled by a tripartite technical committee (TTC) consisting of representatives of government, unions and the mining industry. At present more than 160 mines/shafts are

taking part in this monitoring programme and in excess of 1 500 SCSR are being tested annually.

MAIN OBJECTIVES OF THE SCSR MONITORING PROGRAMME ARE:

a) To detect adverse performance trends in SCSR in daily underground deployment that could ultimately jeopardise a successful escape in the event of an emergency.



b) To assist mine management in achieving legal compliance with Regulation 16.4 of the Mine Health and Safety Act, 1996, i.e. "employer to ensure that no defective self-contained self-rescuer is issued".

c) To detect any trend indicative of 'premature deterioration' in terms of negotiated agreements including periods of guarantee; mines are therefore advantageously placed to minimise (or circumvent) replacement or refurbishment costs.

d) To identify units that remain functional within established norms subsequent to the expiry of negotiated periods of guarantee; mines will therefore benefit in that premature replacement or refurbishment of fully functional units would have been averted.

e) To provide sound technical advice on site to the mines.

f) To provide feedback, through formal reports, on all makes of SCSR, thereby enabling comparative evaluations on an ongoing basis.

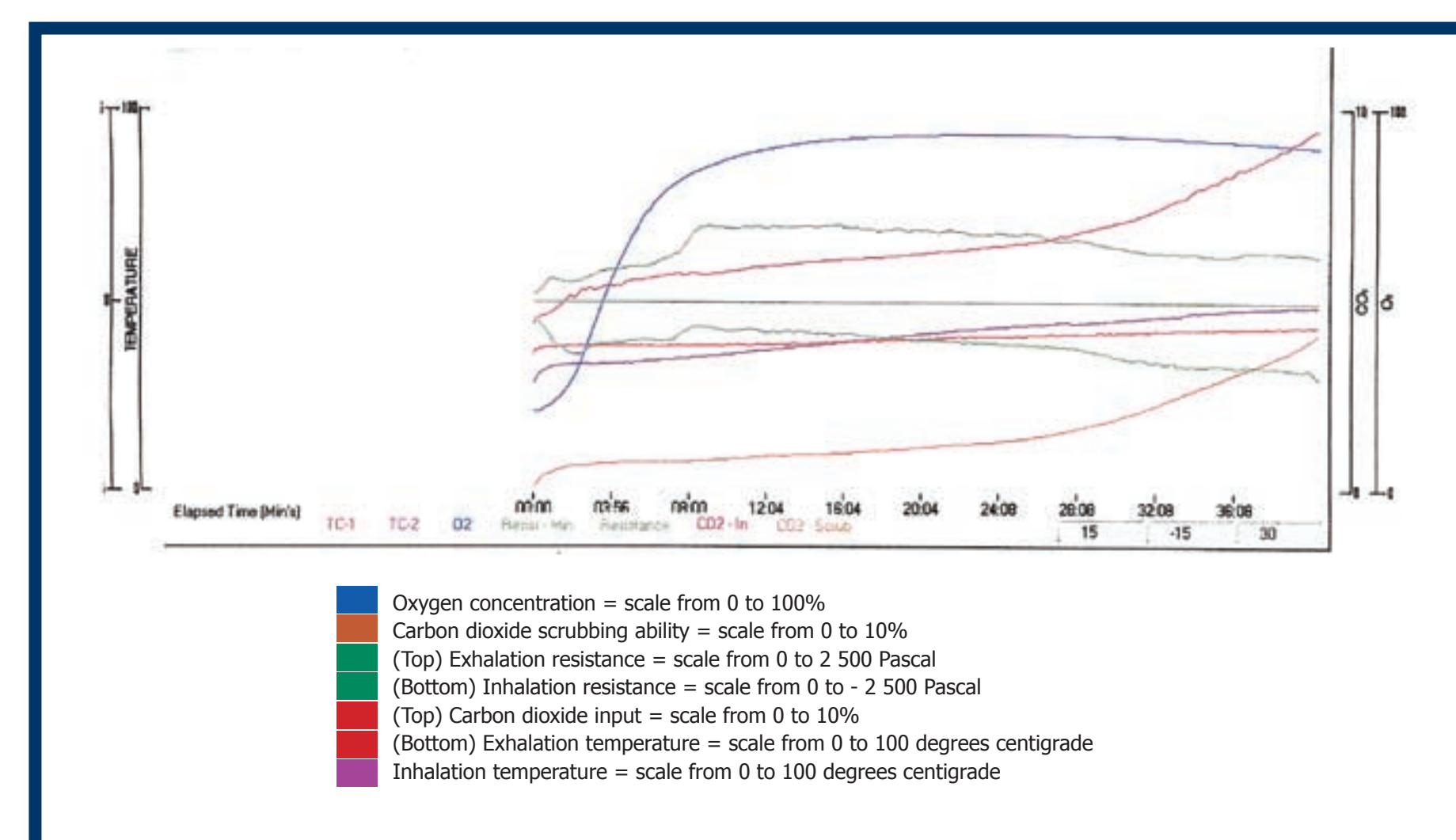


Figure 2. Typical functional performance graph of a Self-Contained Self-Rescuer test on the lung breathing simulator

THE SUCCESS OF THE MONITORING PROGRAMME

The monitoring programme has shown that different units, even when deployed under similar conditions, react and show different degrees of functional performance deterioration. In some types of SCSR this deterioration is more pronounced than in others. In the past few years, more faults were identified than just signs of normal wear and tear, or deterioration of functional performance. These include material failures, structural faults and design weaknesses, which are not related to normal wear and tear. Subsequently, proactive remedial actions could be initiated to rectify these problems timeously. Had the ongoing performance monitoring programme not been in place, any of these problems may only have emerged when the units were used during an emergency, with possibly fatal consequences.

A substantial number of SCSR are activated underground each year, and to date, not a single SCSR malfunctioned – demonstrating the effectiveness and value of the CSIR's SCSR monitoring programme.

Every year, a substantial number of Self-Contained Self-Rescuers (SCSRs) are activated in underground mines and potentially save many lives. The CSIR is the only accredited testing authority in South Africa that can monitor their function and performance, and is recognised as an international benchmark.

