Registration
● Guideline

■ GUIDELINE FOR SATISFACTORY EXPERIENCE: APPLICATION OF THEORY, IN THE MINING INDUSTRY BY AREA OF PRACTICE

PURPOSE

The guideline is meant to elucidate the expectations of engineering and geosciences applicants from different disciplines when describing or evaluating competencies achieved under *Application of theory,* or *Application of the Knowledge of Geoscience Principles and Practice*, as applicable, while working in the Mining industry. The remaining *elements of experience* are as set out in the Satisfactory Engineering Experience Guideline and the Satisfactory Geoscience Experience Guideline

Professional engineer referees are preferred as references; however professional geoscientists with expertise in the area of practice, who have detailed knowledge of the candidate's work, may act as referees for the candidate.

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GUIDELINE

AREAS OF PRACTICE IN THE MINING INDUSTRY

The Mining industry comprises several *areas of practice* of engineering and geoscience:

A. Exploration, mineral deposit mapping and surveying
B. Mine planning and operation
C. Mineral processing
D. Metal extraction
E. Tailings and waste dumps design and management
F. Maintenance
G. Environmental assessment, management, monitoring, mitigation and closure planning
H. Mine infrastructure construction projects

Engineers from different disciplines may take on roles from the same *area of practice*. The typical engineering disciplines associated with each *area of practice* are shown in Figure 1**.**

ELEMENTS OF EXPERIENCE

Applicants for registration are expected to demonstrate a *Working Knowledge* in the vast majority of elements of experience for one *area of practice* for which their discipline is eligible. Eligibility of disciplines by area of practice are:

A. Exploration, mineral deposit mapping and surveying
Eligible disciplines:
- Mining
- Geological
- Geoscience

B. Mine planning and operation
Eligible disciplines:
- Mining
- Geological
- Geoscience

C. Mineral processing

Eligible disciplines:

- Mining
- Metallurgical
- Chemical

D. Metal extraction

Eligible disciplines:

- Metallurgical
- Chemical
- Mining

E. Tailings and waste dumps design and management

Eligible disciplines (design and management):

- Geotechnical
- Civil

Eligible disciplines (management only):

- Mining
- Metallurgical
- Chemical
- Environmental
- Geoscience
- Environmental Geoscience

F. Maintenance

Eligible disciplines:

- Electrical
- Mechanical
- Mining
- Metallurgical

G. Environmental assessment, management, monitoring, mitigation and closure planning

Eligible disciplines:

- Environmental
- Civil
- Chemical
- Mining
- Geological
- Geoscience
- Environmental Geoscience

H. Mine infrastructure construction projects

Eligible disciplines:

- Civil
- Electrical
- Mechanical

Working Knowledge is defined as **achievement of the majority of competencies in the area of practice**. If an applicant has difficulty obtaining a Working Knowledge in one *area of practice*, their experience in other *areas of practice* will be evaluated on a case-by-case basis.

Applicants are also expected to demonstrate an awareness of their limitations in all *areas of practice* for which their discipline is eligible.

MINING INDUSTRY APPLICATION OF THEORY, EXPERIENCE: COMPETENCIES BY AREA OF PRACTICE

A. AREA OF PRACTICE: MINERAL DEPOSIT MAPPING AND SURVEYING

Eligible disciplines: Mining, Geological, Geoscience

Mining and Geological Engineers as well as Geoscientists are typically responsible for mapping the mineral deposit to determine the most effective plan for resource extraction. Competencies demonstrating application of theory, include, but are not limited to:

- exploration within the mine site property to identify new areas of mineralization
- assaying and analytical QAQC
- geological and geotechnical mapping of mineral deposit with software packages
- performing grade reconciliation calculations
- calculating resources and reserves, performing due diligence assessments
- conducting drilling projects and logging of underground drill cores
- mineral grade forecasting to develop short- and long-term mining plan
- geostatistical modeling of geospatial distribution of mineral grade and properties, providing blending plan to minimize mill feed variation
- performing geotechnical assessments for open pit development and slope requirements
- advising engineering with regard to mine blasting pattern, giving recommendations as to width, direction, and grade
- leading continuous improvement initiatives
- identifying and evaluating near-mine exploration opportunities
- developing analytical quality control procedures
- reporting of mineral resources to NI 43-101
- designing and implementing safe surveying procedures

