



We keep mines running

COMPETENCE IN THE  
MINING INDUSTRY

## Over 100 years of experience matters!

There are few industries where safety plays such an important role as in mining. Every step must be carefully planned and every decision is critical to ensure efficient and safe mining operation.

For over 100 years, no other company has committed more to miner's health and safety than Dräger. For generations, miners have relied on Dräger to provide quality products to protect their lives.

The history of Dräger and that of mine rescue date back to 1903 when Bernhard Dräger devised the first breathing apparatus during a physiological self-test after the mine disaster in Nova Scotia, Canada. The first documented application of oxygen rebreathers, the Dräger breathing apparatus, for work and rescue in the mining industry was during the devastating mine disaster in 1906 in Courriers, France. The new possibilities offered by Dräger's breathing apparatus paved the way for the emergence of a completely new profession "mine rescue". In North America, mine rescuers are called "Drägermen", even today.

The further development of breathing apparatus for the mining industry was represented by the Dräger Model 1924, which dominated the market for over ten years with its long duration breathing protection for up to two hours. In 1963, the Dräger BG 174

was introduced and has been used for over 40 years in underground mine rescue. Today, mine rescue teams in different parts of the world are equipped with the new generation of close circuit breathing apparatus – the Dräger PSS BG4 plus, which has been developed and constantly improved to provide the highest breathing protection and the best possible comfort for up to four hours.

Dräger is proud to have played a role in creating mine rescue history with these products. To stay abreast of the evolving requirements in today's complex work environment, Dräger supplies a broad spectrum of safety equipment - from respiratory protection and gas detection for daily operational safety to self-contained self rescuers and refuge shelters for emergency situations. All these products can be combined and used as an integrated safety concept to improve mine and workplace safety. In addition, Dräger also offers a selection of professional service and support programs, from product maintenance and inspection to training courses, to meet individual customer's needs.



# Fit for duty



## Non-invasive workplace alcohol and drug testing

Fitness for Duty (FFD), which concerns alcohol and drug impairment, is emerging as a key issue within the occupational health and safety domain.

As workers who are adversely affected by alcohol or illicit substance abuse can pose a risk to themselves and others in the workplace, drug and alcohol testing has become a contractual or corporate requirement and an inherent component of the FFD procedures in many mining sites. Employers have been recommended to adopt the least invasive testing means such as the application of breathalysers and saliva-based drug testing.

### NON-INVASIVE WORKPLACE ALCOHOL TESTING

Utilizing the latest Dräger sensor technology and incorporating a built-in heating element, the Dräger Alcotest 7510 delivers quick and accurate measurement of breath alcohol concentrations, even at sub-freezing temperatures. It can be calibrated to different cut-off points as required.

Through the employment of a piezoelectric activator as part of the new sampling system, the Dräger Alcotest 7510 is capable of detecting the presence

of residual mouth alcohol that may lead to false positive results. It also allows passive measurement without a mouthpiece, such as measurement of alcohol inside an underground vehicle.

This compact and robust breathalyser is easy and hygienic to use. A simple, three-button menu guides the user through the entire sampling procedure. The backlit display makes it easy to read the menu, instructions and test results, even in poor light conditions. The mouthpiece ejection system inhibits any contact with saliva from the tested person.

Fitted with an infrared communication interface, the Dräger Alcotest 7510 allows wireless data transfer from the breathalyser to the Dräger Mobile Printer. The test results can also be forwarded via the Dräger Mobile Printer to a remote host PC by use of either a modem or Ethernet communication link.



ST-16124-2008

### WORKPLACE DRUG TESTING

The Dräger DrugTest 5000 system, comprising two main components: the Dräger DrugTest 5000 Analyzer and the Dräger DrugTest 5000 Test Kits, provides a fast and reliable means of detecting drug abuse for six substance classes, including amphetamines, designer amphetamines, opiates, cocaine and metabolites, benzodiazepines, cannabinoids or methadone.

