ArcTIC Refuge Chambers

High Temperature Chamber

Designed to provide a refuge or safe haven for underground workers suddenly trapped in a hazardous environment in high temperature areas.

mineARC SYSTEMS | arcTIC HIGH TEMPERATURE CHAMBER

Purpose built insulated chamber for extreme temperature environments.

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MineARC Systems - Built for Safety. **www.minearc.com**

mineARC SYSTEMS

MA-1388

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 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 several international locations including;

- Perth, Western Australia (Head Office)
- Dallas, Texas
- Johannesburg, South Africa
- Santiago, Chile
- Leon, Mexico
- Beijing, China
- Reading, UK

This allows MineARC to provide 24 hour service and engineering support to our expanding list of clients in over 60 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 9001:2008 Quality Management Systems

BSI (British Standard) BS 6164:2011 Health and Safety in Tunnelling

Member of the ITA (International Tunnelling Association)

MineARC® HRM Refuge Live Risk Assessment Testing

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

European CE Certified to Machinery Norms

MineARC can custom engineer and manufacture refuges to provide a safe haven for tunnelling and underground workers suddenly trapped in a high temperature environment.

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Emergency refuge forms an integral part of a tunnelling project's wider Emergency Response Plan (ERP). Fires, fall of ground, flooding, and the release of smoke and other forms of toxic gas are the types of incidents that can occur all too frequently, despite the high levels of planning and safety precautions in place.

In these types of emergencies, where personnel become trapped without adequate ventilation and evacuation is no longer safe or practical, emergency refuge is designed to provide a secure 'go-to' area for personnel to gather and await extraction.

MineARC Refuge Chambers have been successfully used around the world in multiple real-life tunnelling emergencies to save lives.

MineARC's TunnelSAFE Range of Refuge Chambers are highly customisable to suit any project and can be built to comply with British Standard (BS EN 16191:2014) Safety Requirements for Tunnelling Machinery. They can also comply with the ITA's "Guidelines for the Provision of Refuge Chambers Under Construction".

ArcTIC Chambers are custom designed to provide emergency and non-emergency cooling in a high temperature environment. Customised airconditioning systems to withstand high temperature includes the use of thermal ice storage, adiabatic cooling, evaporative airconditioning, high pressure misting and thick mineral wool insulation panels.

Custom Configuration

The MineARC ArcTIC Chamber is custom built to suit occupancy, temperature range and site requirements.

MineARC chambers are continuously re-engineered and refined to create a safe-refuge solution that is fully integrated with modern tunnelling and mining environments.

ArcTIC Chambers are designed to suit transport specifications for a 40 foot shipping container. Configuration may be based on occupancy from 8 to 24 people.

Each ArcTIC Chamber is custom-engineered to site specifications, without compromising on safety or performance.

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Chamber Exterior Front

SIREN
- 112 dBA motion activated

MISTING SYSTEM
- High pressure system provides active cooling for reduced external heat ingress

STROBE LIGHTING
- Extra low voltage
- Green & red LED

AIR VENTS / CHECK VALVES

ELECTROMAGNETIC LOCK
- Push button panel for both interior and exterior access (optional)

PULL HANDLES
- Offset hollow door handles, minimal heat transfer

EXTERIOR PANELS
- Mineal Wool fire resistant insulated panels

SEALING DOOR
- Outward opening
- 200mm insulated door
- Double wipe seals on door, and door frame, for increased smoke protection
- Silica base seals for higher temperature environments

REFLECTIVE SIGNAGE
- Safety & operational
- Optional extra: Multiple languages

SKID BASE
- 250 x 100mm forklift slots
- Front and rear mounted tow points
- Front mounted 25mm steel plate push blocks

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 chamber’s location, whilst push button and pull door handle provides safe access to the safety of the interior.

Chamber Interior

Inside an ArcTIC Chamber, a number of vital life-support systems combine to create a safe refuge for occupants when suddenly trapped in a high temperature environment.

In addition to fire retardant panels and covering, life support systems include: primary and secondary oxygen supplies, CO_2 / CO removal, air conditioning systems, positive pressure systems, and gas detection.

Oxygen Supplies

The ArcTIC Chamber includes oxygen supply via compressed air, storage for oxygen cylinders and is rated for 24 hours. Additional oxygen supply is available by oxygen candle.

