PIABC LEVEL 7 DIPLOMA IN MINERAL PROCESSING

Qualification Number: 610/3437/X

Qualification Specification

Created: 13 November 2023

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INTRODUCTION

PIABC Level 7 Diploma in Mineral Processing (QN: 610/3437/X) is a nationally recognised mineral processing qualification. This first version of the PIABC Limited (PIABC) qualification.

PURPOSE

PIABC Level 7 Diploma in Mineral Processing provides candidates with the knowledge and skills to effectively manage mineral processing and extractive metallurgy processes, to assess risk, and to identify opportunities to enhance value.

The qualification is designed to develop the future leaders in mineral processing and allow candidates to create and increase value within their organisation. It forms a bridge between academic knowledge and the practical skills and expertise that are needed in the industry.

GENERAL OUTCOMES

The general objectives of the PIABC Level 7 Diploma in Mineral Processing (QN: 610/3437/X) are to:

1. Provide those employed, or who wish to be employed in mineral processing, extractive metallurgy and related industries with the skills, knowledge and understanding to underpin and enhance job experience.
2. Provide candidates with a portable qualification to enable job movement throughout the industry.
3. Provide employers operating in mineral processing and extractive metallurgy with a firm basis for judging suitability of candidates.
4. Raise the status of those employed in mineral processing, extractive metallurgy, and related industries.

TARGET GROUP

This Level 7 qualification is appropriate for those wanting to enhance their employment and progression opportunities in the mining, mineral processing, and extractive metallurgy industries.

The target audience for the qualification is recent graduates and those in the early stages of their career working in mineral processing plants, including metallurgists, mining, chemical, mechanical, and electrical engineers, and geologists.

ENTRY REQUIREMENTS

As a guide for entry onto programmes, candidates will normally be expected to have a minimum attainment of:

- Level 6 qualification in a relevant discipline. For example, a relevant engineering or applied science degree.

Alternatively, candidates should be able to clearly demonstrate competency, for example through experience in mineral processing, mining engineering or another related industry, which will allow them to succeed in the programme of study.

For candidates where English is not the candidate's first language, PIABC requests that a candidate provides evidence of their command of English before commencing the PIABC Level 7 Diploma in Mineral Processing (QN: 610/3437/X). PIABC's experience has shown that Candidates who are fully proficient in English are best placed to successfully complete their programme.

The most common qualification is the IELTS test. Other tests may be acceptable if a candidate has already taken them. Please note that test scores must be achieved from one sitting of the relevant qualification. PIABC will not accept individual component scores from multiple tests. The following qualifications are acceptable to show PIABC's minimum English language requirements:

- GCSE English Language/IGCSE (first language): Grade C minimum
- International English Language Testing System (IELTS) Academic module (not General Training): overall score 6.0; no sub-test less than 5.5
- ibTOEFL: 92; no sub-test less than 20
- CAE (Cambridge Certificate of Advanced English): C minimum
- CPE (Cambridge Certificate of Proficiency in English): C minimum
- PTE Academic (Person Test of English, Academic test): 55; no sub-test less than 51
- Assessment by a third party, for example the candidate's current employer, indicating an appropriate command of spoken and written English.

For English Language qualifications not listed here, then please email details of the qualification to PIABC (piabc@iom3.org) for approval.

PROGRESSION

Success in this qualification prepares candidates for progression in the mineral processing, extractive metallurgy, and mining industries to a position where they can assume responsibility for independent process supervision.

This qualification would enable a candidate to go on to doctorate level research on completion.

STAFFING

It is expected that staff involved with the delivery of the course will be appropriately qualified and/or experienced in mineral processing, extraction metallurgy, mining engineering and related topics. The PIABC approval process requires prospective centres to provide details of the staff involved in delivery and assessment including their qualifications and relevant training/employment experience, plus staff development arrangements. Whilst these details are passed on to the external moderator appointed by PIABC, it is the Centre's responsibility to ensure course leaders/tutors' qualifications are both bona fide and appropriate to the level of the qualification.

QUALITY ASSURANCE

PIABC requires that each centre has a quality assurance and enhancement procedure in respect of the programme, and a means of monitoring its implementation.

There should be a team that is responsible for preparing an annual self-assessment of the programme and for monitoring the improvement measures resulting from this.