The system is easy to use and requires only three steps for the entire detection process: sample collection, insertion of the sample into the analyser and result evaluation. Using an optoelectronic system, the analyser provides reliable and precise result of the test sample within just a few minutes.

Thanks to its cutting-edge oral fluid drug testing technology and simple operation, the Dräger DrugTest 5000 system also provides a discreet and hygienic approach for drug management in the mines. Compared to the conventional urine drug testing, the system not only eliminates the need for special facilities and minimizes health risks associated with handling body fluids, but also removes any potential for manipulation and misinterpretation.



ST-15090-2008

Dräger Alcotest 7510



ST-16214-2007

Dräger DrugTest® 5000

# Operational safety



## Respiratory protection for daily use

Protection against dust remains the most commonly needed respiratory protection because of the dust generated by mechanized mining including blasting, drilling and cutting in both surface and underground mines.

The Dräger X-plore range of respiratory protection masks not only ensures effective protection for mine workers against fine dust and particles, but also makes wearing of the mask as simple and natural as using a pair of work gloves. User acceptance is very high due to easy donning and doffing and a high level of wearing comfort.

Equipped with the specially engineered CoolMAX™ exhalation valve, the Dräger X-plore 1300 and the Dräger X-plore 1700 series, offer effective protection against fine dust with very low breathing resistance and allow the user to stay cool by preventing heat build-up underneath the mask. Outfitted with a long lasting and cost effective replaceable filter, the Dräger X-plore 2100 is the reusable alternative to disposable dust masks for frequent work in dusty environments.

In addition to the single filter mask, Dräger also supplies a range of innovatively designed twin filter

half masks that combine flexibility, safety and comfort at the highest level. The Dräger X-plore 3000 series is constructed with the Flexi-Fit harness and X-guided strap system to ensure optimum weight distribution and a safe seal without pressure points. The sweptback position of the filters guarantees a wide and unrestricted field of vision.

Dräger disposable masks are already commonly used in underground mines as effective protection against coal and other dust. The Dräger X-plore 1320 and 1720 series can also effectively filter Diesel Particulate Matter (DPM). For environments with higher concentrations of DPM, half masks like Dräger X-plore 2100 are recommended. Exposure to DPM is not limited to underground mining operations, but also applies to all operations where diesel engines are used.



D-6416-2009

Dräger X-plore® 1320



ST-8673-2007

Dräger X-plore® 1720



ST-949-2008

Dräger X-plore® 3500

## Gas detection for different mining applications

Naturally occurring gases remain a principal airborne hazard in the mining industry and continue to place miners at risk of poisoning through toxic gas exposure, suffocation and fire or explosion caused by combustible gases.

Toxic or combustible gas can be colorless and odorless and reduced oxygen levels are invisible. Hence potential hazards can only be identified in time through the measurement and control of the environment to prevent the occurrence of mine fires, unplanned explosions, and occupational illnesses or injuries.

### PERSONAL AIR MONITORING

Whether the application is in general mining operations or mine rescue, Dräger offers a comprehensive line of gas detection products, the Dräger single gas Pac series and the Dräger multi gas X-am series, for personal air monitoring and workplace exposure monitoring.

Outfitted with the innovative Dräger XXS sensor technology, these personal air monitors offer fast and reliable measurement of the gas concentration level at a relatively low cost of ownership - thanks to the long-term stability and lifespan of the DrägerSensors. The positioning of the DrägerSensors allows gas ingress at both the top and the front of the unit.

The Dräger Pac 3500, a disposable single gas detector with a two-year maintenance free lifetime, and the Dräger Pac 5500, a serviceable single gas detector with unlimited instrument lifetime, are both equipped with an event logger and provide fast detection of CO, O<sub>2</sub> or H<sub>2</sub>S. The Dräger Pac 7000, with unlimited instrument lifetime and extensive data logging capabilities, can be used to measure a variety of gases including CO, CO<sub>2</sub>, Cl<sub>2</sub>, HCN, H<sub>2</sub>S, NH<sub>3</sub>, NO, NO<sub>2</sub>, O<sub>2</sub>, PH<sub>3</sub>, SO<sub>2</sub> and organic vapors.

