Hard Rock Mine Refuge Chambers

MineARC's MineSAFE Modular Range

Engineered to allow for easy transportation in modular sections and to accommodate tight mining confines.

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20-Person MineSAFE
Modular Refuge Chamber
MS-SDM-20-SIV-36

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, tunnelling, chemical processing and disaster relief industries.

With over 25 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 several 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 70 countries across the globe.

All MineARC Refuge Chambers and Safe Havens comply with the highest international regulations and recognised '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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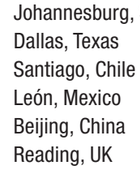


Bureau Veritas ISO 9001:2015 Quality Management Systems

MineARC® HRM Refuge Live Risk Assessment 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

Helping safeguard miners in over 70 countries, across six continents, the MineARC MineSAFE Series is the world's most trusted refuge chamber in metal (hard rock) and non-metal mines.

Emergency refuge forms an integral part of an underground mine's wider Emergency Response Plan (ERP). Fires, explosions, rock-falls, flooding, and the release of smoke and other forms of toxic gas are the types of incidents that occur all too frequently, despite the high levels of planning and the safety precautions in place.

In these types of emergencies, when evacuation is no-longer safe or practical, emergency refuge is designed to provide a safe and secure 'go-to' area for personnel to gather and await extraction. MineARC Refuges have been successfully used around the world in multiple mine and tunnelling emergencies to save lives.

Refuge chambers should be deployed throughout the mine to create a refuge 'network' accessible to all underground personnel whilst on foot. Depending on the country/region, regulations usually state acceptable 'safe distances' between refuge chambers.

Standard Configurations

In consultation with the world's leading mining companies and regional mining authorities, the MineSAFE Range has been continuously re-engineered and refined to create a safe-refuge alternative that is fully integrated with today's modern underground mining environment.

The MineSAFE Modular Design range is engineered specifically to accommodate tight underground confines and mines with restricted access, while still providing sufficient internal space to comply with international best practice guidelines. The range is designed to be easily manoeuverable around sharp corners and within tight mine shafts; it's modular construction means each section can fit within a cage and then be fully assembled underground.

20-Person MineSAFE
Modular Refuge Chamber

Standard configurations area available based on occupancy – from 12 to 30 people, however the modular design allows for any custom capacity required. Each section of the refuge chamber features forklift slots and lifting lugs for easy transportation on-site.

Standard Modular Configurations

MS-SDM-12-SIV-36 (12 Person)

REAR-04 FRONT-08

MS-SDM-20-SIV-36 (20 Person)

REAR-04 CENTRE-08 FRONT-08

MS-SDM-16-SIV-36 (16 Person)

REAR-04 CENTRE-04 FRONT-08

MS-SDM-30-SIV-36 (30 Person)

REAR-04 CENTRE-10 CENTRE-08 FRONT-08

Chamber Exterior Front

Assembly of a Modular refuge chamber is a simple process that can take place on-site once all sections have been transported underground. Each section features a heavy duty flange arrangement, allowing the chamber to bolt together easily once a seal has been applied. MineARC's user-friendly electrical system features a plug-and-play connection between each modular section to make a fully functioning refuge chamber.

The exterior front represents the 'face' of the refuge chamber - designed primarily for easy identification, and quick, easy access during an emergency.

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

Chamber Interior

Inside a MineSAFE Modular Design Refuge Chamber, a number of vital life-support systems combine to create a safe, ongoing environment for occupants. The chamber features a MineARC Series IV Controller; the most advanced safe-refuge technology, anywhere in the world.

Systems include; primary and secondary air (oxygen) supplies, air conditioning systems, positive pressure systems, electrical systems, gas detection and CO_2 / CO removal.

The MineSAFE Standard Design uses MineARC's unique voice activated Series IV electrical scrubbing system in conjunction with MARCISORB chemicals to 'scrub' the build up of harmful CO_2 (carbon dioxide) and CO (carbon monoxide) from the air inside the refuge chamber.

In high enough concentrations, both CO_2 and CO can cause serious injury leading to a loss of consciousness and eventually, death. CO_2 and CO are expired by the occupants as part of their normal breathing activity.

Carbon monoxide can also enter the main chamber via the compressed air intake (if it becomes compromised), and as occupants enter and/or exit the main entrance, making CO_2 / CO scrubbing a vital necessity.

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 the MineARC Series IV Control System, iVAN (Intelligent Voice Audio Navigation) represents a breakthrough in safe-refuge technology. iVAN is an on-board navigation assistant that guides occupants through operational procedures and can be programmed into languages other than English.

