



Chemical Refuge Chambers

The MineARC ChemSAFE Standard Design Range

Designed to provide a safe haven for personnel in the petrochemical industry, suddenly trapped in a hazardous or toxic environment.



chemSAFE
STANDARD DESIGN

ChemSAFE
Standard Design 12-Person
PS-SD2-12-SIV-12



MineARC Systems - Built for Safety.

www.minearc.com



mineARC
SYSTEMS

Company Profile

MineARC Systems is the global leader in the manufacture and supply of emergency safe refuge solutions for the mining, tunneling, chemical processing and disaster relief industries.

With over 20 years' experience, our dedication to ongoing research and development is driven by our key focus to continually offer the best and most advanced safety solutions on the market.

Our team of qualified engineers, electrical designers and technical experts form a global network across five international locations including;

- Perth, Western Australia
- Johannesburg, South Africa
- Dallas, Texas
- Santiago, Chile
- León, Mexico
- Beijing, China
- Reading, UK

This allows MineARC to provide 24 hour service and engineering support to our expanding list of clients in over 65 countries across the globe.

All MineARC Refuge Chambers and Safe Havens comply with the highest international regulations and recognized 'world's best practice' industry guidelines. Our key focus on quality control and product advancement has meant that MineARC Refuge Chambers have successfully saved lives in multiple real life industrial emergencies around the globe.

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MineARC ChemSAFE Refuge Chambers



Custom ChemSAFE with gas monitoring, auto-locking doors & blast rating upgrade

MineARC understands that emergency response requirements differ depending on a site's processing conditions, location of personnel, dangerous goods inventory and a host of other important factors.

In response, MineARC has developed a fully sealed, transportable and cost effective alternative to site building modification – the MineARC ChemSAFE Range.

Within the petrochemical industry, the common practice of modifying existing site buildings to function as shelter-in-place refuge chambers can often prove a timely and costly exercise, resulting in a non-flexible solution as site requirements shift over time. Building modification can also prove ineffective, with numerous air entry and exit points to consider, not to mention costly blast proofing if required.

MineARC ChemSAFE Refuge Chambers offer a safe and secure go-to area for multiple personnel in the event of a toxic chemical release, fire, explosion or other hazardous emergency response scenario.



Bureau Veritas ISO 9001:2008 Quality Management Systems



API 753 Management of Hazards Associated with Location or Process Plant Portable Buildings



2009 ASCE Design of Blast Resistant Buildings in Petrochemical Facilities



Omega Risk Blast Assessment Third Party Testing



Australian C-Tick Standards: AS4100-1998, AS3570.1-18, AS2208, AS3000, AS1716-15



Canadian Standards Association (CSA)



United States National Electrical Code (NEC) 2013/14



European CE Certified to Machinery Norms

Chemsafe Fundamentals: Three Key Principals

1. MAINTAIN

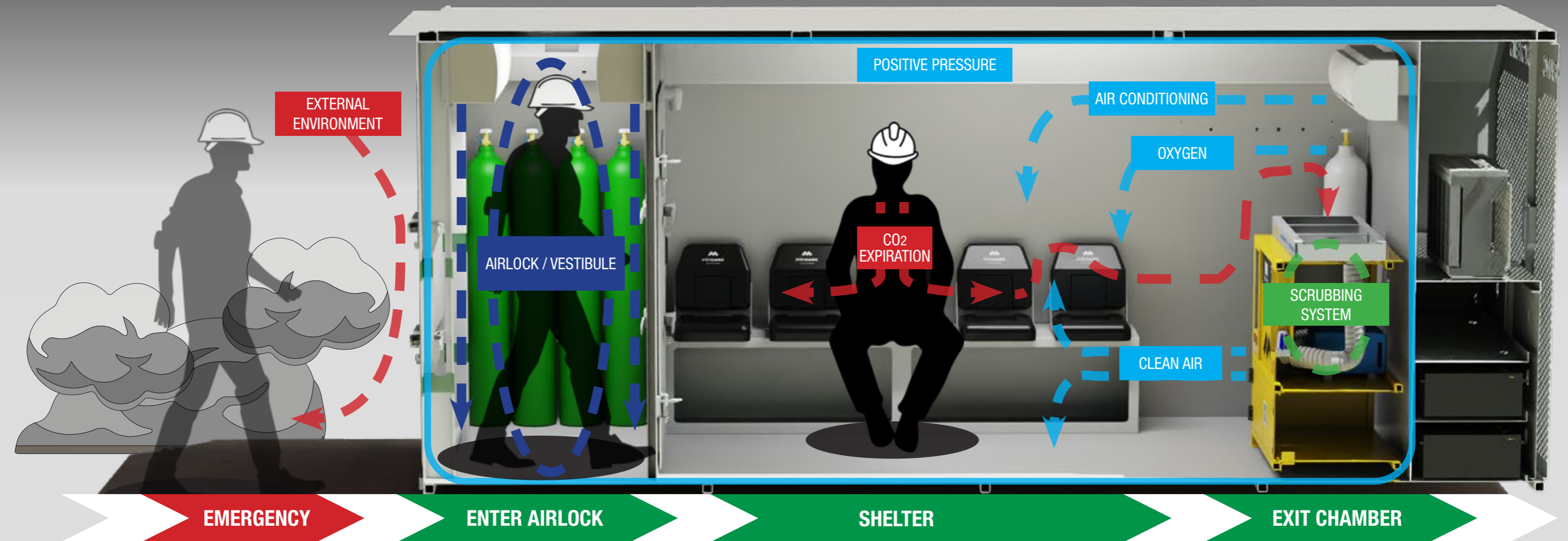
Maintain a sealed internal environment with a positive pressure gradient compared to the external environment.

