
Practical Metallurgy for Engineers and Asset Managers Training Course

12 – 16 April 2027
Tokyo





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Programme Summary

Practical metallurgy for engineers and asset managers is the subject of this one-week training course at intermediate level for professionals without a metallurgy background, ending in a materials decision file for one item of plant equipment. Decisions on steel grades, heat treatment, weld repairs and failure reports are often taken by people never trained to question them. The approach moves from how metals are built and tested to welding, in-service damage and failure investigation. Mars Training Centre UK delivers this programme in practical metallurgy.

The Business Case

A wrong material grade, an untreated weld or a misread failure report can turn a routine repair into a repeat failure or a safety incident. Engineers and managers who can read the metallurgy behind these decisions ask sharper questions of suppliers, fabricators and laboratories, and approve fewer costly mistakes.

- Repeat Equipment Failures: Fail as root causes in the metal are recognised and corrected rather than replaced like for like.
- Rejected Materials and Rework: Decline as material certificates, hardness results and weld procedures are checked before installation.
- Unplanned Outages From Cracking: Reduce as fatigue, creep and hydrogen damage are anticipated in inspection plans.

Principles and Evidence Base

- ISO 6892-1 and ISO 148-1: Tensile and Charpy impact testing explain how strength and toughness values on a certificate are produced in Session 2.
- ISO 10474: Types of inspection documents for steel products guide the certificate review in Session 2.
- ISO 15614-1: Welding procedure qualification for steels frames the review of weld procedures and post-weld heat treatment in Session 3.
- API RP 571: Its catalogue of damage mechanisms structures the review of in-service deterioration in Session 4.

Intended Participants

- Engineers who specify, purchase or approve metallic materials and components.
- Inspection and integrity staff who interpret hardness, thickness and crack findings.
- Maintenance leaders who authorise weld repairs and replacement parts.
- Asset managers who receive failure reports and decide on corrective action.



The programme serves oil and gas production, refining and petrochemicals, power generation and heavy fabrication.

Learning Outcomes

1. Participants will be able to relate how composition, microstructure and heat treatment determine the properties of steels and alloys.
2. Participants will be able to evaluate a material test certificate against the specification ordered.
3. Participants will be able to assess welding procedures, preheat and post-weld heat treatment for common plant steels.
4. Participants will be able to diagnose likely damage mechanisms from operating conditions and inspection findings.
5. Participants will be able to critique a failure analysis report and its recommendations.
6. Participants will be able to justify a material selection for a defined service condition.

Programme Structure

Day 1: Metallurgy Fundamentals for Plant Metals

What gives a metal its strength, toughness and weakness?

- Crystal Structure, Grains and Alloying Elements
- The Iron-Carbon Diagram: Ferrite, Pearlite, Austenite and Martensite
- Carbon, Low-Alloy and Stainless Steel Families
- Duplex Stainless Steels and Nickel Alloys
- Steelmaking, Forming and Their Effect on Defects

Day 2: Heat Treatment, Properties and Testing

How are properties created, measured and certified?

- Annealing, Normalising, Quenching and Tempering
- Hardness Testing and Hardness Limits in Service
- Tensile Testing Under ISO 6892-1
- Charpy Impact Testing Under ISO 148-1 and the Ductile-to-Brittle Transition
- Reading Material Certificates Under ISO 10474 and Positive Material Identification

Day 3: Welding Metallurgy

What happens to the metal when it is welded or repaired?

- Weld Metal, Fusion Line and Heat-Affected Zone
- Hydrogen Cracking, Preheat and Interpass Control
- Welding Procedure Qualification Under ISO 15614-1
- Post-Weld Heat Treatment Purpose and Records
- Weld Defects and Non-Destructive Examination Results



Day 4: In-Service Damage and Failure

How do metals deteriorate and break in operation?

- Damage Mechanism Screening Under API RP 571
- Mechanical and Thermal Fatigue
- Creep and High-Temperature Degradation
- Brittle Fracture and Hydrogen Embrittlement
- Fractography: Reading a Fracture Surface

Day 5: Applying Practical Metallurgy to Plant Decisions

Is the materials decision file sound enough to act on?

- Failure Analysis Report Structure and Review Questions
- Applying Day 4 Damage Screening to a Participant Asset
- Checking Day 2 Certificates and Day 3 Weld Records for That Asset
- Material Selection Trade-Offs for a Defined Service
- Completing the Materials Decision File

Methodology

The programme relies on case analysis using real-format certificates, weld procedure records, inspection data and failed component photographs from refineries, gas plants and power stations. Participants work in small groups to question evidence the way a metallurgist would.

- Suggested activity: Finding the non-conformance in three material certificates.
- Suggested activity: Matching fracture surfaces to their failure mechanism.
- Suggested activity: Reviewing a failure analysis report and challenging its conclusions.

Capstone Output

Each participant completes a materials decision file for one item of plant equipment. It contains the material specification, certificate checks, welding and heat treatment requirements, a damage mechanism screen and a recommended material choice with reasons. It is used when the item is next repaired, replaced or inspected.

Frequently Asked Questions

Is practical metallurgy training suitable for engineers without a materials background?

Yes. It is set at intermediate level for engineers and managers who work with metals but have no formal metallurgy training, and assumes general engineering knowledge.



Which standards does the practical metallurgy programme rest on?

It rests on ISO 6892-1 and ISO 148-1 for testing, ISO 10474 for inspection documents, ISO 15614-1 for weld procedures and API RP 571 for damage mechanisms.

How is the file from practical metallurgy training used at work?

You can use it to check incoming materials, approve weld repairs and challenge failure reports for the equipment you are responsible for.

How does practical metallurgy differ from corrosion management training?

It explains how metals are built, treated, welded and fractured, while corrosion management focuses on chemical attack and its control.