

Hard Rock Mine Refuge Chambers

MineARC's MineSAFE Narrow Design Range

Designed to provide a refuge or 'safe haven' for miners suddenly trapped in a hazardous or toxic environment.



mineSAFE
NARROW DESIGN



MS-ND1-08-ELV-36

The world's leading manufacturer of emergency life-saving refuge

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 15 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 six international locations including;

- Perth, Western Australia
- Johannesburg, South Africa
- Dallas, Texas
- Santiago, Chile
- Beijing, China
- Barcelona, Spain

This allows MineARC to provide 24 hour service and engineering support to our expanding list of clients in over 40 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.

www.minearc.com



Bureau Veritas ISO 9001:2008 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 40 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.



MS-ND1-08-ELV-36

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.



MS-ND1-08-ELV-36
8 Person

The MineSAFE Narrow Design (ND) is designed specifically to accommodate tight mining confines such as shaft mines, while still providing ample internal space for a range of occupancies - from 8 to 26 people. The chamber's portable design makes it easy to manoeuvre and position around site.

Ultimately a MineSAFE ND's dimensions and its rated occupancy can be custom-engineered to suit site specifications, without compromising on safety or performance.



MS-ND1-08-ELV-36
(8 Person)



MS-ND2-12-ELV-36
(12 Person)



MS-ND3-16-ELV-36
(16 Person)



MS-ND4-20-ELV-36
(20 Person)



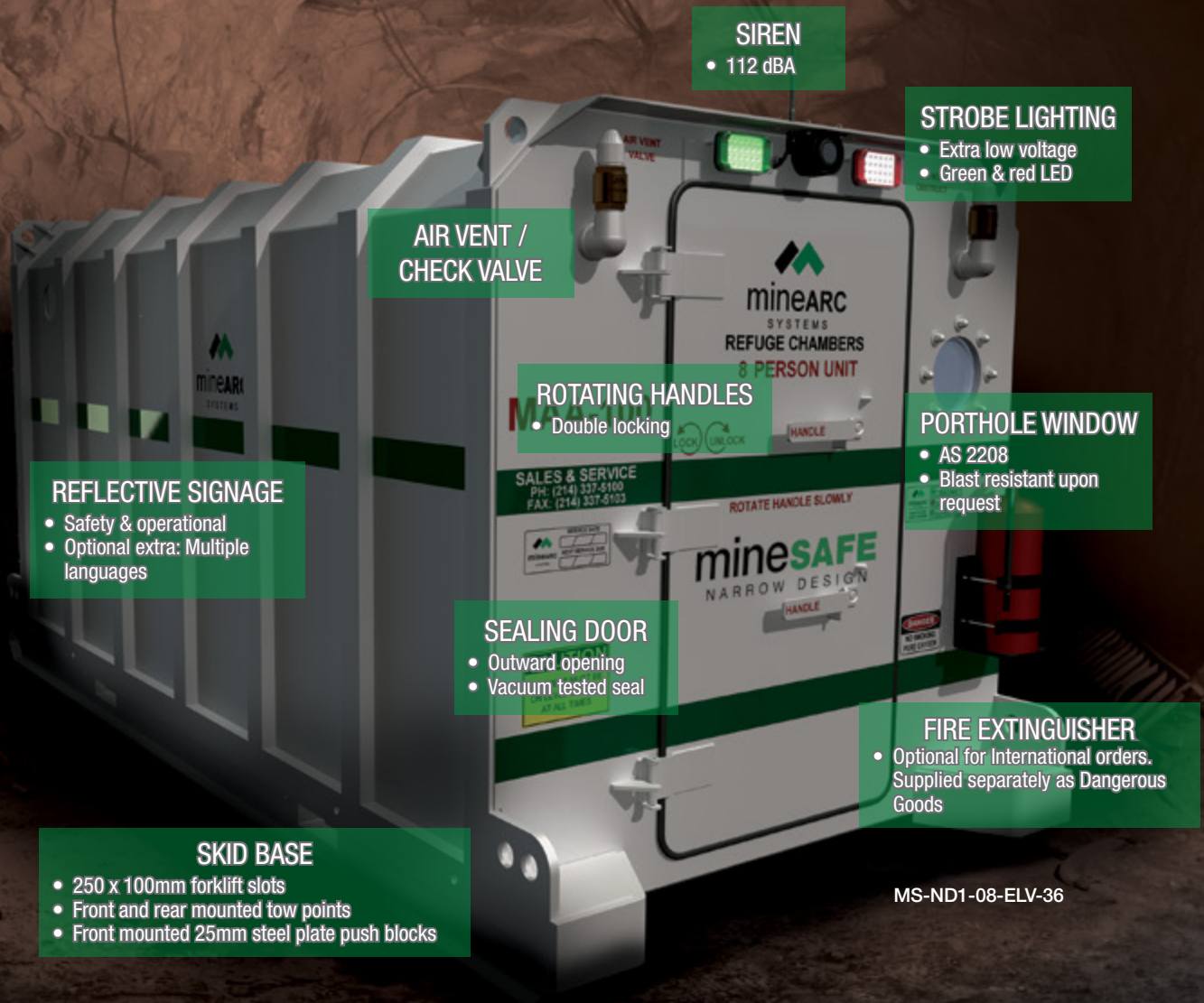
MS-ND5-26-ELV-36
(26 Person)