This self-assessment process should use evidence from different sources including:

- Candidate self-evaluation
- Formal feedback via one-on-one interviews with selected candidates
- The views of external individuals and organisations, for example those companies sending candidates
- Formal interactions with instructional staff

In addition, it is also expected that there will be an internal moderation procedure to ensure standardisation of unit delivery. This will include the following elements:

- Review of assignments and submissions
- Peer review of award materials
- Moderation of any internally assessed elements

There should be a named and appropriately qualified individual (Centre co-ordinator) who has the necessary authority, with whom PIABC can liaise directly on all matters of management, administration, and quality assurance.

EXTERNAL MODERATION

PIABC will appoint appropriately qualified external centre monitors to undertake external quality assurance activities with the centres to ensure the maintenance of standards of quality.

The scope and frequency of monitoring activities will be in part determined by the centre assessment standard strategy for this qualification. PIABC's monitoring strategy will ensure that all centre marked assessments remain fit for purpose and that criteria against which candidates' performance is differentiated are being accurately and consistently applied for this qualification regardless on assessor, candidate, or centre.

PROGRAMME ORGANISATION

It is anticipated that the qualification will require a minimum of 192 guided learning hours, and it is expected a total qualification time of 378 hours for an average learner to satisfactory complete.

The organisation of the qualification is at the discretion of the Centre and will consider the aims, aspirations, and experience of the candidates.

Centres are encouraged to choose the most suitable curriculum model for their candidates. Whilst the sequential delivery of units is a possibility and may provide the most straightforward way of determining completion of individual units, it may be that some degree of integration of units will occur, or that other methods of delivery are more appropriate to meet the needs of candidates. It should be noted however that each unit will be individually assessed.

Centres must ensure that adequate arrangements are in place for supporting candidates. This could be either through separate tutorial sessions or through using time within structured study sessions. Centres using on-line or other forms of open learning must ensure that appropriate tutorial support is provided for candidates.

In relevant circumstances, centres are recommended to provide information and guidance to their candidates on the availability and type of employment the programme may lead to and on the progression routes available for further education and training in packaging.

GUIDANCE ON LEARNING AND TEACHING STRATEGY, METHODS, AND ASSESSMENT

Mineral processing is a practical subject, based on theoretical principles. As far as possible, it is important that the course is taught by relating the underlying theory to practical examples and applications.

Whilst all units are designed to be "stand alone" some topics appear as common themes across more than one unit. This should be recognised by course leaders/tutors and links made in those cases where candidates are working across more than a single unit.

Candidates will come to the course with varying levels of existing knowledge and/or practical experience of some parts of the syllabus. Course leaders/tutors should utilise this, through group work and other structured interactive activities, thus encouraging the sharing of knowledge which has the potential to lead to a high level of understanding.

The relation of theory and practice is a theme that will be reflected in the assessments for each unit and for the programme as a whole. Therefore, in structured learning and individual work, candidates should be aware of the requirement to develop a practical dimension to their understanding.

REASONABLE ADJUSTMENTS

Please refer to "*Access to Assessment – Arrangements for Candidates Needing Reasonable Adjustments, Special Consideration and/or Extenuating Circumstances in the Assessment Process*" document for more information. A copy is available from the PIABC team at piabc@iom3.org.

In carrying out assessments, PIABC's policy is to give all candidates equal opportunity to demonstrate attainment and to provide candidates with disabilities, learning difficulties and other problems the same access to assessment as other candidates.

Assessment arrangements maybe varied however, where the standards permit, for candidates with particular requirements. These requirements may take the form of special condition/extenuating circumstances for candidates whose needs are covered by the Equality Act 2010 or extenuating circumstances for those whose needs result from temporary disability or indisposition such as short-term illness.

In general, variation in assessment arrangements may be needed for physical disability, visual impairment, hearing impairment, specific learning difficulty, medical conditions, and use of English as a second language.

The nature of any special arrangements depends largely upon the qualification being followed and the assessment strategy employed. For scheduled fixed date examinations, then arrangements must be agreed directly with PIABC. For assessments at Level 3 and above, centres must write to PIABC to request concessions at least two months before the assessment. Concessions will be limited by specification and assessment requirements and supporting evidence will be required.