2. MONITOR

Monitor heat and gas levels within the internal environment via the Aura-FX Fixed Gas monitor.

3. CONTROL

Respond to increases in heat and gas levels and where applicable activating the life support systems found within the refuge chamber.



EMERGENCY

An emergency has taken place and personnel that are unable to evacuate to a safe distance must seek shelter.

AIRLOCK/VESTIBULE

An airlock/vestibule improves the ability to maintain a clean internal environment by flushing contaminants before entry into the main chamber. Your chamber might not feature an airlock/vestibule.

MAIN CHAMBER

When personnel enter the main chamber, they will be required to activate the various life support systems. Instructions will prompt personnel to do so as and when required. When an emergency is over and the all clear is given, personnel can exit the chamber as per site procedure.

- CO₂/CO scrubbing
- Oxygen (via an Automated Oxygen Delivery System or manual regulator)
- Gas monitoring
- Air conditioning

All life support systems running in tandem are necessary for the survival of the personnel over an entrapment period.

Standard Configurations

The ChemSAFE Standard Design (SD) Refuge Chamber has been continuously refined to offer the latest in safe refuge technology, providing occupants with optimal safety features, functionality and performance.

As MineARC's original and most requested design, the refuge chamber has been meticulously engineered to ensure ease of transport and a robust exterior. Constructed from 5mm (1/4") steel plate with external steel support wraps as standard, the refuge chamber comes equipped with a skid base, lifting lugs and forklift slots to the sides. The steel structure can be further reinforced to withstand up to 12psi overpressure blast.

Standard configurations are available based on occupancy from 8 to 30 people.



PS-SD2-12-SIV-12

Features

- Series IV Scrubbing System with pre-packaged CO2 chemicals
- Blast rating: 5psi
- iVAN voice prompt system
- Aura-FX Digital Gas Monitoring System
- Positive Pressure Flushing System
- Air conditioning and dehumidifying
- Internal lighting / external warning lights and siren
- 12hr minimum backup power supply (UPS)
- Internal or external airlock



