Every mine has its own design – and, because of this, needs its own, unique emergency response plan. Spatial and technical considerations are taken into account such as: the mining methods and products, length and character of rescue routes, location of escape shafts, etc. All of these factors influence the concrete plans, measures, equipment and training required. However, rescue plans are ever evolving and must be constantly adapted to new developments in and around the mine.
7 steps to an optimum emergency escape concept

1. Know and understand the situation and conditions:
   - Mining method/mined product
   - Geographical location
   - Official and corporate regulations (SOP's)
   - Number of miners (incl. contractors) per shift
   - Length and condition of rescue routes
   - Location of escape shafts and fresh air bases

2. Take natural hazards into account:
   - Temperature/humidity
   - Water ingress/flooding
   - Dust development
   - Mine gas/firedamp

3. Identify activities involving risks:
   - Fueling/handling of hazardous substances (fluids/transportation)
   - Storage of explosives
   - Blasting

4. Account for unexpected incidents:
   - Ventilation failure
   - Gas eruption and leakages
   - Sparks/friction

5. Describe potential hazards/risks:
   - Mechanical obstacles
   - Oxygen deficiency
   - Fire
   - Explosion

6. Perform a risk assessment:
   - List, assess and prioritise hazards/risks
   - Check risks

7. Develop an emergency response plan:
   - Prepare an emergency plan
   - Provide emergency equipment
   - Ensure appropriate emergency training
If a serious incident occurs underground, the safety manager and the mine foreman must decide within minutes whether self-escape is possible or whether a mines rescue team should be deployed.

**Underground – self-escape or rescue mission?**

**EMERGENCY/DISASTER**

- Initiate evacuation/don oxygen self-rescuers
  - Self-rescue
  - Third-party rescue
    - QFS/CABA/SCSR/COS*
      - Regeneration phases
    - Escaping personnel reach a safe refuge (mine exit/rescue chamber)
    - Rescue chambers: Waiting for help from surface to arrive
    - Rescue by mine rescue team

*QFS: Quick fill station or Charge Air, CABA: Compressed Air Breathing Apparatus, SCSR: Self Contained Self Rescuer, COS: Change Over Station*
Coal mining –
when is self-escape the first choice?

Self-escape means: Victims of incidents are able to get themselves to safety and back to the surface without any additional help. This is almost always the case when emergency escape distances are short enough to be managed on foot. Keeping in mind that the escape route has to be open. So, when an incident occurs, there is no flooding, collapses or rockfalls blocking the way. Read on to find out more about examples of self-escape underground and the appropriate methods and equipment.

IF COAL CATCHES FIRE: IT’S TIME TO GET OUT – FAST!

Depending on the kind of coal being mined and the conditions at the face, a fire can take hold fast, intensify, and burn for a long time. Due to this, self-escape is the usual and best option.

In the following graphics, we show you what self-escape plans look like around the world’s coal mines – and how South Africa handles exceptions.
Emergency Escape Systems in Underground Mining

Australia

Coal
Annual production output: 3,000,000 tons
Number of underground miners: 100
Average depth: 80 m
Average travelling time to workplace: 15 min.

Mine Rescue
- 4 teams (9 each) on site
- 10 mutual aid teams (1 hour)
- CCBA

Fire and Explosion Prevention
- FRAS conveyor belt and automatic fire extinguishing system
- Diesel motor engines with automatic fire extinguishing system
- Oxygen gas monitoring
- Air velocity monitoring, CO, CO₂ monitoring
- Power isolation if CH₄ levels reach 1.25 Vol. %
- Reticulated fire fighting water underground
- Intrinsically safe electronic apparatus

Self Rescue
- Emergency tone over phone Loudspeaker (DAC-System) along conveyors
- Chemical oxygen SCSR (nominal duration 25 min.)
- Marked escapeway
- Lifeline with bobbins
- FREEK (with 25 CABA) plus quick fill stations
Emergency Escape Systems in Underground Mining

Czech

Coal
- Annual production output: 2,000,000 tons
- Number of underground miners: 2000
- Average depth: 900 m
- Average travelling time to workplace: 60 min.

Mine Rescue
- 19 teams on site
- 100 mutual aid teams
- CCBA

Fire Prevention
- FRAS conveyor belt
- CO, CH₄ monitoring in all drifts
- Water pipes in all drifts
- Intrinsically safe electronic apparatus
- Water trough

Self Rescue
- Warning via telephone and stench gas
- Chemical oxygen SCSR (nominal duration 50 min.)
- Escape in the direction of ventilation
- Change-over station with 50 additional SCSR (nominal duration 50 min.)