QUALIFICATION LEVEL

PIABC Level 7 Diploma in Mineral Processing (QN: 610/3437/X) is a Level 7 qualification.

Candidates require the skills, knowledge and understanding to show competence in applying technical, and commercial principles to a range of complex and varying tasks.

Candidates are required to analyse problems, determine their root cause, and recommend and implement effective solutions, with a substantial degree of personal responsibility and accountability.

Candidates may have direct responsibility for others or may have responsibilities within a team.

This qualification requires the candidate to understand complex elements from within the natural resource supply chain. It will prepare the candidate to operate as a future leader in mineral processing, extraction metallurgy and mining engineering where they will be expected to able to deal with new and novel problems. The qualification also prepares candidates to advise others about alternative appropriate solutions to problems, and to identify the critical factors associated with the advice that is given.

When work for this qualification is assessed, it is important to realise that evidence will be sought which demonstrates these features.

Level 7 Descriptor

Knowledge descriptor (the holder…)

- Reformulates and uses practical, conceptual, or technological knowledge and understanding of a subject or field of work to create ways forward in contexts where there are many interacting factors.
- Critically analyses, interprets, and evaluates complex information, concepts, and theories to produce modified conceptions.
- Understands the wider contexts in which the area of study or work is located.
- Understands current developments in the area of study or work.
- Understands different theoretical and methodological perspectives and how they affect the area of study or work.

Skills descriptor (the holder can…)

- Use specialised skills to conceptualise and address problematic situations that involve many interacting factors.
- Determine and use appropriate methodologies and approaches.
- Design and undertake research, development, or strategic activities to inform or produce change in the area of work or study.
- Critically evaluate actions, methods, and results and their short- and long-term implications.

Source: Ofqual Handbook: General Conditions of Recognition (Last Updated 26 June 2023)

QUALIFICATION STRUCTURE

In designing the qualification, each unit has been given an informative title, a level, a credit value, learning outcomes and assessment criteria. The assessment process is based on those learning outcomes and assessment criteria. The learning and teaching strategy must be designed so that candidates have the opportunity to meet the learning outcomes in an effective manner by demonstrating that they can achieve the assessment criteria.

To achieve this qualification the candidates will need to complete the six mandatory units (Units A to F) and then choose one optional unit (Unit G or H).

Ofqual Unit No.	Title		Unit Level	Guided Learning Hours	Total Unit Hours	Credits
Mandatory Units						
H/650/9127	Unit 7A	Mineral Processing in the Mining Value Chain	7	9	30	3
J/650/9128	Unit 7B	Mineralogy for Mineral Processing	7	18	30	3
K/650/9129	Unit 7C	Comminution	7	36	60	6
R/650/9130	Unit 7D	Flotation	7	36	60	6
T/650/9131	Unit 7E	Statistical Methods	7	27	48	5
Y/650/9132	Unit 7F	Individual Project	7	48	120	12
Optional Units (1 unit only)						
A/650/9133	Unit 7G	Physical Separation	7	18	30	3
D/650/9134	Unit 7H	Hydrometallurgy	7	18	30	3
Qualification Level			7			
Total Guided Learning Hours (GLH) Time				192		
Total Qualification Time (TQT)					378	
Total Qualification Credits						38

UNIT CONTENT

MANDATORY UNITS

UNIT 7A – MINERAL PROCESSING IN THE MINING VALUE CHAIN

Ofqual Unit No: H/650/9127
Unit Level: 7
Grading Structure: Pass

Total Learning Hours: 30
Guided Learning Hours: 9
Unit Credits: 3

This unit will introduce candidates to the various links in the mining value chain and identify the contribution of each to overall value distribution. It describes the impact of mineral processing up and down the chain and the factors that must be considered in order to make well informed process decisions.

