5. NON-DESTRUCTIVE TESTING AND PRODUCT INSPECTION

Non-Destructive Testing or NDT brings together all the processes and techniques that provide **information on the integrity and health of a material or part** without damaging it. It is for materials what medical imaging is for the human body.
NDT (applied to forged, rolled, cast and welded parts) highlights all the defects that might alter the availability, safety of use and / or more generally the conformity of a part for its intended use.

Two types of defects are searched:
- surface defects such as cracks, holes, splits, pittings…
- internal defects such as porosities, blisters, inclusions, blind cracks, variations in thickness due to wear or corrosion…

Additional checks verifying the chemical nature of the materials used and the mechanical strength of the parts may also help.

For this intent, the **main control techniques** we are proposing are:

- Visual Testing - VT,
- Penetrant Testing - PT,
- Radiographic Testing - RT,
- Ultrasonic Testing - UT,
- Leak tightness Testing - LT,
- PMI / Ferrite rate,
- Hydrostatic test.

NDT TABLE AND DETAILS

Method	Defects highlighted	advantages	Limits	Examination stage
Visual Testing - VT	Emerging discontinuities (splits, scratches, porosities, cracks, etc.)	Economical, fast	Can only detect surface defects of significant size	All stages
Dye-penetrant (PT)[1]	Emerging discontinuities (splits, cracks, porosities, pittings, etc.)	Reliable detection of small surface defects	Can only detect emerging discontinuities	Weld beads (intermediate or final) or machined parts
X-ray or gamma radiography (RT)	Cavities or foreign materials included in the part	Detection of all types of internal defects	Significant cost linked to controlled thicknesses, complexity of implementation	Weld beads
Ultrasonic (US)	Deep defect in the material resulting in a discontinuity of the mechanical properties (crack, inclusion, porosity, etc.)	Detection of all types of internal defects, not limited to metallic materials	Significant cost for single parts	Raw material, weld beads and machined parts
Leak tightness (LT)	Leak tightness defect which allows a leak	Detection of defects passing through the material, even very small	Can only detect passing through defects	Finished parts

[1] Products used for this test comply with PMUC (Products and Materials Used in Nuclear Power Plant) requirements for nuclear applications.
[2] The inspectors undergo an annual assessment of their visual acuity according to NF EN ISO 18490 as operators certified COFREND level 2 according to EN ISO 9712.

While some of these controls are imposed by construction codes or regulatory requirements, we are also able to take into account the specific requirements of our customers. To serve this purpose, we have:
- examination procedures validated by Cofrend level 3 certified staff according to EN ISO 9712 or ASNT-TC-1A level 3,
- Cofrend level 2 certified examiners according to EN ISO 9712 or ASNT -TC-1A level 2,
- the main construction codes specifying the examination methods and applicable acceptance criteria (ASME V, ASME VIII, ASME B31.1, ASME B31.3, CODAP / CODETI, NF EN 13480 / NF EN 13445, RCC-M, RCC-MRx, etc.).

CHEMICAL ANALYSIS OF MATERIALS / CHECKING **THE MECHANICAL STRENGTH** OF THE PARTS

PMI TEST (Positive Identification of Materials)

This test method enables to:
- identify and analyze the composition of a metal or alloy: the respective proportions of the main chemical elements (Mn, P, Si, Cr, Ni, Al, Mo, Cu, Cb, V, Ti, Co, Sn, W, etc.) are measured and compared to a materials database to define the material grade of the controlled part,
- confirm the grade of the material used (traceability with the material certificate).

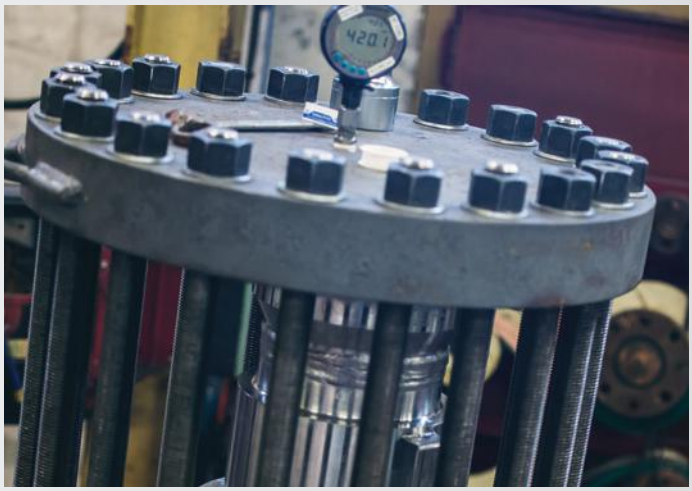
It can be carried out very quickly on any metal part or weld without damaging the part.
Standard: ASTM A 751.

FERRITE RATE

Controlling the ferrite index of an austenitic and duplex stainless steel weld allows to control the risk of hot cracking, the risk of high temperature embrittlement, low temperature mechanical properties or to confirm corrosion resistance.
Standard: NF EN ISO 8249.

HYDROSTATIC TEST

The hydrostatic test **verifies the structural integrity of pressure equipment**, by pressurizing a fluid at a given pressure for a defined period of time.
A **visual examination** before, during and after the test ensures that the equipment does not allow any leak and does not deform under stress.
Our pressure gauges are class 0.5 and the tests can be carried out using water or air, up to test pressures of 3000 bars.



Standards / Qualification[2]
NF EN 13018, NF EN 13927, ASME Section V article 9
NF EN ISO 3452-1 to NF EN ISO 3452-4, NF EN ISO 23277, ASME Section V article 6
NF EN ISO 5579, NF EN ISO 17636-1, ASME section V article 2
NF EN ISO 16810, NF EN ISO 16827, NF EN 17640, ASME section V article 5
NF EN 13625, NF EN ISO 20485, NF EN 1593, ASME section V article 10

CALIBRATION

For specific applications, we can have our devices calibrated by an approved laboratory (COFRAC, ISO 17025, etc.). This calibration can be carried out using different fluids (water, air, hydrocarbon) to be as close as possible to the customer process. It ensures optimum measurement accuracy.

CUSTOMER INSPECTION OR INDEPENDENT THIRD PARTY INSPECTION

All of the control steps and tests can be validated by a third party or directly by the customer.