B. AREA OF PRACTICE: MINE PLANNING AND OPERATION

Eligible disciplines: Mining, Geological, Geoscience

Mining and Geological Engineers as well as Geoscientists are responsible for developing the most efficient resource extraction plan and managing the daily operations of the mine. Competencies demonstrating application of theory, include, but are not limited to:

- conducting drilling projects and logging of underground drill cores
- grade mapping of mineral deposit with software packages
- performing grade reconciliation calculations
- calculating resources and reserves, perform due diligence assessments
- preparing pre-feasibility and feasibility studies of mine expansions
- performing feasibility studies for mine life extensions
- designing reclamation plans
- developing and maintaining the mine production plan as well as the drilling and blasting plan
- designing optimum mining shapes accounting for seismic activity and ground support
- designing stope size, shapes, and sequencing
- designing and sizing of material handling systems
- designing and implementing mine ventilation systems
- designing and implementing dewatering systems
- long term design of tailings embankment, pit slopes, and waste dumps
- monitoring of equipment utilization
- logistic planning of shovel and truck fleet
- geostatistical modeling of geospatial distribution of mineral grade and properties, providing blending plan to minimize mill feed variation

- establishing production targets and monitoring their achievement, analyzing mine productivity
- leading continuous improvement initiatives in different areas of the mine
- designing and implementing mine safety systems

C. AREA OF PRACTICE: MINERAL PROCESSING

Eligible disciplines: Mining, Metallurgical, Chemical

Mineral processing is a multi-disciplinary area of practice with Mining, Metallurgical, and Chemical Engineers all taking the role of process engineers to oversee the design and production in mills, implement process improvements, and optimize plant performance. Although engineers from some discipline may focus more on certain processes, the competencies demonstrating application of theory, are the same for all disciplines; they include, but are not limited to:

- daily tracking and reporting of metallurgical balance sheets
- performing mass balance and data reconciliation calculations: recognition of limits of mass balancing software
- providing metallurgical production forecasts, ensuring mill throughput is consistent with mine production plan
- controlling and investigating process problems and developing solutions
- maximizing process efficiency of individual circuits by recommending or implementing corrective actions
- developing pilot-scale tests of new processes and process improvements
- overseeing assay lab, providing direction and consultation on required methods for various types of analysis – possible but not a given
- preparing operating budgets
- coordinating and justifying capital expenditure projects in mill
- supervising installation and commissioning of new equipment and processes
- leading continuous improvement initiatives in the mill
- process modeling
- designing and implementing environmental control systems for production processes
- designing and implementing safe operating procedures for mill workers

D. AREA OF PRACTICE: METAL EXTRACTION

Eligible disciplines: Metallurgical, Chemical, Mining

Metallurgical and Chemical Engineers are typically involved in process engineers in metal extraction. Chemical Engineers are more typically involved in hydrometallurgy than in pyrometallurgy, while Metallurgical Engineers are involved in both. Mining Engineers with extensive experience in mineral processing may also be involved in metal extraction. Competencies demonstrating application of theory, include but are not limited to:

- daily tracking and reporting of metallurgical balance sheets
- performing mass balance and data reconciliation calculations: recognition of limits of mass balancing software
- providing metallurgical production forecasts, ensuring metal extraction throughput is consistent with mill output
- controlling and investigating process problems and developing solutions
- maximizing process efficiency of individual circuits by recommending or implementing corrective actions
- using equilibrium phase diagrams to guide determination of process conditions
- developing pilot-scale tests of new processes and process improvements
- overseeing of assay lab, providing direction and consultation on required methods for

various types of analysis
- coordinating and justifying capital expenditure projects
- supervising installation and commissioning of new equipment and processes
- leading continuous improvement initiatives
- process modeling
- designing and implementing environmental control systems for production processes
- designing and implementing safe operating procedures for mill workers

E. AREA OF PRACTICE: TAILINGS AND WASTE DUMP DESIGN AND MANAGEMENT

Eligible disciplines:
Design and Management: Geotechnical, Civil
Management: Mining, Metallurgical, Chemical, Environmental, Geoscience, Environmental Geoscience

