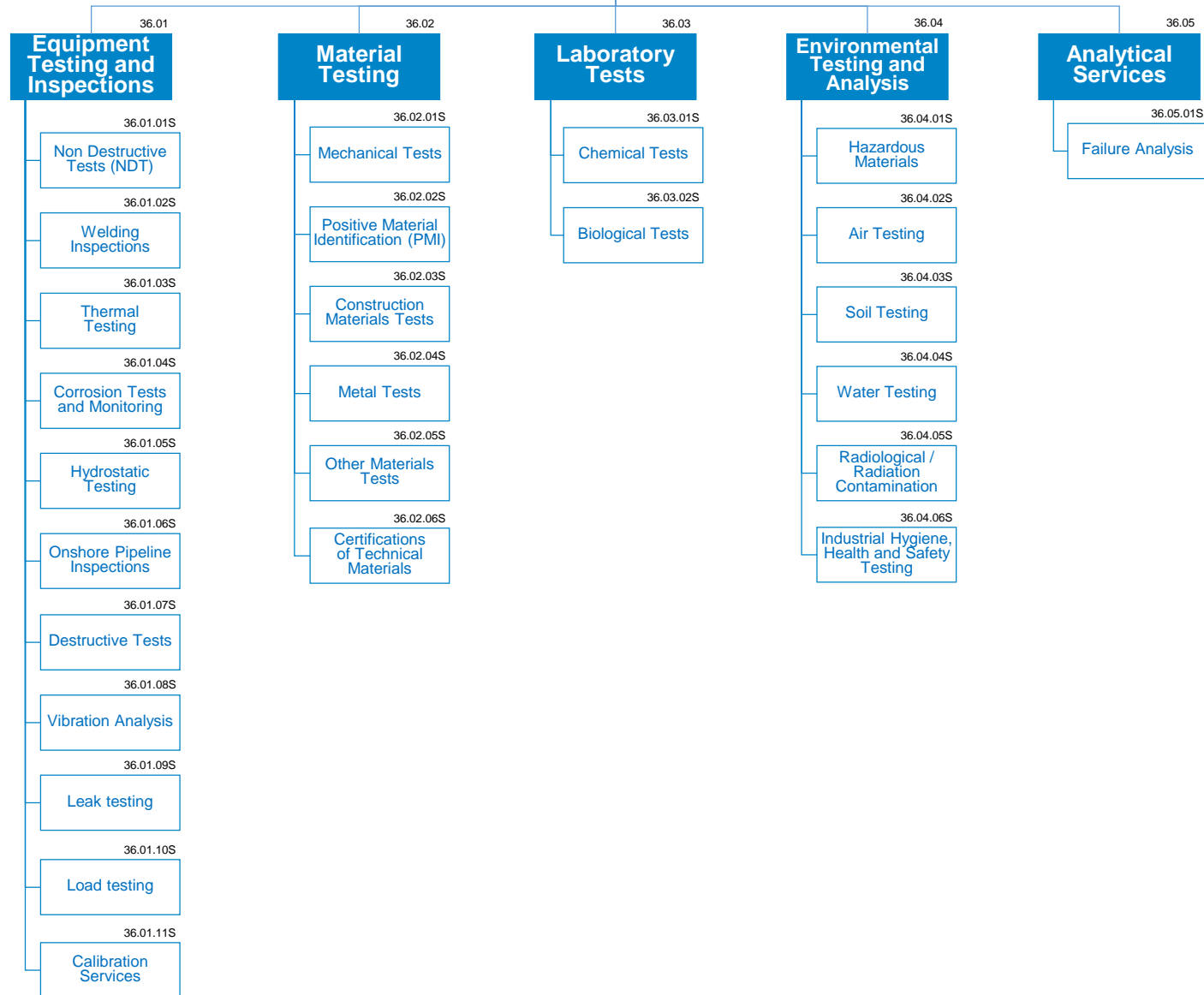


# Testing and Analysis



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Testing and Analysis activities are continuously required in the industrial world during the manufacturing process on materials as well as equipment and systems. Testing and Analysis activities can be performed at manufacturing plant / site as well as in laboratories. Those tests can also set the basis for products' acceptance.

Environmental Testing and Analysis is increasingly required with activities that cover air, soil, water with a special focus on hazardous materials and radiation / contamination.