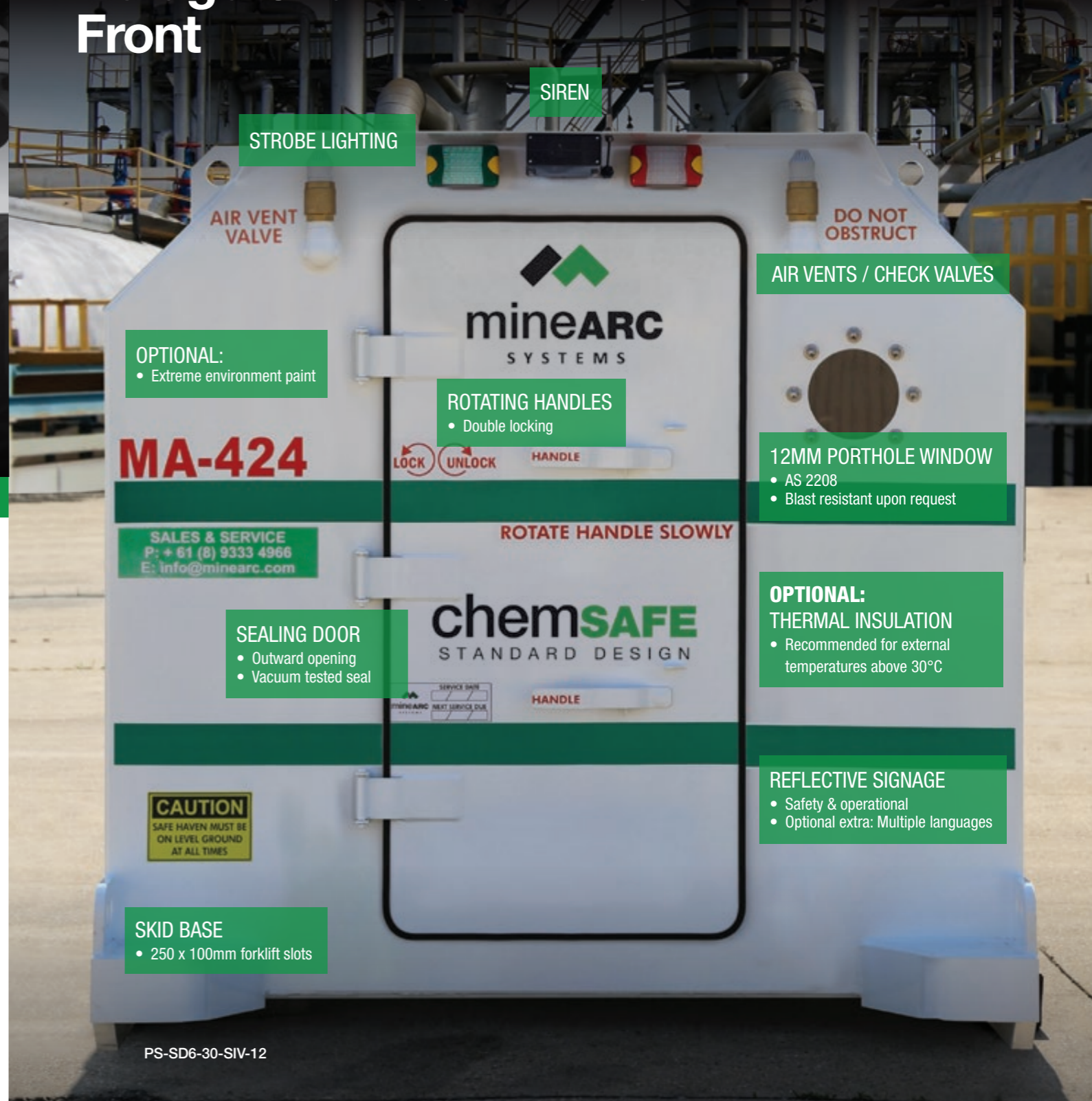
PS-SD1-08-SIV-12 (8 Person) PS-SD2-12-SIV-12 (12 Person) PS-SD3-16-SIV-12 (16 Person) PS-SD4-20-SIV-12 (20 Person) PS-SD5-26-SIV-12 (26 Person) PS-SD6-30-SIV-12 (30 Person)

Standard Dimensions

Model	Occupancy (persons)	Height (m/inch)	Width (m/inch)	Length (m/inch)	Weight (kg/lb)
PS-SD1-08-SIV-12	8	2.21 / 87"	2.25 / 89"	4.19 / 165"	4300 / 9400
PS-SD2-12-SIV-12	12	2.21 / 87"	2.25 / 89"	4.80 / 189"	4700 / 10200
PS-SD3-16-SIV-12	16	2.21 / 87"	2.25 / 89"	6.02 / 237"	5400 / 11900
PS-SD4-20-SIV-12	20	2.21 / 87"	2.25 / 89"	7.23 / 285"	6000 / 13200
PS-SD5-26-SIV-12	26	2.21 / 87"	2.25 / 89"	8.44 / 332"	8400 / 18500
PS-SD6-30-SIV-12	30	2.21 / 87"	2.25 / 89"	9.64 / 380"	8600 / 19000

Custom dimensions and occupancies available. Refuge chamber dimensions are ultimately designed to client specifications. Weights provided are Australian standard 12hr models. Indicative weights only. Custom variations will impact final refuge chamber weight.

Refuge Chamber Exterior Front



- SIREN**
- STROBE LIGHTING**
- AIR VENT VALVE**
- DO NOT OBSTRUCT**
- AIR VENTS / CHECK VALVES**
- OPTIONAL:**
 - Extreme environment paint
- ROTATING HANDLES**
 - Double locking
- 12MM PORTHOLE WINDOW**
 - AS 2208
 - Blast resistant upon request
- OPTIONAL: THERMAL INSULATION**
 - Recommended for external temperatures above 30°C
- SEALING DOOR**
 - Outward opening
 - Vacuum tested seal
- REFLECTIVE SIGNAGE**
 - Safety & operational
 - Optional extra: Multiple languages
- SKID BASE**
 - 250 x 100mm forklift slots

PS-SD6-30-SIV-12

The 'face' of the refuge chamber is designed primarily for easy identification and quick access during an emergency.

The strobe lighting, warning siren and reflective signage alert passers-by to the refuge chamber's location, while the rotating door handles provide simple, straight forward access to the safety of the interior.

An additional feature of the ChemSAFE Standard Design range is a fully pressurised airlock, providing added protection against the ingress of smoke and other harmful toxins. Airlocks are available as either an internal or external feature of the refuge chamber.

Refuge Chamber Interior

Refuge Chamber Interior



OPTIONAL:
POSITIVE PRESSURE MAINTENANCE SYSTEM

OPTIONAL:
AUTOMATED OXYGEN DELIVERY SYSTEM

INTERIOR LIGHTING

CLIMATE CONTROL SYSTEM

OXYGEN SUPPLY:
MEDICAL GRADE OXYGEN CYLINDERS

- Minimum capacity based on G size cylinder (8,580L); quantity required outlined below:

Model	8-Person	12-Person	16-Person	20-Person	26-Person	30-Person
12 hr	1	1	1	2	2	2

*Medical grade Oxygen cylinders to be provided by end user.