Airconditioning and Cooling Systems

Air conditioning is vital to combat the potentially fatal effects of heat stress. The ArcTIC Chamber's cooling systems are custom designed to withstand high temperatures (100^{0}C - 300^{0}C) and include:

- Thermal ice storage, with typically 700L - 2,000L frozen ice capacity, plus glycol chilling circuit, to surround ice storage coils used in heat exchange with the refridgerative airconditioning unit
- Adiabatic cooling with pre cooling pads, to lower the air temperature prior to ingress by the evaporative airconditioning unit
- High pressure misting system to cool chamber exterior, with 1200L - 2400L non-potable water storage below seats
- Refrigerative airconditioning to regulate a cool environment whilst controlling humidity, ventilation and chamber temperature
- Multiple air vents spread throughout the chamber, cool air dispersed by fan in ceiling
- Thick insulation panels (70mm - 200mm).

Scrubbing System

ArcTIC Chambers use an Extra Low Voltage (ELV) CO_2/CO Scrubbing System that utilises pre-packaged MARCISORB chemical absorber cartridges. The scrubbing system removes build up of harmful CO_2 and CO from the air inside the chamber.

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

Feature Summary

- ✓ **240V Power**
- ✓ **24 hour UPS Battery Backup (custom duration available)**
- ✓ **Emergency and Non-Emergency Cooling**
- ✓ **Aura-FX Digital Gas Monitoring**
- ✓ **Positive Pressure Management System**
- ✓ **GuardIAN Intelligence Network - refuge chamber monitoring (optional)**

Interior Features

- Hydrostatic flooring
- Tek Tile vinyl flooring, with fire retardant, slip resistance
- Underfloor insulation
- XFLAM insulated panels
- Ice tank
- Under seat water storage
- Side escape hatch
- Oxygen tank storage
- Oxygen candle and igniter
- Sealed battery storage
- Air vents
- LED lighting
- Temperature gauge
- ELV scrubbing system

Exterior Features

- External protection for AC and compressed air
- Compressed Air Filtration (CAMS)
- Adiabatic cooling
- High pressure misting system
- Fire retardant panels
- Tow points, skid base, forklift slots and lifting lugs
- Electromagnetic door locks
- Insulated roof
- Blast rating: 5psi

Chamber Exterior Rear

The rear of the ArcTIC Chamber houses the air conditioner, condenser unit, plus valves for the high pressure misting system, all designed for chamber cooling.

Thermal ice storage is securely encased near the rear of the chamber, with a customised ice storage cooling system, large volume tank, fan and heat exchanger.

A secure storage area at the rear of the chamber also holds the UPS battery back up (Uninterruptible Power Supply) and Compressed Air Management System (CAMS).

The UPS is a fail-safe system that can power the refuge chamber's internal life support systems for a minimum of 24hrs, should mine power become cut-off.

CAMS allows regulated 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.

CAMS' gas toxicity monitor automatically diverts compressed air if oxygen levels in the airline fall below a set level (18% oxygen in free air), signifying air contamination.

Additionally, the incorporated flood protection valve automatically shuts down compressed air to avoid catastrophic and costly chamber damage in the event of water ingress.

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Chamber Technology
Standard Features

Aura-FX Gas Monitoring

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

Closely monitoring gas levels in the chamber allows occupants to take corrective actions to maintain a safe and inhabitable environment. Aura-FX Digital Gas Monitoring System is a proprietary fixed gas monitoring unit, designed specifically for use in refuge chambers.

- ✓ **Real-time gas monitoring with live analysis**
- ✓ **Triple gas monitoring as standard**
- ✓ **Internal chamber monitoring (external monitoring optional)**
- ✓ **Intuitive scrolling digital display shows gas level trends**
- ✓ **Reduced risk of human error**

Compressed Air Management

The Compressed Air Management System (CAMS) is a breathable air system that is unique to the market; offering a range of features aimed at reducing running costs and improving operational safety during an emergency.

Aside from providing clean breathable air through a superior four-phase filtration process, some of the major benefits of CAMS include:

- ✓ **optimisation of mine air services**
- ✓ **guarantee against over-pressurisation of the refuge chamber**
- ✓ **gas toxicity monitoring**
- ✓ **flood protection**
- ✓ **reduced service time during filter change-out**

CAMS communicates vital information relating to the integrity of the internal refuge chamber via 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.

CAMS has an air pressure sensor and shut off valve, allowing it to regulate air flow into the chamber, automatically emitting periodic 'bursts' of compressed air when the internal pressure drops below 200Pa. This maintains a positive pressure 'seal', ensuring contaminants cannot enter the refuge chamber from the outside.

The 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. This system detects compressed smoke bursts, where oxygen is displaced dramatically, rather than sampling low pressure air for slow release contaminants.