The Dräger X-am 2000 1- to 4- gas detector is the cost effective multi gas monitor for the measurement of combustible gas and vapor as well as O<sub>2</sub>, H<sub>2</sub>S and CO. Approved for zone 0 and customizable with different sensors, the Dräger X-am 5000 offers the flexibility of tailor-made configurations to measure up to 5 gases needed for specific applications. The new Dräger X-am 5600, with a dual infrared Lower Explosive Limit (LEL) and carbon dioxide sensor, can detect up to 6 gases and is recommended for coal mining environments.

### FIRE AND EXPLOSION PREVENTION

To prevent fire and explosion in underground mines, especially in coal mines, regular cave monitoring and seal checks are performed for the detection of methane build-up or fire damp at the mine roof as well as methane leakage from the mine's sealed-off area.

The innovative catalytic Ex sensor in the Dräger X-am 5000 and X-am 7000, measures both 0-100 % LEL and 0-100 Vol.% methane concentration. A range of special calibrations for the catalytic Ex sensor allow even more sensitivity when detecting specific combustible gases and vapors.

In the event that a stationary Ex gas detection system used to detect seam gas outbreaks in longwall mining fails, the innovative area monitoring system, the Dräger X-zone 5000 in combination with the Dräger X-am 5000 or X-am 5600, can be connected to the control system as an interim solution to shorten the production stop time. All the gas emission levels and alarms can be transferred to the control room for real-time monitoring and safe production.



D-16522-2009

Dräger Pac® 7000



D-23637-2009

Dräger X-am® 5600



D-23602-2009

Dräger X-zone® 5000



### CONFINED SPACE ENTRY/POST BLAST INSPECTION

Gases can become even more dangerous in confined areas where ventilation is minimal or explosives have been used and the blasting by-product nitrogen oxides are created. Therefore, testing for atmospheric hazards prior to and during entry into a confined space or before re-entry into a working post-blast is necessary to ensure the safety of the miners.

The small profile of the Dräger X-am 2000, X-am 5000 or X-am 5600, in combination with the external pump, is well suited to these applications. The optional external pump operates with a flexible hose up to 30 m / 100 ft long and starts automatically when the gas monitor is inserted. Another solution for such applications is the Dräger X-am 7000 multi gas detector with the optional high performance built-in pump that can sample gases with a probe up to 45 m / 150 ft in length.

### SPOT MEASUREMENT

Apart from electronic gas monitors, detection tubes are still widely used for certain applications in mines, both above and underground. Dräger-Tubes, which boast a tradition of nearly 80 years, are a reliable source for spot measurement and precautionary warnings. Main

applications include the detection of diesel emission, testing the effectiveness of ventilation systems with an air current kit, detection of formaldehyde and phenol after the injection of a large amount of foam within a very short time and with reduced ventilation.

### DIESEL EXHAUST DETECTION

The operation of diesel-powered equipment in the mining industry, especially in underground mines, inevitably generates another airborne hazard - diesel exhaust. Given the restricted ventilation and enclosed working environment, the local build-up of NO<sub>x</sub> may result in potential short and long term health issues; hence the importance of emission monitoring to ensure the gas level does not exceed the permissible exposure limit.

Thanks to the shock-proof and -resistant product construction, the Dräger MSI EM200-E diesel exhaust gas tester is designed to withstand the harsh conditions in underground mining. Equipped with 3 plug-in mounted electrochemical sensors, CO, NO and NO<sub>x</sub> for the measurement of CO and nitrous fumes, the Dräger MSI EM200-E allows accurate measurement of undiluted diesel exhaust gas in underground mines.



ST-9480-2007

Dräger X-am® 5000  
with external pump



ST-46-2001

Dräger-Tubes®



5600609-EM200E

Dräger MSI EM200-E





# Effective escape concept



D-30153-2009



ST13391-2008

## From individual self escape device to group shelter system

Mine incidents continue to cause great concern among the mining community and the public at large. The primary need for the development of an effective mine-specific emergency escape strategy is becoming even more prominent within the industry.