Learning Outcomes: what you need to know/understand		**Assessment Criteria:** what you need to do	
1.0	Understand, at a high level, the mining value chain and the role played by the various professionals in generating value.	1.1	Define the factors contributing to value of an operation or project in the resources industry, and of the dynamic nature of this value.
		1.2	Define the roles and responsibilities of a metallurgist
		1.3	Explain what is meant by commercial and economic value of a resource
2.0	Understand sustainability and value drivers for the global mining industry	2.1	Describe the international sustainable development goals, and the balance between economic growth, the welfare of society and the environment.
		2.2	Describe the current state of the art of sustainability in mining.
3.0	Demonstrate awareness of ethical, social, and intercultural responsibilities	3.1	Identify the responsibilities of mining companies
		3.2	Describe social and cultural connections, and those between people and the natural environment.
4.0	Use of diagnostic tools for performance management	4.1	Explain production strategies in mining and mineral processing operations, and their impact on economic, social, and environmental outcomes.
		4.2	Describe the factors a metallurgist must consider making well informed process decisions.

UNIT 7B – MINERALOGY FOR MINERAL PROCESSING

Ofqual Unit No: J/650/9128
Unit Level: 7
Grading Structure: Pass

Total Learning Hours: 30
Guided Learning Hours: 18
Unit Credits: 3

Through this unit candidates will become sufficiently familiar with mineralogical tools and data to capably undertake a mineralogical process performance assessment and use best available analytical methods to interpret the data and its implications for metallurgical processes. The content of this unit underpins metallurgical process knowledge with a knowledge of the geological factors that drive the metallurgical characteristics of an orebody.

Learning Outcomes: what you need to know/understand		**Assessment Criteria:** what you need to do	
1.0	Understand the value of mineralogy, its use as a tool and how operations access mineralogical information	1.1	Define process mineralogy
		1.2	Describe the role of mineralogy in ore-body evaluation and process diagnostics
		1.3	Describe the uses of mineralogical samples and the stages in their preparation
		1.4	Explain the basic principles of petrology and lithology in relation to geology
		1.5	Explain how knowledge of the orebody and geometallurgy are important when exploring the journey from mine to mill
		1.6	Explain the importance of the people working in mineralogy
2.0	Understand the practical applications of mineralogical tools, analytical methods, and strategies to manage mineralogical challenges	2.1	Describe a range of mineralogical tools
		2.2	Interpret data from automated systems
		2.3	Collect, analyse, and interpret liberation data
3.0	Demonstrate the ability to make effective decisions based on evaluation of mineralogical data and observations	3.1	Define a problem and develop a solution based on theoretical knowledge.

UNIT 7C – COMMINUTION

Ofqual Unit No: K/650/9129
Unit Level: 7
Grading Structure: Pass

Total Learning Hours: 60
Guided Learning Hours: 36
Unit Credits: 6

In this unit candidates will develop a sound knowledge of the basic theory and current best practice in comminution, classification, and other related processes. Candidates will develop competency in the use of available tools and analytical methods for operating, monitoring, and evaluating circuits and become aware of the relevant areas of technical research and development.

Learning Outcomes: what you need to know/understand		**Assessment Criteria:** what you need to do	
1.0	Understand the science of comminution	1.1	Define the science of comminution and its history
		1.2	Describe comminution in the context of the mineral processing value chain
		1.3	Summarise typical operations and equipment
2.0	Understand comminution unit operations and circuits	2.1	Summarise unit operations and equipment including ancillary equipment
		2.2	Explain performance of comminution equipment based on knowledge of theory and practice.
		2.3	Evaluate comminution circuit performance based on knowledge of operational considerations and breakage/classification theory
3.0	Understand testwork and laboratory characterisation	3.1	Explain typical laboratory characterisation tests and why they are useful
		3.2	Explain how operational data is collected in comminution circuits
		3.3	Calculate breakage indices
4.0	Demonstrate the ability to effectively communicate a performance plan for a comminution circuit using knowledge of theory and operational practice	4.1	Demonstrate use of current and relevant tools and methodologies to develop a performance plan
		4.2	Effectively communicate performance plan

UNIT 7D - FLOTATION

Ofqual Unit No: R/650/9130
Unit Level: 7
Grading Structure: Pass

Total Learning Hours: 60
Guided Learning Hours: 36
Unit Credits: 6

In this unit candidates will develop a sound knowledge of the basic theory and current best practice in flotation and other related processes. Candidates will develop competency in the use of available tools and analytical methods for operating, monitoring, and evaluating circuits and become aware of the relevant areas of technical research and development.