GuardIAN
Chamber Monitoring (optional)

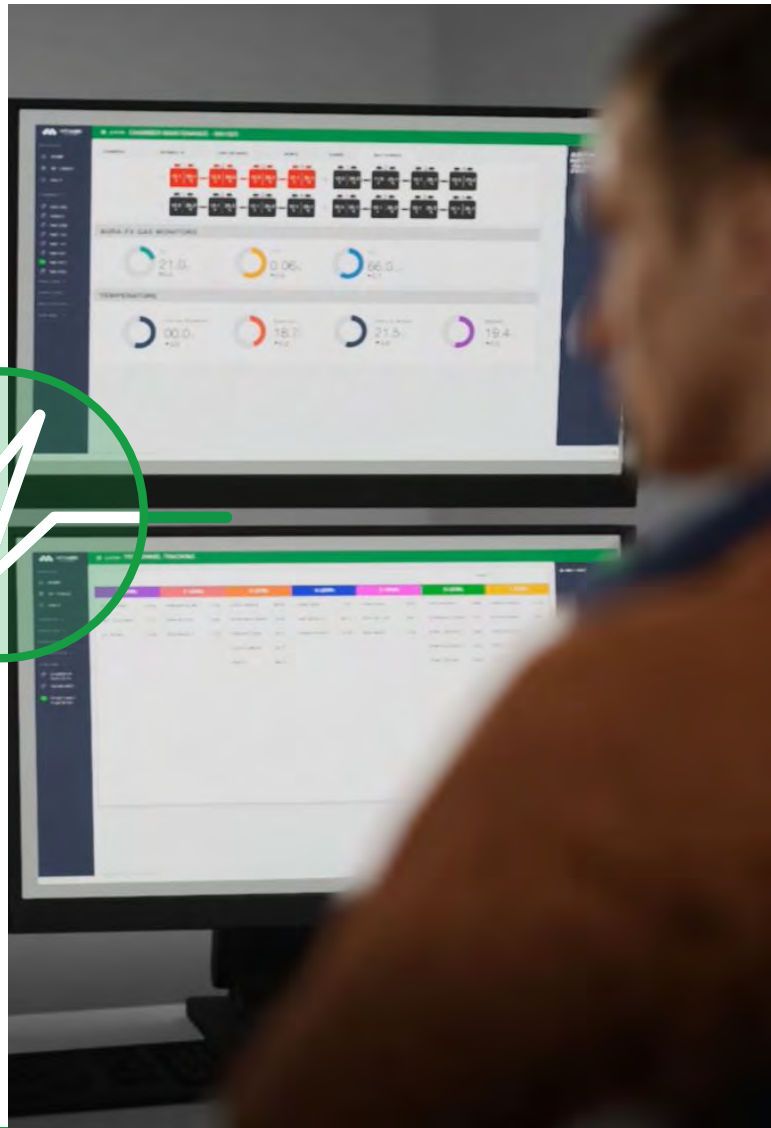
GuardIAN Refuge Chamber Monitoring provides remote, real-time diagnostics of a refuge chamber fleet, and allows MineARC Engineers to provide off-site troubleshooting assistance.

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.

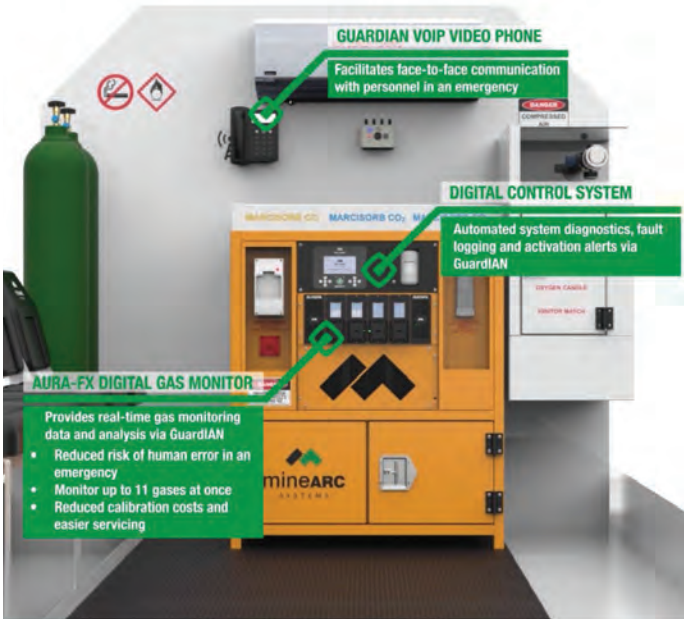
GuardIAN Refuge Chamber Monitoring is an on-board system that continuously monitors all vital refuge operating systems. During standby mode GuardIAN checks for component faults and monitors refuge chamber usage or entry to the chamber.

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.



GuardIAN
Chamber Monitoring (optional)



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 a live, recorded stream of the refuge chamber interior 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.

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