As stipulated in the mining regulations of many countries, all persons underground at the time of a mine incident shall be equipped, trained and able to make an escape to the surface, or a place of safety, if physically capable. Technologies and systems used to enhance self escape from underground mines include but are not limited to self rescue apparatus and refuge emergency bases.

### SELF ESCAPE WITH SELF RESCUER

Depending on the mining method and the specific condition of the underground mine, different types of self rescuers, filter or chemical oxygen based, have been used in the mining industry. The chemical oxygen Self-Contained Self Rescuers (SCSR) from Dräger are among the most commonly used escape self rescuers in the mining industry, offering protection against smoke, oxygen deficiency and toxic gases in emergency situations.

With different nominal duration between 25 to 60 minutes, the Dräger chemical oxygen SCSR can be incorporated into the self escape system according to the specific requirements. The integrated starter cartridge with quick start mechanism ensures immediate oxygen supply to the wearer upon donning.

The new Dräger Oxy 6000 chemical oxygen SCSR with a nominal duration of 60 minutes brings a new level of safety. The innovative "Safety Eye", a clear status window, allows the wearer to check for the presence of moisture and yellow KO<sub>2</sub> fragments within the device on a daily basis, hence offering an immediate confirmation of operational readiness. Thanks to the state-of-the-art design, the Dräger Oxy 6000 offers a 10-year service lifetime without additional testing and maintenance.



