

Formula 1

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Formula 2

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Formula 3

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Related Content

Title	Type	Slug
Blast Design Excel Template v4.2	resource	blast-design-excel-template
Drill Rig Maintenance Inspection Checklist	resource	drill-rig-maintenance-checklist
Rock Mass Rating (RMR) Field Survey Sheet	resource	rmr-field-survey-sheet
Drilling Energy Benchmarking Dashboard (Power BI)	resource	drilling-energy-dashboard
TBM Advance Rate Prediction Curve Library	resource	tbm-advance-rate-library

Detailed Explanation

Edge-AI deployment in underground drills requires overcoming extreme constraints: limited power (typically 12–24 V DC), high vibration, dust ingress (IP67/IP68 rated enclosures), electromagnetic interference from blasting and LHDs, and intermittent or zero-latency network connectivity. Unlike cloud-based AI, edge models must execute sub-100ms inference on quantized neural networks (e.g., TinyML or TensorRT-optimized U-Nets) fused with real-time sensor streams—such as gyroscopic orientation,

bit-load torque, acoustic emission spectra, and downhole gamma-ray spectrometry. The spec sheet defines mandatory interfaces (e.g., CAN bus ISO 11783-12 for drill telemetry, RS-485 for spectral sensors) and validates model accuracy against ground-truth core assay data using domain-adapted metrics like Grade-Weighted F1-Score. Crucially, it mandates dual-mode operation: supervised mode (with human-in-the-loop validation) and autonomous mode (with fail-safe rollback triggers based on confidence thresholds and anomaly detection). Deployment lifecycle management—including model versioning, A/B testing on parallel inference engines, and cryptographic signing of OTA updates—is codified to meet ISO/IEC 62443-3-3 security requirements for industrial control systems.

Key Components

#	Component
1	Ruggedized Edge Inference Unit (REIU)
2	Multi-sensor Fusion Gateway
3	Drill-Embedded Model Runtime (DEMR)

Applications

#	Application
1	Real-time lithology classification during drilling
2	In-situ grade estimation (e.g., Cu%, Au g/t) from spectral + mechanical signatures
3	Automated drill-path correction for boundary targeting

Related Concepts

#	Concept
1	TinyML
2	Digital Twin Integration for Drilling

#	Concept
3	ISO 13943 Mining Terminology

Tags

underground mining, edge computing, AI deployment, grade control, orebody modeling

Edge-AI Deployment Spec Sheet for Underground Drills

ToolFusion Engineering