FREEK
- 45 min.
- 20 min.
Emergency Escape Systems in Underground Mining

South Africa

Coal
Annual production output: 4,400,000 tons
Number of underground miners: 7,500
Average depth: 200 m
Average travelling time to workplace: 30 min.

Mine Rescue
- 6 teams on site (5 each)
- 10 mutual aid teams
- CCBA

Self Rescue
- Telephone
- Chemical oxygen
- SCSR (nominal duration 25 min. and 60 min.)
- Escapeway signage
- Lifeline with bobbins
- Refuge chambers (500 m distance), Change-over stations with long duration set

Fire Prevention and Explosion Prevention
- Smoke detector
- Oxygen gas detector CH₄ monitoring, Temperature monitoring, Air velocity monitoring
- Intrinsically safe electronic apparatus
Mining –

When is a mine rescue mission the only alternative?

Some extraction projects in the international mining industry extend to almost gigantic lengths and depths. Deep mining aptly describes mining at ever increasing depths – today, mining is carried out at depths that would have been unimaginable, not all that long ago. It also means that escape routes are longer and that there is no way to complete an escape entirely without any third-party assistance. Read on to find out more about escape planning, equipment and strategies for deep mines.

ESCAPE IN METAL MINES: DON’T PANIC – STAY CALM!

In ore and mineral mines, underground escape routes are often long and steep. Here, the key priority is to stay calm, find a safe refuge – for instance in a refuge chamber – and wait for rescue team organized at the surface. This is illustrated in exemplary form by escape plans for mines rescue, like those from South African gold mines.
Emergency Escape Systems in Underground Mining

South Africa Gold

- Annual production output: 600,000 tons
- Number of underground miners: 2150
- Average depth: 1900 m
- Average travelling time to workplace: 120 min.

Mine Rescue

- 22 teams
- 14 mutual aid teams (1 hour)
- CCBA

Fire Prevention

- Automatic fire extinguishing system
- Smoke detector
- CO, CH₄ monitoring
- Air velocity monitoring

Self Rescue

- Telephone
- Chemical oxygen SCSR (nominal duration 30 min.)
- Escapeway signage
- Escape route plans
- 39 refuge chambers (500 m distance)

Max. 700 m
# Emergency Escape Systems in Underground Mining

## Canada

**Nickel / Gold / Base Metal**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual production output</td>
<td>1,300,000 tons</td>
</tr>
<tr>
<td>Number of underground miners</td>
<td>250</td>
</tr>
<tr>
<td>Average depth</td>
<td>1300 m</td>
</tr>
<tr>
<td>Average travelling time to workplace</td>
<td>30 min.</td>
</tr>
</tbody>
</table>

## Mine Rescue

- 16 teams
- 13 mutual aid teams
- CCBA

## Fire Prevention

- FRAS conveyor belt and automatic fire extinguishing system
- Diesel motor engines with automatic fire extinguishing system
- CO monitoring
- Temperature monitoring
- Air velocity monitoring
- Reticulated fire fighting, water underground

## Self Rescue

- Telephone, radio, PED System, stench gas
- Escapeway signage
- 35 refuge chambers
Emergency Escape Systems in Underground Mining

**USA**

**Silver / Gold**
- Annual production output: 125,000 ounce (gold)
- Number of underground miners: 120
- Average depth: 457 m
- Average travelling time to workplace: 15 min. to 20 min

**Mine Rescue**
- 4 teams on site (6 each)
- 6 mutual aid teams (1–6 hours)

**CCBA**

**Fire Prevention**
- FRAS conveyor belt and automatic fire extinguishing system
- Automatic fire extinguishing system, Fire suppression system on major equipment
- CO monitoring in main ventilation areas
- Fire fighting equipment, water pipes in all drifts

**Self Rescue**
- Radio, W-LAN, stench gas
- Filter self rescuer + compressed oxygen
- SCSR
- Escapeway signage
- 29 refuge chambers

**Primary and secondary escapeway**

**Change-over station**
Emergency Escape Systems in Underground Mining

**Australia**

**Base Metal**
- Annual production output: 3,000,000 tons
- Number of underground miners: 80
- Average depth: 500 m
- Average travelling time to workplace: 20 min.

**Mine Rescue**
- 2 teams (6 each) on site
- 2 mutual aid teams
- CCBA

**Self Rescue**
- Leaky feeder system, PED System, stench gas
- Chemical oxygen SCSR (nominal duration 30 min.)
- Underground signage Daily information FAC (fresh air chamber)
- 2 ladderways in fresh air
- 29 refuge chambers

**Fire Prevention**
- FRAS conveyor belt and automatic fire extinguishing system
- Diesel motor engines with automatic fire extinguishing system
- Temperature monitoring Air velocity monitoring
- Reticulated fire fighting water underground, Foam deluge system fitted to underground fuel bay
- Smoke detector
Emergency Escape Systems in Underground Mining

Canada
Zinc / Copper

Annual production output: 1.600.000 tons
Number of underground miners: 190
Average depth: 1600 m
Average travelling time to workplace: 30 – 60 min.