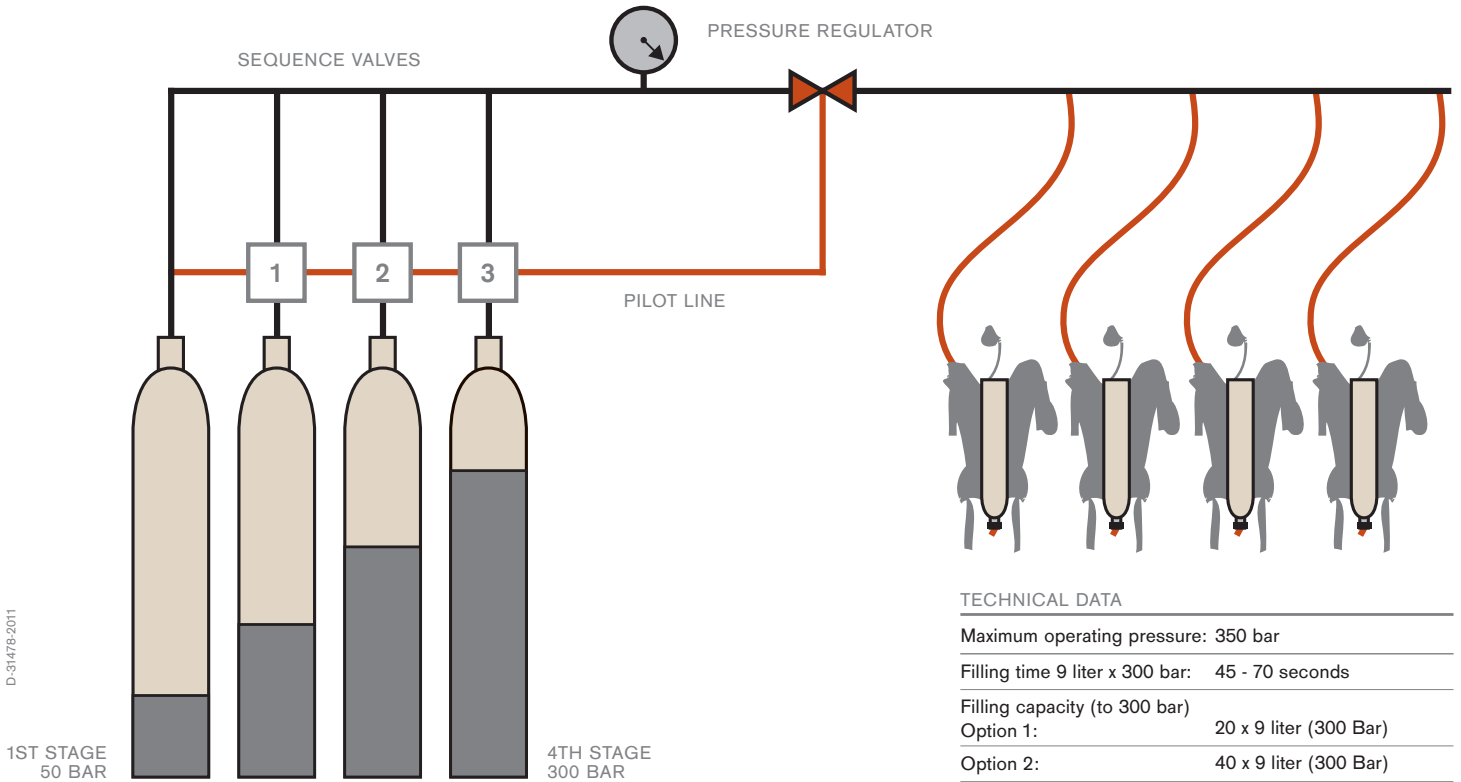
D-3789-2009

Dräger Oxyboks



D-98-2010

Dräger Oxy 6000



D-31478-2011

The initial reaction of persons involved in an underground incident is a significant determinant of their survival. To be prepared for an emergency situation, regular training on the use of the oxygen self rescuer is essential. All Dräger chemical oxygen SCSRs can be supplied in a training version. An optional mouthpiece combination is also available for the simulation of realistic operational temperatures in addition to breathing resistance.

