

Distributed Temperature Sensing (DTS) for Mining Applications

Mining activities involve complex, large-scale processes operating in some of the harshest and most demanding environments. From underground mines to open-pit operations and mineral processing facilities, ensuring safety, reliability, and operational efficiency is critical.



Thermal risks such as fires, overheating equipment, and geotechnical instability pose significant challenges in mining environments. Early detection of these conditions is essential to protect personnel, assets, and production continuity.

Distributed Temperature Sensing (DTS) using optical fiber technology provides continuous, real-time temperature monitoring over long distances. By delivering precise thermal profiles, DTS enables early detection of abnormal conditions and supports safer, more efficient mining operations.

Key Challenges

- **Harsh conditions:** Dust, moisture, vibration, and extreme temperatures
- **Large-scale infrastructure:** Extensive conveyor systems, tunnels, and haul routes
- **Fire risk:** Combustible materials, machinery, and electrical systems
- **Limited accessibility:** Underground and remote areas are difficult to inspect
- **Operational continuity:** Downtime leads to significant production losses
- **Safety requirements:** Strict regulations to protect personnel and assets

DTS Technology Overview

Distributed Temperature Sensing (DTS) systems use optical fibers as continuous linear temperature sensors. A DTS control unit sends laser pulses through the fiber and analyses backscattered light (typically Raman scattering) to determine temperature along the fiber length.

Key Benefits

- Continuous monitoring over tens of kilometres
- Real-time temperature data
- Immune to electromagnetic interference
- Passive sensing element (no power required in the field)
- Intrinsically safe solution minimising the risk of ignition and fire

System Architecture

A typical DTS deployment in mining includes:

Communication interfaces to:

- SCADA and mine control systems
- Fire detection and suppression systems
- Conveyor control and protection systems
- Maintenance and asset management platforms

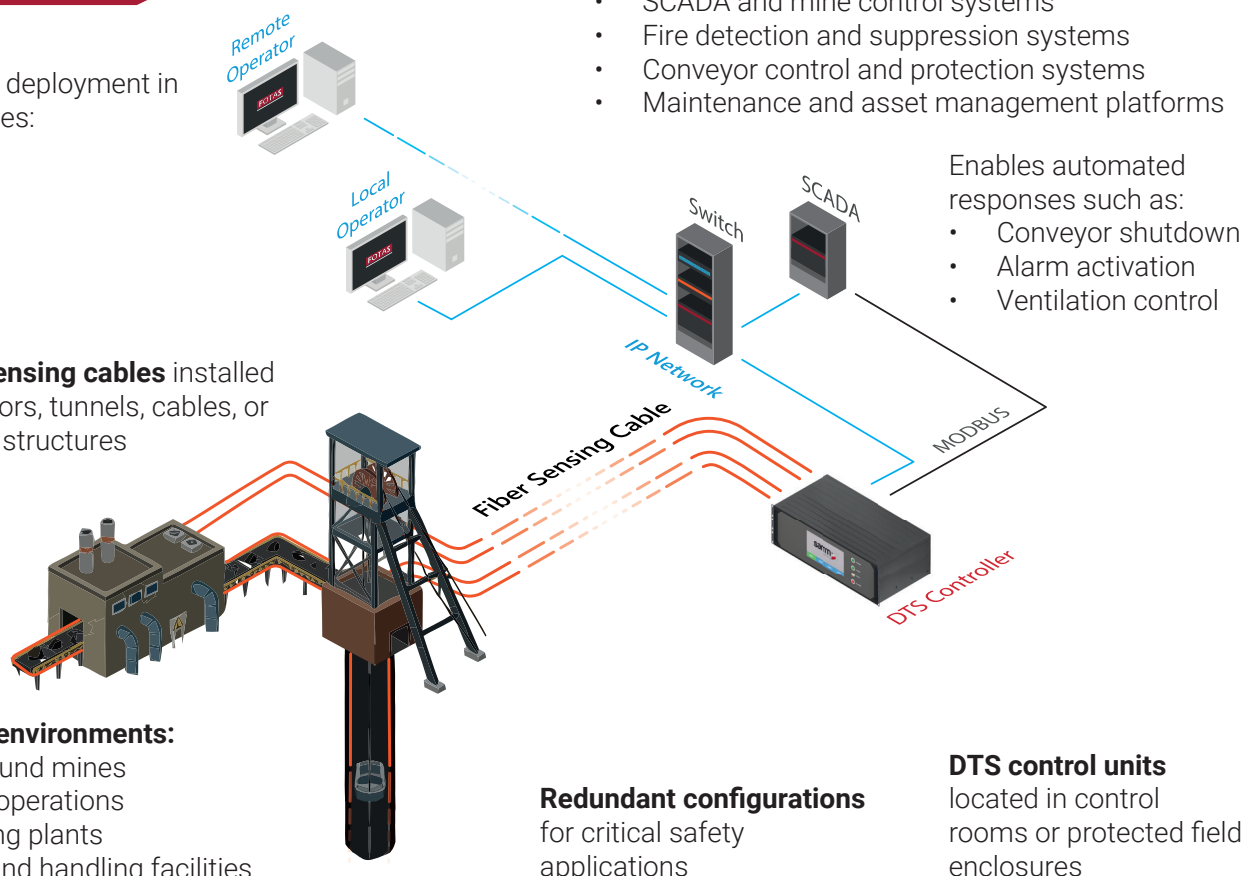
Fiber optic sensing cables installed along conveyors, tunnels, cables, or embedded in structures