Learning Outcomes: what you need to know/understand		**Assessment Criteria:** what you need to do	
1.0	Understand the science of flotation and key concepts	1.1	Define flotation and the history of flotation in mining, and summarise future technology trends in flotation
		1.2	Summarise unit operations and equipment including ancillary equipment used in flotation
		1.3	Explain the relevant terminology and fundamental concepts including an overview of flotation reagents and conventional circuit configurations.
		1.4	Summarise flotation physics and hydrodynamics
		1.5	Summarise flotation chemistry
		1.6	Describe the relationship between mineralogy, liberation, and flotation response
2.0	Evaluate flotation circuit performance and operating practices based on knowledge of theory, unit processes and mineralogy	2.1	Analyse flotation data using conventional numerical models and advanced statistical and modelling techniques.
		2.2	Assess process performance and effectively predict process outcomes using modern tools and technologies
		2.3	Critically assess process performance based on observations of the system, analysis of data, and common approaches to process management
		2.4	Evaluate and optimise flotation circuit designs for different ore types and process requirements.
3.0	Understand the use of laboratory data, scale-up and applications of laboratory tests	3.1	Describe laboratory tests used in flotation
		3.2	Explain scale-up
4.0	Collect representative and meaningful data in accordance with sampling theory and commonly used practical methods	4.1	Explain data collection in flotation circuits
		4.2	Design and produce a plan for a plant trial
		4.3	Perform mass balancing in flotation circuits

Learning Outcomes: what you need to know/understand		**Assessment Criteria:** what you need to do	
5.0	Demonstrate the ability to effectively communicate a performance plan to troubleshoot and address complex flotation challenges using knowledge of theory and operational practice	5.1	Describe flotation process management analysis and optimisation strategies
		5.2	Apply commonly used tools and techniques to solve typical circuit problems
		5.3	Describe basic flotation modelling concepts
		5.4	Effectively communicate performance plan

UNIT 7E – STATISTICAL METHODS

Ofqual Unit No: T/650/9131
Unit Level: 7
Grading Structure: Pass

Total Learning Hours: 48
Guided Learning Hours: 27
Unit Credits: 5

In this unit candidates will develop a sound level of competency in designing experiments, analysing mineral processing data, and selecting the appropriate statistical tool to extract the full value from mineral processing plant data. Candidates will develop a sound level of proficiency in using statistical tools.

Learning Outcomes: what you need to know/understand		**Assessment Criteria:** what you need to do	
1.0	Understand the value of statistical analysis in mineral processing	1.1	Describe the basics of statistical analysis
		1.2	Discuss experimental design and industrial applications of statistical analysis
		1.3	Discuss complex data sets and their impact on mineral processing
		1.4	Summarise research methods
		1.5	Select an appropriate statistical tool for a problem
		1.6	Explain data pre-processing and preliminary data analysis
		1.7	Explain statistical data reconciliation
		1.8	Summarise issues associated with the propagation of errors
2.0	Understand how statistical tools work with common forms of mineral processing data	2.1	Summarise probability distributions
		2.2	Define key parts of mineral processing data
		2.3	Summarise comparative plant testing
		2.4	Describe the importance of hypothesis testing
		2.5	Interpret data
3.0	Understand how to design and analyse efficient experiments	3.1	Describe the features of good experimental design
		3.2	Describe time series analysis
		3.3	Explain experimental design for performance optimisation

UNIT 7F – INDIVIDUAL PROJECT

Ofqual Unit No: Y/650/9132
Unit Level: 7
Grading Structure: Pass

Total Learning Hours: 120
Guided Learning Hours: 48
Unit Credits: 12

In this unit candidates apply the knowledge and capabilities developed in other units to a specific technical investigation or design. The project is a complex, open-ended problem that requires the acquisition, analysis and interpretation of results and provide an opportunity for creativity. Successful completion of the Individual Project will demonstrate that the candidate can formulate a problem in engineering terms, manage and schedule resources, and find solutions by applying appropriate and current mineral processing tools and methods.