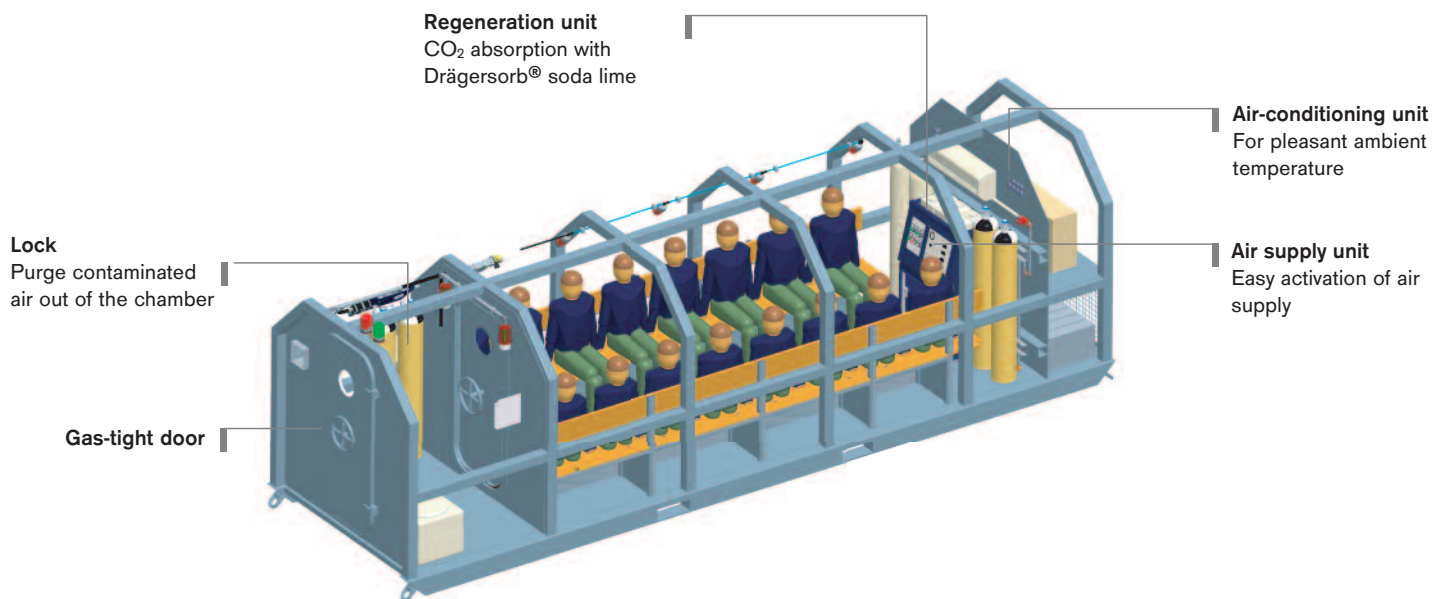
**SELF ESCAPE WITH CHARGEAIR SYSTEM**

In the immediate aftermath of an underground mine explosion, the miners' ability to effectively escape may be limited due to poor visibility caused by smoke and dust as well as a lack of communication. The Dräger ChargeAir Station used in combination with Self-Contained Breathing Apparatus (SCBA) presents a good alternative and extension of the belt-worn SCSRs to enhance self escape and first response capability of underground personnel.

The Dräger ChargeAir Station is a tailor-made respiratory protection system which allows the simultaneous charge of up to 5 breathing apparatuses in minutes. It can also be supplied in combination with the First Response Emergency Evacuation Kit (FREEK), a dust-tight unit for the safe keeping and storage of SCBAs and other safety equipment.

Enjoying an outstanding reputation among professional users, the Dräger PSS SCBA series is the best choice for your emergency escape system, making long escape routes more viable. Combining advanced ergonomics and the well established Dräger PSS Pneumatics with a wide range of configurable options, the Dräger PSS 5000 provides the user with the comfort and versatility to meet the demands of first response and self escape.





**CHAMBER FOR CHANGE OVER OR AS SHELTER**

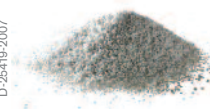
An emergency response underground in accordance with the escape and rescue plan can be further supplemented by escape and refuge chambers to ensure the safety and rescue of workers in hazardous situations. In the event of an emergency caused by fire, explosion, cave-in or other mine incidents, when smoke or poisonous gases reach a sufficiently high concentration that is immediately dangerous to life or health, the miners underground are required to escape to the nearest refuge chamber.

Equipped with an internal or external source of breathing air or regeneration system, the Dräger

refuge chamber supplies breathable air and generates positive pressure to prevent any contaminated outside air from entering the chamber. The air inside the chamber is additionally regenerated in a closed-circuit system by adding oxygen and removing carbon dioxide from the exhaled air with Drägersorb soda lime to prevent carbon dioxide poisoning.

Tailored to the specific needs of the customer, Dräger escape and refuge chambers can be furnished with communication facilities and/or protective equipment as well as food and drinks. This will allow personnel to take a safe break en route to safety or to wait for help in a more bearable condition for a longer period of time.

D-254119-2007



Drägersorb® soda lime

# Professional mine rescue



## Breathing protection and environment assessment

In case of emergency, only with the help of the mine rescue teams, can the trapped or injured miners be rescued and the mine be recovered.

The availability of mine rescue capability for emergency rescue and recovery is required by law in most of the mining countries around the world. In a mine rescue and recovery mission, the protection of the mine rescue team is vital to their safe operation and fulfillment of the mission.

### BREATHING AIR FOR LONG DURATION MISSION

Throughout history, whenever mine rescue teams are called upon to save lives or fight fires during an emergency, above or below ground, the Dräger Closed Circuit Breathing Apparatus (CCBA) has always been the first choice for mine rescue teams worldwide. It offers the user maximum comfort and flexibility for long duration operation up to 4 hours, even when maneuvering in tight spaces.

Modified on the basis of the proven Dräger PSS BG 4, the new Dräger PSS BG 4 plus represents a good example of joint efforts between Dräger and the end users to meet the precise needs of the user.

Numerous improvements and new accessories have also been incorporated into the existing system to increase safety and durability and further enhance the ease of maintenance.