MARCISORB Chemical Cartridges

The MineARC Series IV Scrubbing System uses pre-packaged MARCISORB chemical absorber cartridges.

MineARC's MARCISORB CO_2 and MARCISORB CO cartridges provide superior scrubbing capacity, are easy to load, safe to handle, and can store for long periods.

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's internal temperature.

Optional Features

Blast Shield Protection

- Polycarbonate window protector
- External protection for AC and mine air
- Protection for lights and sensors

Blast Rating Upgrade

- Additional 100mm x 50mm upright stiffeners
- Additional lateral stiffeners

Airlock System

- Separate flushing area prior to entry to main chamber
- Primary flushing via connection to mine air supply, regulated with simple ball valve operation
- Emergency push button flushing via 8,000L (282ft3) breathable air cylinders

Carbon Monoxide Safety-Off-System (COSOS)

- In-line compressed air carbon monoxide detection
- Automatically isolates compressed air feed when CO reaches 25ppm

60amp Macey Connector

- Medium/high voltage connectors available
- Meets Australian standards

Transformer

- Standard 1000V Step Down to 240-220V
- Custom configurations available

GuardIAN
Chamber Monitoring

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

GuardIAN Refuge Chamber Monitoring is an on-board system that continuously monitors all vital refuge operating systems. During standby mode GuardIAN checks for component faults and monitors refuge 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 refuge 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.

Chamber Integrity Monitoring

The Compressed Air Management System (CAMS) communicates vital information relating to the integrity of the internal refuge chamber ia the GuardIAN Network.

An increase in CAMS activity would indicate a breach of the refuge chamber seal, thus sending an alert to designated personnel that the chamber is compromised.

GuardIAN
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 & 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.

UPS Battery Management

When used in conjunction with GuardIAN, the MineARC Satellite UPS System allows for real-time, remote monitoring of each individual battery. Battery faults can be identified immediately via the GuardIAN Dashboard and Alert Feed, with auto-generated event notifications sent directly to any personal device. Voltage and temperature diagnostics for each individual battery within a string can also be viewed via a graph, highlighting any fluctuations over the past 24 hours.

Complete your network with GuardIAN Connect

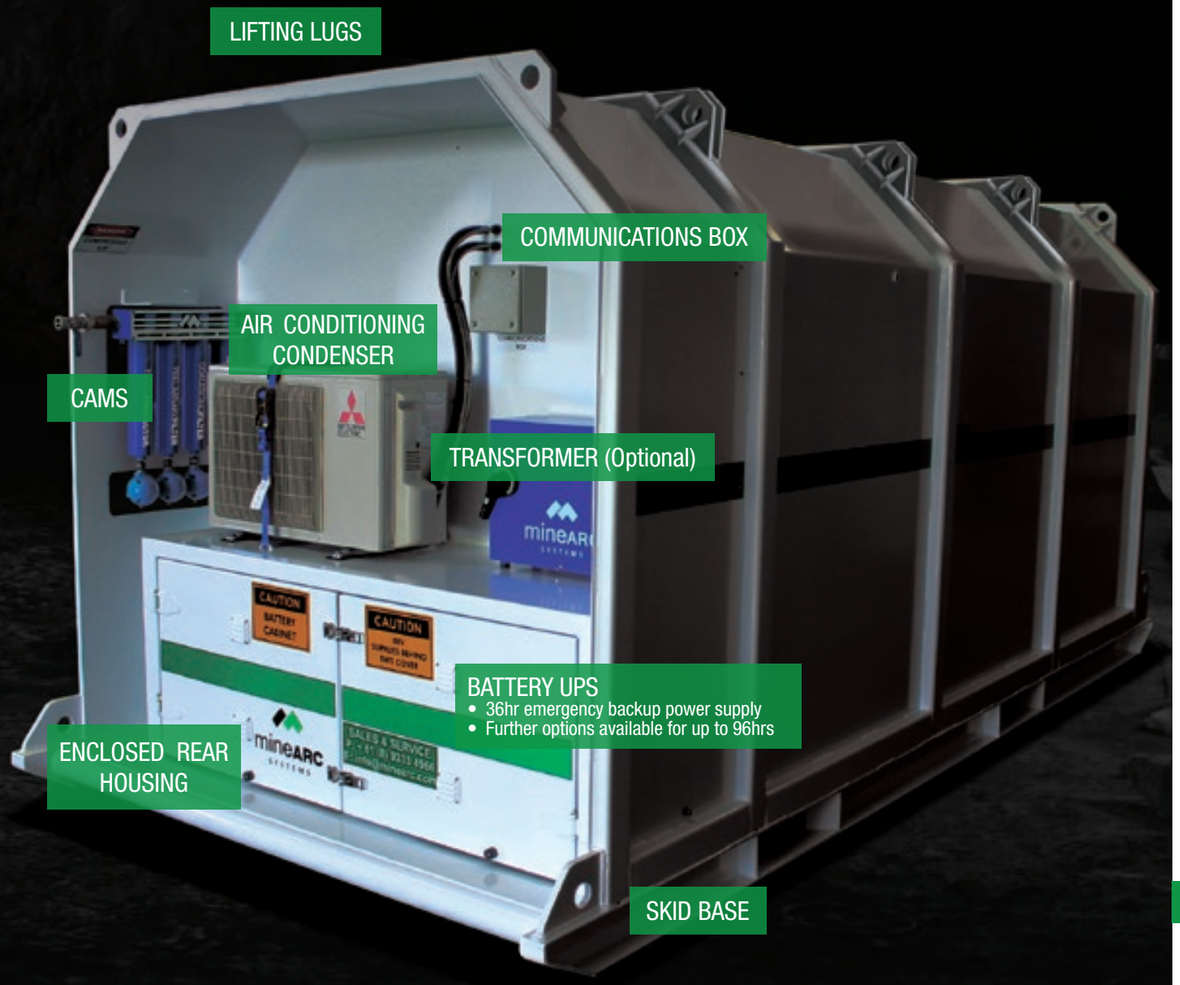
GuardIAN Connect, powered by RFI Technology Solutions is a high speed, fit for purpose, linear access layer network, allowing the connection of the GuardIAN Nodes, Smart Lighting and Refuge Chamber to the GuardIAN Intelligence Network.