## MAIN RATIONALES BEHIND THE STANDARD CATEGORIZATION

### Equipment Testing

- Non Destructive Testing (NDT) is a wide group of analysis techniques used in science and technology industry to evaluate the properties of a material, component or system without causing damage. Current NDT methods are: Acoustic Emission Testing (AE), Electromagnetic Testing (ET), Guided Wave Testing (GW), Ground Penetrating Radar (GPR), Laser Testing Methods (LM), Leak Testing (LT), Magnetic Flux Leakage (MFL), Microwave Testing, Liquid Penetrant Testing (PT), Magnetic Particle Testing (MPT), Neutron Radiographic Testing (NR), Radiographic Testing (RT), Thermal/Infrared Testing (IR), Ultrasonic Testing (UT), Vibration Analysis (VA), Eddy Current Testing (EC) and Visual Testing (VT).
- Welding Inspection requires a wide variety of knowledge on the part of the inspector, including an understanding of welding drawings, symbols, and procedures; weld joint design; code and standard requirements; and inspection and testing techniques. Different Welding inspection methods can apply:
  - Visual Inspection (if performed correctly, a visual inspection is often the easiest and least-expensive method for many applications. However, a good-looking weld doesn't always ensure internal quality, and discontinuities aren't always visible to the naked eye)
  - Surface crack detection (used to detect fine cracks, seams, porosity, and other surface-breaking discontinuities, surface crack detection is usually applied using one of two methods: liquid penetrant inspection or magnetic particle inspection)
  - Radiographic and ultrasonic weld inspection (two non-destructive testing methods that detect discontinuities within the internal structure of a weld)
  - Destructive weld testing (involves the physical destruction of the completed weld to detect various mechanical and physical characteristics)
- Thermal analysis techniques include differential scanning calorimetry, differential thermal analysis, thermo-mechanical analysis, dynamic mechanical analysis, thermogravimetric analysis, and pyrolysis combustion flow calorimetry. Infrared thermography (IRT), thermal imaging, and thermal video are also included.

- The target of a corrosion test of can be the verification of the quality/reliability of a base material and its manufacturing process as well as of welded joint. The weldability of a material as a general concept also implies the ability to maintain the corrosion resistance appropriate to the service required for the component.
- Hydrostatic Testing is a way in which pipelines, pressure vessels, plumbing, gas cylinders, boilers and fuel tanks can be tested for strength and leaks. Pressure testing is a similar testing method and is included in this category. Hydrostatic Testing specifically for pipelines is covered under Group 35 ("Site Services").
- Pipeline Inspection includes two types of service:
  - In-line service: quick scans, full assessments, pre-engineering, mechanical works, mechanical and chemical cleaning, gauging, caliper runs, inspection, reporting and consulting.
  - Out-line service: pipeline location & depth detection, soil corrosion detection, stray current detection, evaluation of cathodic protection, effectiveness, damage points detection & location.
- Pipeline Pigging Services are also included under Pipeline Inspection services and they are usually performed through intelligent pigs (or smart pigs) to assess the integrity of assets in a quick and non-intrusive manner. Smart pigs are intelligent pipeline inline inspection tools that examine the structural integrity of pipeline systems.
- Load testing is the process of putting demand on a system and measuring its response. This category specifically refers to Physical Load Testing only (not software load testing).
- Leak testing refers to all leak tests (gas leak, water leaks, valves leaks, ...) that have not yet been covered (e.g. pipeline inspection or hydrostatic testing).

### Material Testing

- A mechanical test shows whether a material or part is suitable for its intended application by measuring properties such as elasticity, tensile strength, elongation, hardness, fracture toughness, impact resistance, stress rupture and the fatigue limit.
- Positive Material Identification (PMI) is the analysis of a metallic alloy to establish composition by reading the quantities by percentage of its constituent elements. Typical methods for PMI include X-ray fluorescence (XRF) and optical emission spectrometry (OES).

### Laboratory Tests

- "Pipeline Integrity Services" is the analysis of the data gathered during the phases of inspection (Non-Destructive welds, Non-Destructive tests)

### Environmental Testing and Analysis

- Hazardous Material Analysis is based on a review of the Material Safety Data Sheets (MSDS's) for products to determine appropriate classification based on material properties (i.e. flammable and combustible liquids, toxic materials, corrosive materials, water-reactive materials, oxidizing materials, hazardous gases, non hazardous, etc.). Classifications are typically based on definitions provided in the applicable building and/or fire code.
- Radioactive contamination, also called radiological contamination, is the deposition of, or presence of radioactive substances on surfaces or within solids, liquids or gases, where their presence is unintended or undesirable

### Analytical Services

- Failure Analysis is the process of collecting and analyzing data to determine the cause of a failure, often with the goal of determining corrective actions or liability. Materials can fail due to a number of reasons: fatigue, overload, creep, corrosion, erosion, poor welds, wear, improper materials, design, manufacturing, defects, modifications, poor maintenance, and misuse.