To reduce the temperature of inhaled air and minimize physical stress to the user, the breathing air cooler can be filled with ice. An alternative cooler which requires no ice and makes separate cooling logistics obsolete is also available. Reactivated after only 5 hours, the cooler offers unlimited use and is easily retrofitted.

The Dräger PSS BG4 plus can also be equipped with the Dräger FPS 7000 RP full face mask with a hydration system to offer more comfort and protection against heat stress and dehydration. The special design of the hydration system, which can be used in combination with CamelBak's Pakteen™ or Delta-5 Tactical Vest™ for water replenishment up to 3 liters, helps to ensure safe and easy ingestion of fluid during rescue missions.



ST-12482-2008

Dräger FPS® 7000



D-12247-2009

Dräger FPS® 7000 with drinking device



Outfitted with the fully electronic warning and signal unit Bodyguard/Sentinel II, the Dräger PSS BG 4 plus provides the user with important information, such as cylinder pressure, remaining duration or temperature during the assignment. The information is presented visually and acoustically. The data registered by Bodyguard/Sentinel II can also be downloaded via a computer for data management and analysis.

#### ORIENTATION IN SMOKY ENVIRONMENTS

In the event of a mine fire or explosion, fire fighting and similar emergency response situation, vision is often impaired by dense smoke or darkness. The new generation of Thermal Imaging Cameras (TICs) introduced by Dräger is another invaluable tool for casualty search and situational assessment during mine rescue missions.

As the first ATEX, IECEx and ETL/Intertek certified intrinsically safe thermal imaging camera, the Dräger UCF 7000 represents a new generation of TICs which can be used in zone 1 and 2 classified explosive areas.

The light weight design of the Dräger UCF 7000 enables single handed operation. Apart from the

excellent image quality, the "snapshot" function of the Dräger UCF 7000 makes it even possible to "see around corners" when the movement of the equipment or the field of view is limited. When fast response and quick adaptation are required, one of the three additional operating modes - Fire, Person (for search and rescue), or ThermalScan - can be selected and adjusted at the touch of a button.

Also intrinsically safe, the Dräger UCF 9000 offers even higher resolution and an integrated video camera in addition to the features of the Dräger UCF 7000.

#### MINE ENVIRONMENT EVALUATION

Before re-entry and during rescue and recovery operation, mine rescue teams need to perform frequent gas measurements to determine the possible impact of gases present on their rescue mission. The Dräger X-am 7000 multi gas detector can be equipped with three electrochemical, and two catalytic bead, infrared or photo ionization sensors, allowing simultaneous detection and continuous monitoring of up to five gases. The high performance built-in pump makes it possible to sample gas in combination with a probe.