Standard Dimensions

Model	Occupancy (persons)	Height (m/inch)	Width (m/inch)	Length (m/inch)	Weight (kg/lbs)
MS-ND1-08-ELV-36	8	2.00 / 78	1.90 / 74	4.20 / 165	4,400 / 9,700
MS-ND2-12-ELV-36	12	2.00 / 78	1.90 / 74	4.80 / 188	4,627 / 10,200
MS-ND3-16-ELV-36	16	2.00 / 78	1.90 / 74	6.02 / 237	5,534 / 12,200
MS-ND4-20-ELV-36	20	2.00 / 78	1.90 / 74	7.24 / 285	6,668 / 14,700
MS-ND5-26-ELV-36	26	2.00 / 78	1.90 / 74	8.44 / 332	7,348 / 16,199

Custom dimensions and occupancies available. Refuge dimensions are ultimately designed to client specifications. Weights provided are Australian standard 36hr models. Indicative weights only. Custom variations will impact final refuge chamber weight.

Chamber Exterior Front



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 Narrow Design Refuge Chamber, a number of vital life support systems combine to create a safe, ongoing environment for occupants.

Systems include primary and secondary oxygen supplies, air conditioning systems, positive pressure systems, electrical systems, gas detection and CO/CO2 absorption systems (referred to as 'scrubbing' systems).

All MineARC Refuge Chambers are easy to inspect and maintain, requiring minimal preventative maintenance. The MineSAFE Narrow Design has a low ongoing cost of ownership for consumables (such as the active chemicals used in the scrubbing system).

INVERTER



OXYGEN SUPPLY #2:

MEDICAL GRADE OXYGEN CYLINDERS (Not pictured)

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

Model	4-Person	6-Person	8-Person
36 hr	1	1	2

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

AIR CONDIT

- R410a re
- UL listed

OPTIONAL: OXYGEN SUPPLY #3:

OXYGEN CANDLE KIT (Not pictured)

- 2,600L oxygen produced / 60 mins ignition; Military approved
- Supplied separately as Dangerous Goods

ELV CO/CO2 SCRUBBING SYSTEM



POWER FLUCTUATION PROTECTION



WARNING
 RCDS AND LOAD BREAK SWITCH ON TRANSFORMER AND CIRCUIT BREAKERS ARE TO BE IN THE OFF POSITION BEFORE ANY ELECTRICAL WORK IS CARRIED OUT ON THE REFUGE CHAMBER

BATTERY CONTROL SWITCH SHOULD BE LEFT IN STANDBY POSITION WHEN WAITING FOR EMERGENCY USE

WHEN CHARGING IS REQUIRED BATTERY CONTROL SWITCH MUST BE IN THE STANDBY POSITION

WARNING
 BATTERY ISOLATION SWITCH MUST BE IN THE OFF POSITION BEFORE ANY ELECTRICAL WORK IS CARRIED OUT ON THE CHAMBER

DIGITAL CONTROLLER INTERFACE

INTERIOR LIGHTING

- 8watt fluorescent

CONDITIONING SYSTEM

- Refrigerant cooling
- Mitsubishi Split System

AIR (OXYGEN) SUPPLY #1: COMPRESSED MINE AIR

- Low pressure air supply (120psi; 830kPa)

AURA-FX DIGITAL GAS MONITOR

Control System

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

Standard: ELV System

MineARC's ELV (extra-low-voltage) System comes as standard with the MineSAFE Narrow Design.