Designed specifically for an underground mining environment, GuardIAN Connect uses a single coaxial cable to carry both power and data.

Chamber Exterior Rear

The rear of a MineSAFE Refuge Chamber houses important air filtration, electrical and backup power supply systems. The rear wall housing has been extended to provide greater protection for these systems.

A secure cabinet at the base houses the refuge chamber's UPS (Uninterruptible Power Supply) battery backup system. The UPS is a failsafe system that can power the refuge chamber's internal life support systems for a minimum of 36hrs, should mine power become cut-off.



The CAMS air pressure sensor and a shut off valve allow air flow into the chamber to be regulated, automatically emitting periodic 'bursts' of compressed air into the refuge chamber when the pressure inside drops below 200Pa. This process optimises mine air usage and guarantees against over-pressurisation of the refuge chamber. Over a 12 month period this can equate to significant financial savings.

The system's gas toxicity monitor automatically diverts mine air if oxygen levels in the airline fall below a set level (19% oxygen in free air), signifying air contamination. Additionally, the incorporated flood protection valve automatically shuts down mine air to avoid catastrophic damage due to ingress of water into the mine air or accidental hook-up to mine water.

Feature Summary

Modular Configuration
5mm Steel Plate
CO_2 & CO Scrubbing
Breathable Air (O_2) Supply
Air Conditioning
36-96hrs UPS Battery
Porthole
Aura-FX Gas Monitoring
Advanced Digital Controller
i.V.A.N. (Intelligent Voice Audio Navigation)

Standard Features

- Modular, manoeuverable design for tight mining confines
- 5mm steel plate construction with reflective signage
- Skid base with additional forklift slots and lifting lugs
- Blast rating: 5psi
- Compressed Air Management System (CAMS)
- Advanced Series IV digital control system with i.V.A.N
- CO and CO_2 scrubbing (pre-packaged chemical cartridges)
- Breathable air (O_2) supply
- Aura-FX Digital Gas Monitoring System
- Air conditioning and dehumidifying
- Water based fire extinguisher (optional for non-Australian orders)
- Battery backup (UPS) - 36hrs minimum
- Ergonomically designed seating
- Internal/external communications and lighting
- Viewing porthole and rear escape hatch
- Emergency food & water rations (optional for International orders)

Optional Features

- Special dimensions and transport configurations available
- Fully flushing, pressurised airlock
- GuardIAN Remote Monitoring & Diagnostics
- Battery backup UPS upgrade to 48, 72, 96hrs
- Internal LCD monitors screens
- First aid kit (standard on US models)
- Step-down transformer
- Blast shield protection (reinforced construction), upgradable to withstand percussion blasting
- Blast rating upgrade
- Carbon Monoxide Safety-Off-Systems (COSOS)
- Wheel package with integrated towing points
- Remote video camera monitoring

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.

Additional products include **First Aid Kits**, **Spinal Boards** and **Oxygen Resuscitation Kits**.

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