Learning Outcomes: what you need to know/understand		**Assessment Criteria:** what you need to do	
1.0	Formulate a hypothesis and develop a project scope	1.1	Demonstrate the process of technical investigation and the application of scientific method, including establishing a hypothesis
		1.2	Demonstrate a structured approach to problem solving
		1.3	Demonstrate the ability to plan a project
2.0	Develop skills in project management and data presentation	2.1	Communicate project goals
		2.2	Demonstrate time management and project management skills
3.0	Execute a technical investigation	3.1	Undertake the technical investigation.
		3.2	Draw conclusions and develop recommendations.
4.0	Develop presentation and report writing skills for communicating with technical and non-technical audiences	4.1	Create a detailed project report
		4.2	Deliver an oral presentation on the project
		4.3	Demonstrate different forms of data presentation and reporting

OPTIONAL UNITS

UNIT G – PHYSICAL SEPARATION

Ofqual Unit No: A/650/9133
Unit Level: 7
Grading Structure: Pass

Total Learning Hours: 30
Guided Learning Hours: 18
Unit Credits: 3

In this unit candidates will develop a sound knowledge of the basic theory and current best practice in physical separation (solid/solid separation), dewatering (solid/liquid separation) and other related processes. Candidates will develop competency in the use of available tools and analytical methods for operation and the characterisation of materials including waste and tailings, process monitoring, and the evaluation of circuit performance. Candidates will become aware of the relevant areas of technical research and development.

Learning Outcomes: what you need to know/understand		**Assessment Criteria:** what you need to do	
1.0	Understand the fundamentals of the physical separation and dewatering processes commonly used in mineral processing	1.1	Describe physical separation methods
		1.2	Summarise unit operations and equipment
		1.3	Use knowledge of separation mechanics to categorize separation equipment
2.0	Demonstrate the ability to evaluate and optimise separator performance	2.1	Summarise characterisation methods for physical separation and dewatering processes
		2.2	Apply troubleshooting approaches to address operational challenges.

UNIT 7H – HYDROMETALLUGY

Ofqual Unit No: D/650/9134
Unit Level: 7
Grading Structure: Pass

Total Learning Hours: 30
Guided Learning Hours: 18
Unit Credits: 3

In this unit candidates will develop a knowledge of the basic theory and current best practice in hydrometallurgy, especially leaching and extraction. Leaners will become aware of the relevant areas of technical research and development, especially relating to alternatives to flotation for metallic ores.

Learning Outcomes: what you need to know/understand		**Assessment Criteria:** what you need to do	
1.0	Understand hydrometallurgy and where it fits in mineral processing	1.1	Describe the fundamentals of hydrometallurgy, its history, and likely future trends
		1.2	Describe the main chemical systems in hydrometallurgy
2.0	Understand leaching processes	2.1	Summarise leaching systems
		2.2	Summarise the fundamentals of copper leaching
		2.3	Describe the leaching of gold ores
		2.4	Describe practical aspects of specific leaching processes
		2.5	Summarise practical systems for hydrometallurgy
		2.6	Summarise environmental considerations in hydrometallurgy.
3.0	Understand hydrometallurgical extraction processes	3.1	Describe the use for precipitation for metal extraction.
		3.2	Describe the use of solvent extraction and ion exchange (SXEW) processes.
		3.3	Describe the process of gold recovery from carbon adsorption
		3.4	Describe cementation processes
		3.5	Explain hydrogen reduction processes and where they are used
		3.6	Describe electrowinning in hydrometallurgical processes.

ASSESSMENT

Each unit A to H is assessed through a centre-devised and managed assignment covering all learning outcomes. The assignments will be internally assessed, and internally quality assured by the centre.

For each cohort a sample selection from each unit (A to H) will be external quality assured by PIABC. The sample selection will be determined by PIABC in line with its centre assessment standard strategy and external quality assurance sampling policy. This will be undertaken before qualification certification. PIABC's centre assessment standard strategy will ensure that all centre devised and marked assessments remain fit for purpose and that criteria against which candidates' performance is differentiated are being accurately and consistently applied for this qualification.

Each unit is graded either *Pass or Fail.*

The grading structure for each unit assessment is not subject to change.

QUALIFICATION CERTIFICATION

Candidates successfully completing the qualification will be awarded a *Pass*.

The overall grading structure for the qualification is not subject to change.

REGULATORY INFORMATION

Subject/sector area:	4.2 Manufacturing Technologies
Qualification operational start date:	13/11/2023
Qualification review date:	13/11/2025
Applicable age ranges (years):	19+

FURTHER INFORMATION

Please contact PIABC Limited directly at:
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