OPTIONAL:
GUARDIAN REMOTE MONITORING SYSTEM

OPTIONAL:
TRANSFORMER

OPTIONAL:
GUARDIAN LTE CONNECTIVITY

OPERATING PROCEDURES

- Wall mounted + hardcopy manuals

SERIES IV DIGITAL CONTROLLER INTERFACE

CHEMICAL CARTRIDGE PLENUM TRAY

CIRCUIT BREAKER

MOTION SENSOR

EMERGENCY ESCAPE HATCH

- Inward opening
- Accessible internally & externally
- Neoprene memory seal

BATTERY UPS ISOLATION SWITCH

AURA-FX DIGITAL GAS MONITOR

AURA-FX EXTERNAL GAS MONITORING

SEATING

- Ergonomically designed
- Durable, hard wearing fabric
- 500mm seating per person

SCRUBBER FLOW AIR VENT

NON-SLIP FLOORING

- Raised, removable

STORAGE

- Under seat + cabinet

Inside a MineARC ChemSAFE Standard Design Refuge Chamber, a number of vital life-support systems combine to create a safe, ongoing environment for occupants.

Systems include; air (Oxygen) supplies, air conditioning and dehumidifying, positive pressure systems, electrical and communications, gas detection and CO2 absorption (referred to as 'scrubbing' systems).

i.V.A.N.

The digital controller interface is the operational hub of the refuge chamber. From here, all power, lighting and scrubbing systems can be managed with the push of a button.

Exclusive to MineARC, iVAN (Intelligent Voice Audio Navigation) represents a breakthrough in safe-refuge technology. iVAN is the on-board navigation assistant that guides occupants through operational procedures.

Air Conditioning

Air conditioning is vital to combat the potentially fatal effects of heat stress. A continuous build up in heat is caused by the occupant's metabolic activity, as well as any ambient (external) heat affecting the refuge chamber internal temperature.

Optional: Automated Oxygen Delivery System

The MineARC Automated Oxygen Delivery System (AODS) is designed to maintain a safe, breathable atmosphere within the refuge chamber.

Once the system is activated, the AODS disperses metered amounts of oxygen supplied by a compressed oxygen cylinder, based on Aura-FX gas readings. The AODS maintains oxygen levels between 18.5% and 23% inside the refuge chamber when the external fresh air supply has been compromised or is unavailable.

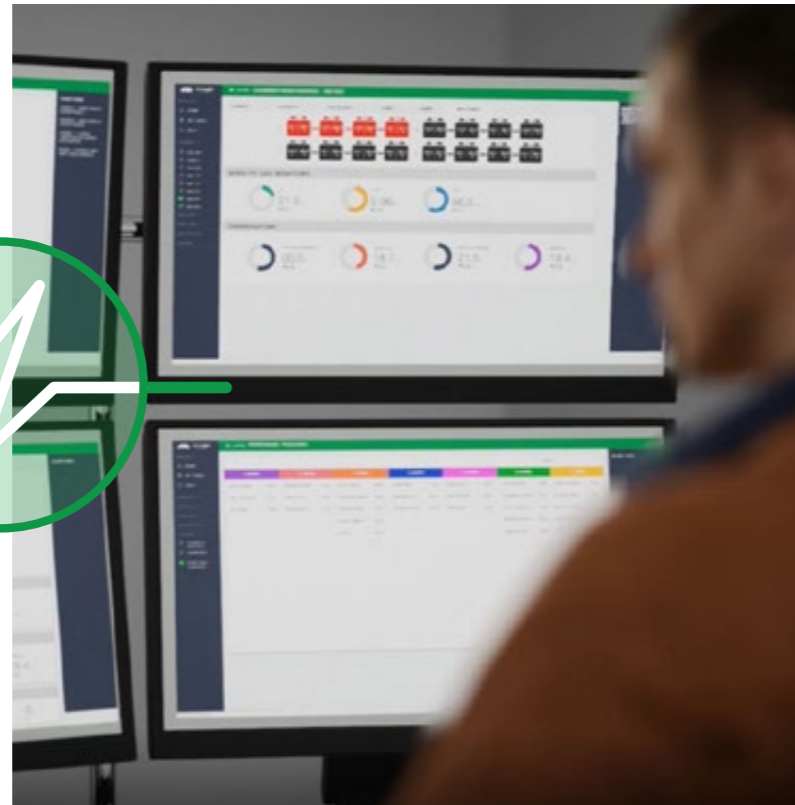
Optional: GuardIAN Refuge Chamber Monitoring

MineARC's **GuardIAN Refuge Chamber Monitoring System** is an exciting development in chamber technology. GuardIAN enables real-time monitoring; providing confidence that an operation's fleet of refuge chambers are emergency ready at all times.