The ELV Control System is installed in conjunction with a UPS battery backup that can power the system for a minimum of 36hrs, should mine power be cut off.

Optional Upgrade: Series IV System

The Series IV Electrical Scrubbing System is considered to be the most advanced safe refuge technology in the world.

Exclusive to the Series IV Control System is i.V.A.N (Intelligent Voice Audio Navigation); an on-board navigation assistant that guides occupants through operational procedures. Additional benefits of the Series IV System include superior digital control, intuitive operation and motion sensor logging.

The Series IV Control System is installed in conjunction with a UPS battery backup that can power the system for a minimum of 36hrs, should mine power be cut off.

MARCISORB Chemical Cartridges

MineARC's Scrubbing Systems use pre-packaged MARCISORB chemical absorber cartridges to 'scrub' the build up of harmful CO₂ (carbon dioxide) and CO (carbon monoxide) from the air inside the refuge chamber.

In high enough concentrations, both CO₂ and CO can cause serious injury leading to a loss of consciousness and eventually death. CO₂ 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/CO₂ scrubbing a vital necessity.

MineARC's MARCISORB CO and MARCISORB CO₂ 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 caused by a build up in occupant's own metabolic activity, as well as any ambient (external) heat affecting the refuge chamber's internal temperature.

MineARC

System Intelligence

Reduces Operational Costs:

- ✓ Reduced servicing time
- ✓ Real-time troubleshooting, reducing maintenance staff down-time
- ✓ Advanced maintenance planning
- ✓ Extended calibration periods for gas monitoring
- ✓ Reduced gas sensor replacement costs
- ✓ Extended sensor life
- ✓ Faster and easier sensor replacement
- ✓ Lower energy costs through the optimisation of mine air usage
- ✓ Flood protection, eliminating costly chamber refurbishment
- ✓ Reduction in replacement parts due to theft
- ✓ Reduced service kit costs
- ✓ Streamlined purchasing process

Improves Operational Safety:

- ✓ Operational communication during emergency use
- ✓ Direct video and gas monitoring for evacuation planning
- ✓ Greater system automation for reduced risk of human error
- ✓ Centralised diagnostics and analysis of entire MineARC Refuge Chamber fleet via computer, tablet or smartphone
- ✓ Programmable push email notifications for important refuge chamber events
- ✓ Voice prompting gas monitoring for chemical change-out and oxygen regulation
- ✓ Air toxicity shut off prevents smoke and carbon monoxide ingress via the compressed airline
- ✓ Increased monitoring ensures all critical components remain in the chamber
- ✓ Reduced 'out-of-service' time for all refuge chambers
- ✓ Eliminates chamber misuse

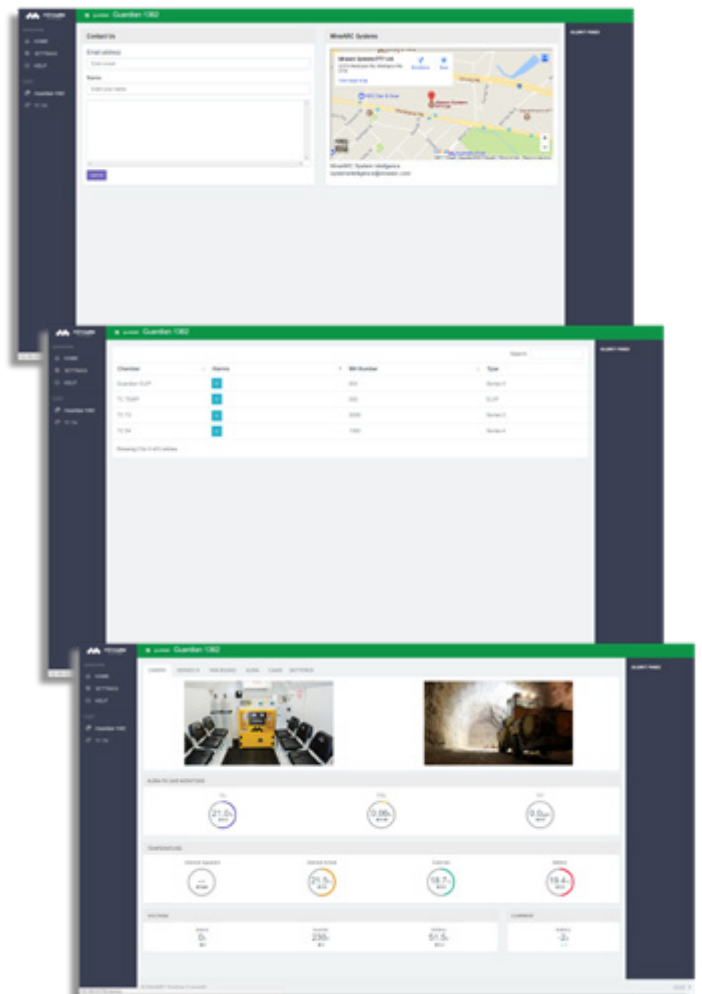
GuardIAN Remote Monitoring & Diagnostics System