Mine Rescue
- 4 teams on site
- 8 mutual aid teams

CCBA
RC
RC
RC
RC
RC
RC
RC

Self Rescue
- Warning via radio communication, leaky feeder and stench gas
- SCSR stored on vehicles (nominal duration 60 min.)
- Escapeway signage by arrows
- 21 refuge stations (compressed air and RANA)

Fire Prevention
- FRAS conveyor belt
- Foam deluge system in fuel bay
- Intrinsically safe electronic apparatus
- Diesel motor with automatic fire extinguishing systems, large mobile equipment with fire suppression systems
- Gas monitoring
- 0.15 %
Emergency Escape Systems in Underground Mining

South Africa

Diamond
Annual production output:  2,400,000 tons
Number of underground miners:  440
Average depth:  620 m
Average travelling time to workplace:  30 min.

Mine Rescue
- 1 team on site (4 men)
- 6 mutual aid teams (2,5 hour)
- CCBA

Fire Prevention
- Automatic fire extinguishing system (diesel and oil tanks, tyre store)
- Smoke detector
- Oxygen gas detector
- CO, CH₄ monitoring
- Fire suppression system (underground vehicles), Recirculated fire fighting water underground, Fire fighting equipment

Self Rescue
- Telephone, loudspeaker, radio
- Chemical oxygen SCSR (nominal duration 35 min. and 60 min.)
- Escapeway signage
- Change-over Station
- 14 refuge chambers (700 m distance)
Above ground, emergency response plans generally anticipate self-escape and the provision of designated assembly points for mine personnel. Risk analysis provides information about any potential risks or hazards that may be involved. In downstream processing facilities, this applies particularly to toxic hazards or the risk of explosions as a result of leakage and increased concentrations of hazardous substances. Third-party rescue becomes necessary when personnel are unable to rescue themselves by escaping to a safe location. This can be the case, for example, when the atmosphere in a larger processing plant is contaminated with hazardous substances over a wide area and for a long period of time.

THE RIGHT EMERGENCY EQUIPMENT FOR INCIDENTS ABOVE GROUND

The choice of appropriate escape or rescue equipment depends on the results of risk assessment and the emergency response plan. The relevant criteria here are the degree of contamination with hazardous substances, the length of escape routes, possible oxygen deficiency, or fire.
# 8 points you should consider during the selection

<table>
<thead>
<tr>
<th>1. Hazardous substances</th>
<th>Which hazardous substances (gases, vapours, particles) may be encountered? What are the threshold limit values? What maximum concentrations could be expected during an incident? Could there be a lack of oxygen?</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Risk of fire and/or explosion</td>
<td>How high is the risk of a fire or explosion? Does the escape/rescue apparatus need ATEX certification? Does it have to provide protection against toxic combustion gases? Does the material have to be flameproof/fireproof?</td>
</tr>
<tr>
<td>3. Protection factors</td>
<td>The protection factor an escape/rescue device has to provide sufficient protection is derived from the determination of possible hazardous substances, the applicable threshold limit values, and the toxin concentrations in a worst case scenario.</td>
</tr>
<tr>
<td>4. Evacuation time</td>
<td>The emergency response plan provides the time window open for escape in certain emergency scenarios. Escape devices need to be able to provide protection for at least the duration of this time window.</td>
</tr>
<tr>
<td>5. Refuge areas</td>
<td>Is it possible to escape to a safe area? Is it likely that people in a safe refuge will have to wait for further evacuation measures?</td>
</tr>
<tr>
<td>6. Physical stresses</td>
<td>The weight and breathing resistance of respiratory protection equipment subjects the user to physical stress. This may also be accompanied by heat, extreme humidity, and poor visibility. While fulfilling safety requirements, the weight and the breathing resistance of the equipment should also be kept as low as possible.</td>
</tr>
<tr>
<td>7. Ease of use</td>
<td>In the case of an alarm, a fast and intuitive handling concept can provide the precious seconds that save lives. The better the handling of an escape device, the lower the risk of user errors.</td>
</tr>
<tr>
<td>8. Cost-effectiveness</td>
<td>Procurement costs aside, various other factors also influence the cost-effectiveness of escape devices: Service life (shelf life in storage), reusability, suitability for regular missions requiring respiratory protection, servicing requirements, and cleaning and maintenance needs.</td>
</tr>
</tbody>
</table>

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**More Information:** [WWW.DRÄGER.COM/MINING](http://WWW.DRÄGER.COM/MINING)