GuardIAN Monitoring is an on-board system that continuously monitors all vital refuge chamber operating systems. During standby mode GuardIAN checks for component faults and monitors chamber usage or entry to the chamber.

The GuardIAN Chamber Monitoring system is hosted on an internal server within the refuge chamber so that no client software installation is required. The responsive webpage is easily accessible from any computer, tablet or smartphone and features a summary of your entire chamber fleet and overall operational status, with the ability to drill down to a detailed report of each chamber.

GuardIAN Chamber Monitoring provides the added advantage of remote troubleshooting assistance by MineARC Engineers, who can login to view the chamber diagnostics dashboard with sites' permission.



Optional: GuardIAN Refuge Chamber Monitoring

Event Logging & Fault Diagnostics

MineARC's Series IV Digital Controller links directly to the GuardIAN Network, streaming real-time system data, including automated system checks, fault logging (battery, scrubber, temperature and inverter), system diagnostics, internal and external temperature measurements, and system actions such as scrubber activation.

MineARC's Aura-FX also provides real-time gas monitoring data and analysis via the GuardIAN Network dashboard.

Live Video Monitoring and VOIP Video Phone

Internal video monitoring is provided by a remote controlled, motion activated GuardIAN IP camera. When activated, the camera will send out a live, recorded stream of the interior of the refuge chamber to the GuardIAN Network.

To assist occupants during an emergency or safety drill, chambers are also equipped with a VOIP video phone, facilitating face-to-face communication between the refuge chamber and the surface.



Positive Pressure Monitoring System (PPMS)

The Positive Pressure Maintenance System (PPMS) enclosure is securely mounted to the interior wall of the refuge chamber. Powered by a 24VDC power supply, the electric solenoid valve opens and closes to release measured amounts of breathable air from compressed air cylinders in order to maintain a positive internal pressure.

The quantity of compressed breathable air cylinders is configurable to suit various internal volumes and durations of operation.