D-7287-2010

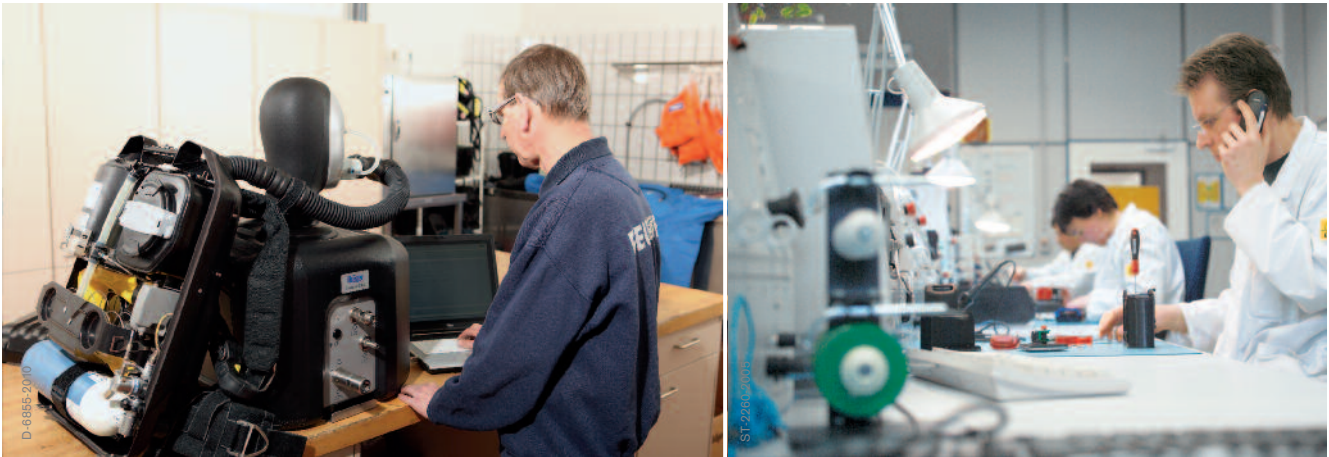
Dräger UCF 7000



ST-67-2006

Dräger X-am® 7000

# Dedicated device maintenance



## Functional testing and data management

After the operation is before the operation. In view of the unpredictability of mine incidents, all of the safety equipment must always be 100% safe and be ready for use at all times.

Reliable sensor technology and gas detectors can certainly protect miners and mine rescue teams against invisible gas hazards, but only through regular maintenance, calibration and function testing can this reliability be maintained.

The Dräger Bump-Test-Station, independent of external power supply, allows a functional (bump) test to be performed with a test gas to check the warning function of the gas detector anywhere in the field. The test results can also be transmitted to Dräger Mobile Printer for documentation. The Dräger E-Cal system, an automatic test and calibration system, performs calibration on up to 10 instruments at a time. All aspects of calibration and documentation are controlled and managed by the computer through the Dräger CC-Vision software.

To ensure the highest level of safety and performance of the personal protective equipment, Dräger offers a series of equipment for daily testing and optimum care and maintenance of Closed-Circuit Breathing Apparatus (CCBA) and Self-Contained Breathing Apparatus (SCBA) sets.

The Dräger Test-it 6100 is a mobile test device especially designed to test all functions of the Dräger PSS BG4 plus at an attractive price and low operating costs. With the integrated artificial lung, the new Dräger Quaestor test equipment series permit dynamic simulated breathing tests in addition to function and leakage tests. Both the Dräger Quaestor 5000 (semi-automatic) and the Dräger Quaestor 7000 (fully automatic) are available in four different configurations to suit different work processes and needs in terms of test volume and spectrum of respiratory protection products to be tested.



ST-4700-2005

Dräger Bump-Test-Station



D-4239-2009

Dräger Test-it 6100



D-6500-2010

Dräger Quaestor 5000

# Holistic service and support



## Customized product related programs

### DRÄGER WORKSHOP SYSTEM

Dräger not only provides a full range of products in order to keep safety equipment in the best possible condition, but also offers complete workshop systems tailored to meet different needs from conceptualization to individual configuration. Amongst other things, these include oxygen booster pumps and a broad range of powerful compressor systems, which will be planned, assembled and supported according to specific requirements.

### DRÄGER RENTAL PROGRAM

When in need of additional safety equipment for a smelter or refinery shutdown or as an interim replenishment during equipment repair, Dräger can offer a comprehensive selection of rental equipment from gas detection to respiratory protection to meet infrequent or unplanned demand. With fully functional devices available from the shelf, the Dräger rental program provides a flexible and affordable alternative to purchasing new equipment.

### DRÄGERSERVICE

As an integral part of our commitment to support your effective health and safety management, DrägerService offers a wide range of flexible services to meet specific needs and requirements – from maintenance and repair of individual units to comprehensive service packages. Equipped with advanced test equipment specially designed and developed for servicing Dräger safety equipment and supported with an extensive global network of well trained and certified service technicians, DrägerService is always there - whenever and wherever needed.

### DRÄGER TRAINING

Protecting life is the top priority at Dräger – realized not only in the premium quality of our equipment but also in our practical trainings and seminars. Training and certification in use, service and maintenance of safety-related devices, and the corresponding regulations, are becoming increasingly important. Our proven seminars are either targeted to a specific group of devices or particular group of people (e.g. safety engineers).

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