Geotechnical Engineers are qualified to oversee the design and sustainable management of waste dumps and tailing disposal facilities. Civil Engineers may also be qualified to oversee design and management, depending on the tailings and wastepiles. Many other engineering and geosciences disciplines are frequently involved in the implementation of those designs under the direct or indirect supervision of a geotechnical engineer. Competencies demonstrating Application of theory,. include, but are not limited to

- designing and planning of tailings dams
- calculation of beaching characteristics
- slope design and analysis
- designing and maintaining water management systems
- designing and implementing slope monitoring systems
- justifying capital expenditures for tailings management
- monitoring and reporting on tailings growth, coordination with mill tailings production
- evaluation of potential environmental problems relating to tailings or waste management
- evaluation of progressive reclamation and closure scenarios

F. AREA OF PRACTICE: MAINTENANCE

Eligible disciplines: Mechanical, Electrical, Mining, Metallurgical

Mechanical and Electrical Engineers are typically involved as maintenance engineers. Mining and Metallurgical Engineers also take on this role in some mines. Maintenance engineers are responsible for preventative and curative maintenance of mining and processing equipment, tanks, and pumps. They also serve as internal resources for the design of mechanical and electrical systems. Competencies demonstrating application of theory, include, but are not limited to:

- designing mechanical and electro-mechanical systems
- modifying existing systems and equipment
- performing failure analysis, determining root cause of equipment failure
- scheduling maintenance plan
- working with other engineers to identify capital expenditure projects
- designing, sizing and selecting equipment, tanks, and pumps
- leading continuous improvement initiatives in Maintenance department
- conducting inspections of equipment to assess performance
- developing and implementing reliability engineering plans
- using predictive maintenance to identify potential problems
- making design calculations to enable preparation of detailed designs/drawings
- designing and implementing safe operating procedures for maintenance personnel

G. AREA OF PRACTICE: ENVIRONMENTAL ASSESSMENT, MANAGEMENT, MONITORING, MITIGATION AND CLOSURE PLANNING

Eligible disciplines: Environmental, Civil, Chemical, Mining, Metallurgical, Geoscience, Environmental Geoscience

Integrated management of environmental issues is a key concern in modern mining. Environmental Engineers are involved in environmental issues in all areas of the mine. Many other engineering and geosciences disciplines are also involved in managing environmental issues. Competencies demonstrating Application of theory, include, but are not limited to:

- designing and carrying out of environmental impact assessments of mining projects
- designing and carrying out of environmental effects monitoring programs of mining projects
- determining physical, biological, and socioeconomic baseline environmental conditions
- identifying and assessing potential environmental impact of mining project and recommending and implementing preventative and mitigating measures to minimize environmental impact
- performing quantitative risk assessment calculations
- designing and implementing of decommissioning and rehabilitation/remediation plans, updating of these plans with evolution of mining project
- designing and implementing groundwater remediation plans
- designing and implementing waste management plans for liquid, solid, and gaseous effluents
- designing and implementing post-decommissioning environmental monitoring plans
- designing and implementing environmental control systems for production processes

H. AREA OF PRACTICE: MINE INFRASTRUCTURE CONSTRUCTION PROJECTS

Eligible disciplines: Civil, Electrical, Mechanical

Civil engineers are typically responsible for infrastructure construction projects for mines. For candidates in this area, the Project and Construction Management Guideline may provide additional guidance. This area of practice has not been particularly problematic for out-of-discipline applicants in the mining industry. A short list of competencies demonstrating Application of Theory is provided; they include, but are not limited to:

- maintaining records of job progress, costs, material usage
- providing conceptual, preliminary and detailed design and specifications for mine construction projects and modification of existing infrastructure
- reviewing plans and specifications to determine material requirements
- preparing drawings for site development using CAD software
- reviewing project documents and drawings for technical content, adherence to project standards and specifications, and compliance with codes
- preparing proposals, administering contract, and tender documents
- supervising field QA/QC throughout construction projects
- providing material procurement and cost estimates; liaising with suppliers to facilitate and expedite material delivery
- providing field assistance in drawing and specification interpretation

Figure 1. - Typical Engineering Disciplines Associated With Each Area of Practice