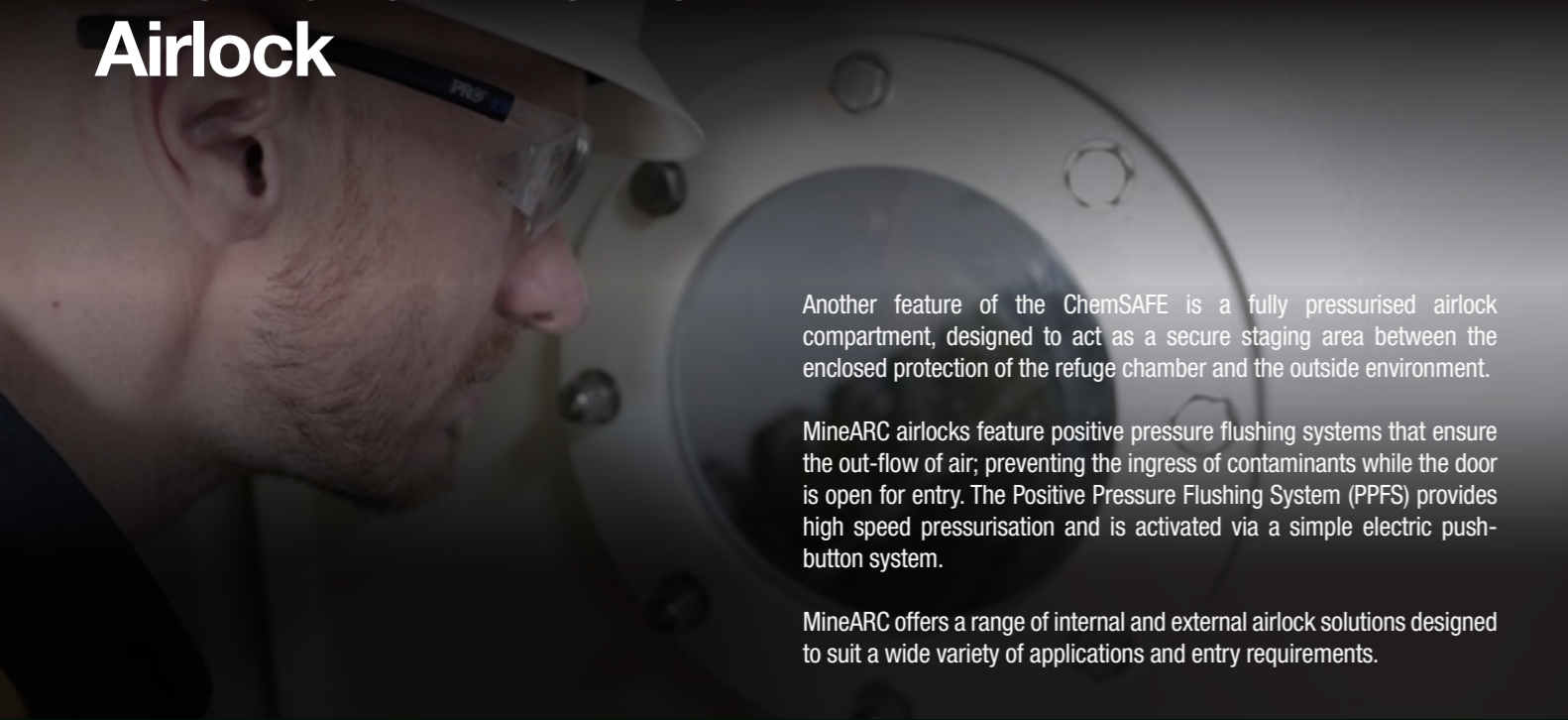
Aura-PT Handheld Digital Gas Monitor

The Aura-PT provides personnel with the ability to digitally monitor up to six gases in their immediate surroundings.

Light and compact, when used in conjunction with MineARC's GuardIAN Intelligence Network, dangerous gas levels can be communicated to the central GuardIAN Server via adjacent GuardIAN Nodes.



Internal & External Airlock



Another feature of the ChemSAFE is a fully pressurised airlock compartment, designed to act as a secure staging area between the enclosed protection of the refuge chamber and the outside environment.

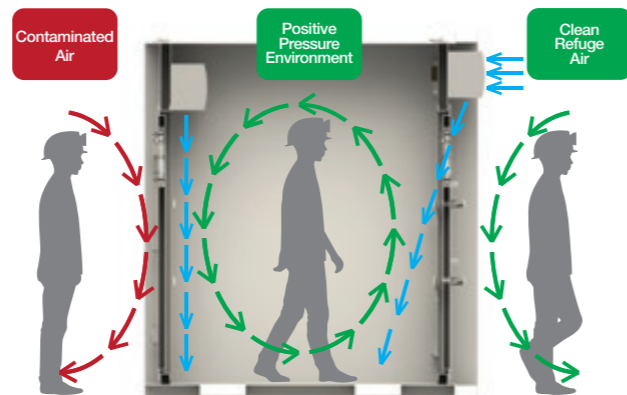
MineARC airlocks feature positive pressure flushing systems that ensure the out-flow of air; preventing the ingress of contaminants while the door is open for entry. The Positive Pressure Flushing System (PPFS) provides high speed pressurisation and is activated via a simple electric push-button system.

MineARC offers a range of internal and external airlock solutions designed to suit a wide variety of applications and entry requirements.

Internal Airlock

MineARC internal airlocks provide a neat, fully integrated airlock solution.

Designed as a structural modification to the ChemSAFE shell, the internal airlock provides a seamless entry way into the main refuge chamber, while retaining portability of the unit as a whole. This ensures coherent structural integrity and protection across the refuge chamber.



External Airlock



MineARC external airlocks are more suited to scenarios where direct access from an existing building door frame to the refuge chamber is required. The airlock can be custom-made to measure, ensuring an air-tight access point for facility personnel to move safely between on-site buildings and the refuge chamber during an emergency without the risk of exposure to external atmospheric hazards.

MineARC external airlocks may also be retro-fitted to pre-existing refuge chambers upon request.

An optional feature of both the internal and external airlock is a door activation locking system; enforcing that one door is locked shut at any one time during entry. This ensures no chance of accidental exposure to the external atmosphere whilst the main refuge chamber door is open.

MineARC offers a range of additional options and custom features, dependent on site specifications and requirements.

Internal & External Airlock



MineARC offers a range of internal and external airlock solutions designed to suit a wide variety of applications and entry requirements.

Gas and Contaminant Scrubbing



Scrubbing System

ChemSAFE Standard Design Refuge Chambers use MineARC's unique Series IV scrubbing system in conjunction with MARCISORB chemicals to 'scrub' the build up of harmful CO₂ and CO gas from inside the refuge chamber. The system continuously monitors and alerts occupants (with voice prompts) to internal and external gas levels. Gas monitoring systems can be customised to site standards.

The refuge chamber's scrubbing system uses pre-packaged MARCISORB CO₂ absorber cartridges. MineARC's MARCISORB cartridges provide superior scrubbing capacity, are easy to load, safe to handle, and can store for long periods.



Blast Rating Upgrade

An optional feature of the ChemSAFE Standard Design is blast rating upgrade up to 12psi.

MineARC utilises highly specialised materials and engineering techniques to build refuge chambers that can withstand the concussive forces of extreme blasts and explosions within the petrochemical industry. Through careful analysis of a site's application and hazard assesment, MineARC can engineer a highly customised refuge chamber to meet their specific blast rating requirements.