MineARC's GuardIAN Remote Monitoring and Diagnostics System is an exciting new 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 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.

GuardIAN's secure online interface 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 is an optional upgrade for the MineSAFE Narrow Design.



MineARC

System Intelligence



Aura-FX Digital Gas Monitoring Diagnostics

MineARC's new Aura-FX Digital Gas Monitoring System is a proprietary fixed gas monitoring unit, designed specifically for use in MineARC refuge chambers and safe havens. A vast improvement on current digital gas monitors (DGMs) on the market, Aura-FX provides a refuge chamber specific solution to gas monitoring. Aura-FX has the ability to individually monitor up to 11 gases via a series of user-friendly, digital screens. Audible voice alarms will prompt occupants to replace scrubbing chemicals or adjust oxygen supply levels in the refuge chamber as required.

When utilised as part of the MineARC System Intelligence network, Aura-FX provides real-time gas monitoring data and analysis via the GuardIAN dashboard.

Aura-FX is a standard feature of the MineSAFE Narrow Design.

GuardIAN System Monitoring, Event Logging and Fault Diagnostics

MineARC's Digital Controller links directly to GuardIAN, streaming real-time system data to a surface control room(s). Data includes automated system checks, battery fault logging, system diagnostics, internal and external temperature measurements, and system actions such as scrubber activation.

System faults, events and scheduled service notifications can be sent to designated personnel as email alerts; notifying them of upcoming service requirements, potential emergencies or mal-use as they occur.

GuardIAN Live Video Monitoring and VOIP Video Phone

Live video streaming can greatly assist in evacuation planning during an emergency; providing the capability to determine the capacity of the refuge chamber and monitor the well-being of occupants. 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. External video monitoring is also available as an optional upgrade to the GuardIAN System.

To assist occupants during an emergency or safety drill, GuardIAN also equips your refuge chamber with a VOIP video phone. This facilitates face-to-face communication between the refuge chamber and the surface; improving the psychological well-being of chamber occupants during an emergency, providing assistance to perform any difficult or technical procedures and facilitating face-to-face trouble shooting for service staff in order to reduce the need for multiple surface visits during a maintenance run.



Compressed Air Management System Diagnostics

The MineARC Compressed Air Management System (CAMS) is a dedicated air management unit designed specifically for use in refuge chambers. The unique air management system monitors and regulates compressed air flow into the chamber. When utilised as part of the MineARC System Intelligence network, vital information relating to the integrity of the internal refuge chamber atmosphere is communicated in real-time via the GuardIAN dashboard. 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 is a standard feature of the MineSAFE Narrow Design.

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 feature unique to the Narrow Design range.

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



MS-ND1-08-ELV-36

8-26 Person Occupancy

Manoeuvrable Design

Designed for Tight Mining Confines

5mm (1/4") Steel Plate

CO and CO₂ Scrubbing

Breathable Air (O₂) Supply

Air Conditioning

36 Hours Battery UPS

Extra-Low-Voltage Controller

Standard Features

- 5mm (1/4") steel plate construction
- Blast rating: 5psi
- CO & CO₂ scrubbing
- Pre-packaged chemical cartridges
- Advanced extra low voltage control system
- 2 x sources of breathable air (O₂) supply
 - CAMS
 - Medical oxygen cylinders
- Air conditioning and dehumidifying
- Aura-FX Digital Gas Monitoring System
- Battery backup (UPS) 36hrs standalone
- Side escape hatch with internal/external access
- Viewing porthole
- Stainless steel fittings throughout
- Ergonomically designed seating
- Lifting lugs, skid base and forklift slots
- Emergency food and water rations
- Fire extinguisher (optional for International)
- Fire blanket
- Chemical toilet

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
- Receptacle plug (trailing cable connecting plug)
- 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
- Oxygen candle kit



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The world's leading manufacturer of emergency life-saving refuge