Deployment environments:

- Underground mines
- Open-pit operations
- Processing plants
- Storage and handling facilities

Redundant configurations
for critical safety applications

DTS control units
located in control rooms or protected field enclosures



Key Factors for Successful Deployment



Cable selection: Ruggedised and armoured fiber suitable for mining conditions



Routing strategy: Placement close to critical assets for accurate monitoring



Zoning and alarms: Logical segmentation for effective incident detection



Redundancy: Loop configurations for high-risk areas



Mechanical protection: Installation methods to prevent damage from equipment or material flow

Key Applications

Conveyor Belt Monitoring

Conveyor systems are critical for transporting bulk materials. DTS enables:

- Early fire detection along conveyor belts
- Identification of overheating idlers and bearings
- Detection of belt misalignment and friction

Underground Tunnel and Shaft Monitoring

Underground environments present elevated fire and safety risks. DTS provides:

- Continuous linear heat detection in tunnels and shafts
- Early identification of fire or overheating equipment
- Support for ventilation and emergency response systems

Power Cable Monitoring

Electrical infrastructure is vital for mining operations. DTS supports:

- Detection of cable hot spots and faults
- Monitoring of joints and terminations
- Optimisation of cable loading and reliability

Mobile and Fixed Equipment Monitoring

Critical equipment such as crushers, mills, and drive systems can be monitored for:

- Overheating components
- Lubrication failures
- Mechanical faults

Stockpile and Bulk Material Monitoring

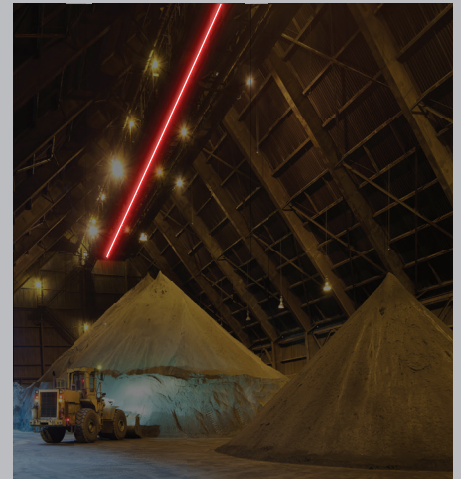
Stored materials such as coal or ore can self-heat, leading to fire risk. DTS enables:

- Detection of internal hot spots within stockpiles
- Continuous monitoring of storage areas
- Early intervention to prevent combustion

Tailings and Geotechnical Monitoring

Temperature variations can indicate changes in geotechnical conditions. DTS can be used for:

- Monitoring tailings dams and embankments
- Detecting seepage or internal movement
- Supporting structural integrity assessments



Key Benefits



Enhanced safety: Early detection of fire and overheating risks



Full coverage: Continuous monitoring over large and complex areas



Reduced downtime: Faster fault detection and response



Improved asset reliability: Early identification of equipment issues



Low maintenance: Passive sensing with long operational life



High durability: Suitable for harsh mining environments



Scalable solution: Applicable across multiple mining processes