- Increased blast rating to client specification
- Additional 100mm x 50mm upright stiffeners
- Additional lateral stiffeners
- Fully enclosed rear housing for componentry protection

PS-SD6-30-SIV-12
(w/ 12psi Blast Rating & Flange for External Airlock)

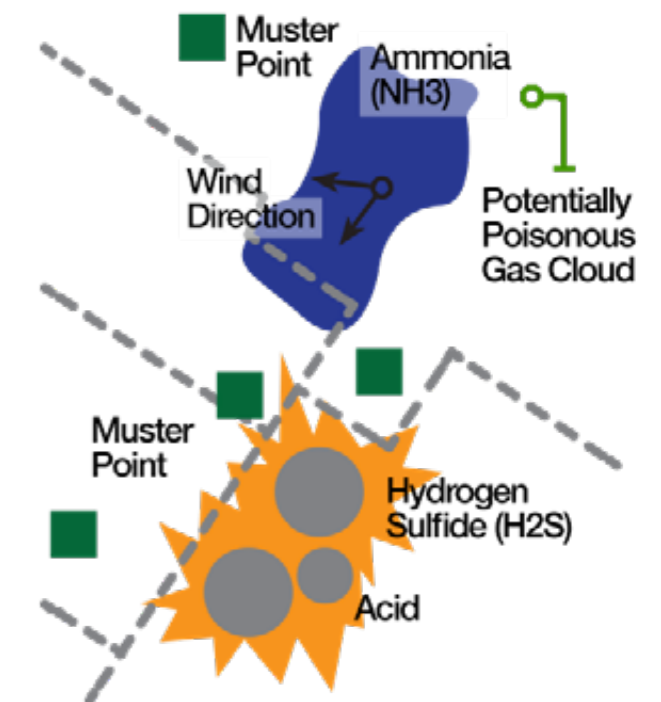
Third Party Verification

MineARC has the engineering capabilities to perform in-house blast analysis calculations on all refuge chambers. In addition, third party testing has been performed by professional blast engineers, in accordance with *ASCE: Design of Blast-Resistant Buildings in Petrochemical Facilities (2nd)*.

As part of their in-depth analyses, third-party blast engineers developed Building Damage Level (BDL) curves in order to test the performance of MineARC Refuge Chambers, taking into consideration the orientation of the unit with respect to the explosion source. Blasts that can impact either the long or short side of the structure, as well as both sides at an angle were tested.

The results of these studies show that MineARC's blast resistant structure can withstand a long-duration, free-field blast load of up to 12psi for 200ms, while sustaining no greater than a Moderate Building Damage Level (BDL 2.0).

In addition to building damage curves, blast engineers also calculated the occupant vulnerability (OV); the percentage of refuge chamber population that could sustain fatal injuries at different levels of building damage. In the case of MineARC's BDL of 2.0, the corresponding OV is proven to be negligible.

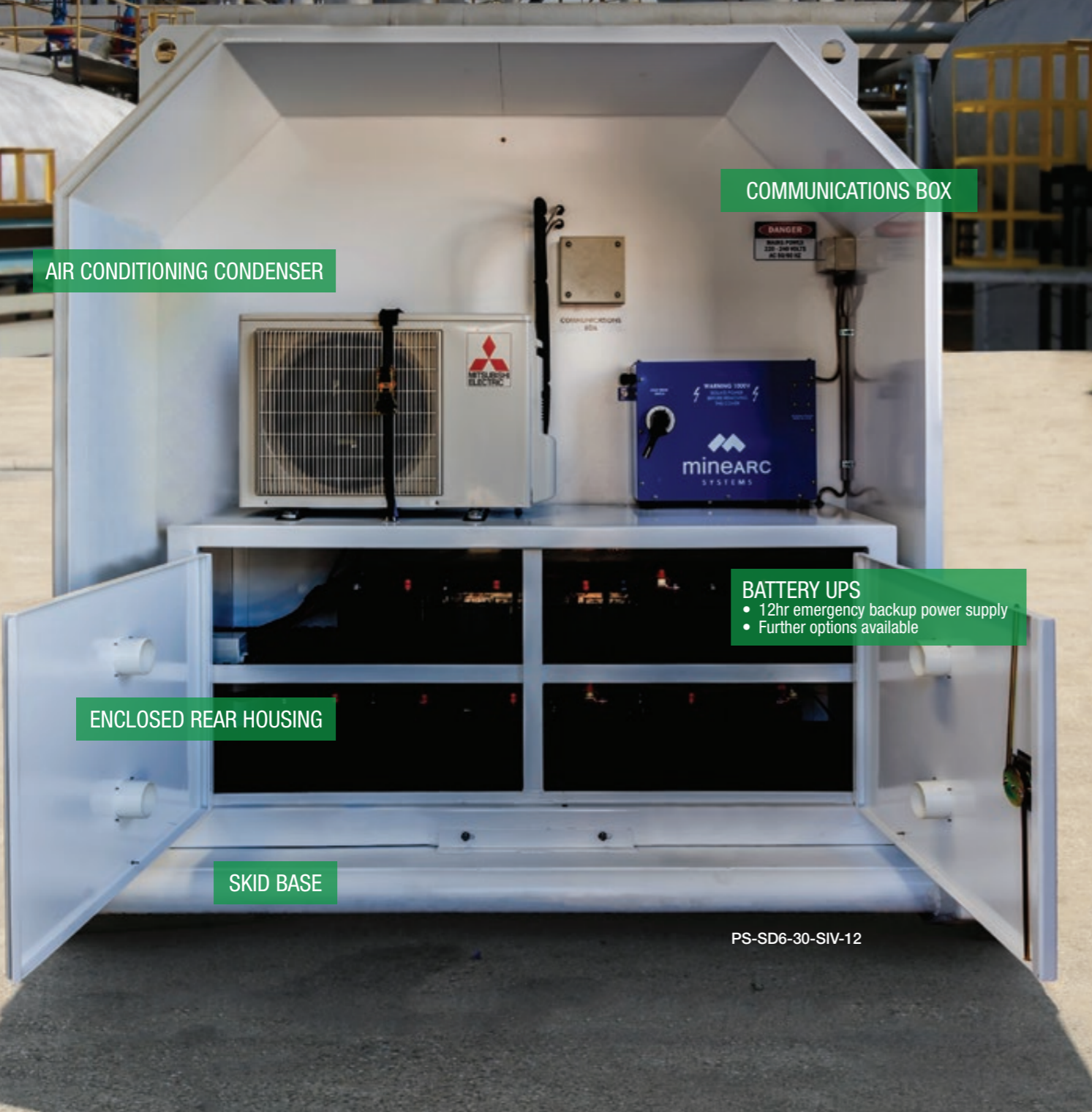




Refuge Chamber Exterior Rear

The rear of a MineARC ChemSAFE Standard Design houses important electrical and backup power supply systems. A secure floor-to-roof cabinet provides greater protection for these systems, unlike more basic designs.

The base of the cabinet contains the refuge chamber's UPS (Uninterruptible Power Supply) battery backup system. The UPS is a failsafe system that can power the chamber's internal life support systems for a minimum of 12 hours, should mains power be cut-off.



Feature Summary



5mm (1/4") Steel Plate Construction

Internal or External Airlock

Oxygen Supply

5psi Blast Rating with Option to Upgrade

CO2 Scrubbing & Aura-FX Gas Monitoring

0% ACH (External Air Change per Hour)

12hrs Minimum Stand-Alone Duration

Optional Features

- Blast Rating Upgrade (up to 12psi)
- Special Dimensions and Transport Configurations
- First Aid Kit
- Step-Down Transformer
- Remote Video Camera Monitoring
- Additional UPS Battery
- Positive Pressure Maintenance System
- Automated Oxygen Delivery System
- Thermal Insulation/Extreme Temperature Package
- GuardIAN Intelligence Network

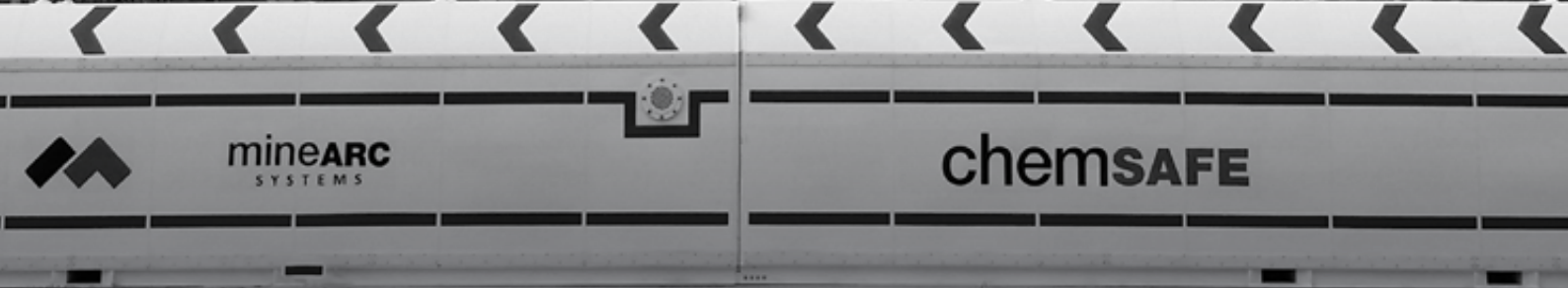


Optional Add-Ons: Emergency Response Products

MineARC's **ZOLL AED Range** provides the best support to help save a life. Users are provided with real-time feedback for quality, depth and rate of chest compressions; providing confidence and clarity throughout the defibrillation process.

The **Rugged Oxygen Generator (ROG)** is a portable, lightweight oxygen generator that delivers 90 litres of breathable oxygen for 15 minutes. Easy-to-use and small enough to carry in a backpack, the ROG gives immediate access to a potentially life saving oxygen supply.





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