



ANALYTICAL INSTRUMENTS GROUP

# SPIDERX - EDGE



RESIDUAL STRESS - RETAINED AUSTENITE  
PORTABLE THETA/THETA X-RAY DIFFRACTOMETER

[www.gnr.it](http://www.gnr.it)

# About us

With 35 years of technological experience, **GNR** is a worldwide market manufacturer of advanced analytical instruments in Optical Emission Spectrometer and XRD / XRF domain, developing procedures of analysis for various applications, supplying the corresponding laboratory equipment and providing consulting and customer support worldwide.

**GNR** can rely on a well-established team of highly qualified researchers and technicians, supported by the cooperation with leading University departments, which ensures a constantly updated technological growth.

**GNR** is present on the main international markets through an efficient and motivated technical and commercial network, able to provide outstanding support for any customer requirements.



GNR Head Office and Production Site is located in Agrate Conturbia (Novara), near Lago Maggiore; 20 minutes from MALPENSA Airport.

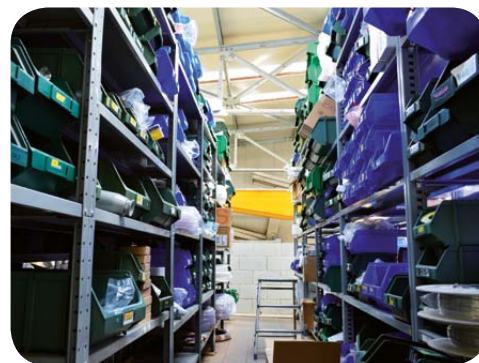
## Certified Company

Highest quality in our products and services is a core value for **GNR**.

Full commitment is dedicated to support our quality system in the overall process and continuous improvement is fundamental to guarantee GNR compliance to the internationally accepted quality management standard ISO 9001.



GNR periodically organizes at its facility courses and training for technicians and agents as well as seminars and demonstrations.



Thanks to an extensive network of agents GNR provides technical support and delivers spare parts worldwide.

In relation to the process of continuous development, GNR reserves the right to change specifications of the instruments without previous notice at any time; the real ones will always be those shown in the final order confirmation.

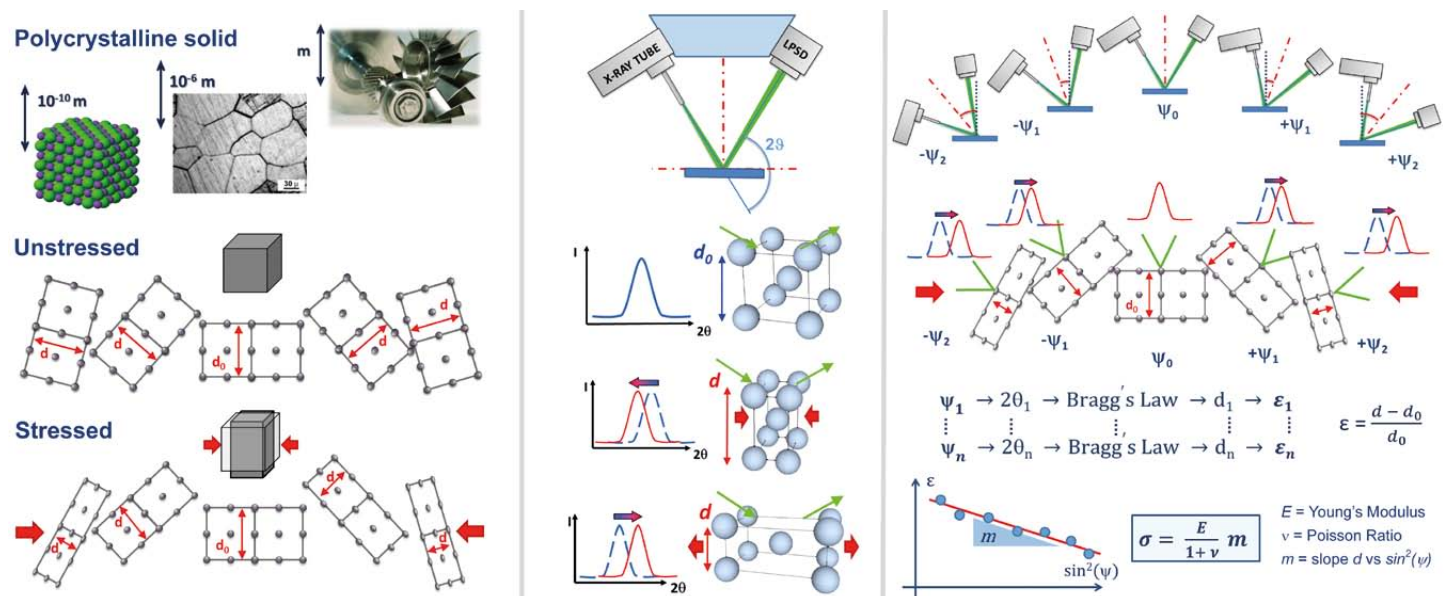
Residual stresses can be defined as those stresses existing within a body in the absence of external loading or thermal gradients. In other words, residual stress is defined as “the stress resident inside a component or structure after all applied forces have been removed”.

Residual stresses can be present in any mechanical structure because of many causes.

Manufacturing processes are the most common causes of residual stress. Potentially, all manufacturing and fabricating processes such as casting, welding, machining, moulding, heat treatment, plastic deformation during bending, rolling or forging introduce residual stresses into the manufactured object.

Stresses are not directly measured by X-rays. In X-ray diffraction the deformation (strain) of a crystallographic plane, along a certain direction, is observed. The measure of the displacement of the peak corresponding to that plane is correlated to the stress thanks to the elastic theory of the materials.

Using the interatomic spacing as the ultimate gage length, the X-ray diffraction is applicable to crystalline materials, especially for metals but also for ceramics. It measure the absolute stress without the need of an unstressed sample.



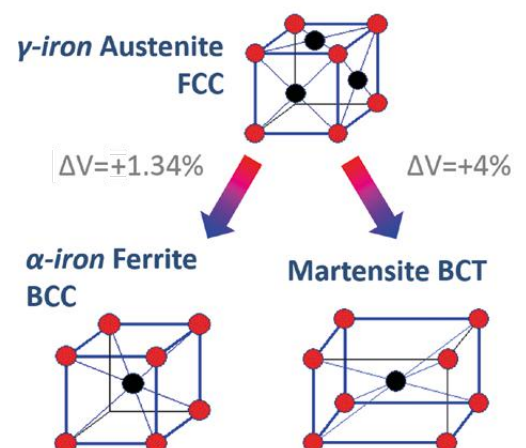
Austenite is a face centered cubic (FCC) phase present in steel at high temperature. Upon cooling, most of the steel is transformed into ferrite, a body centered cubic (BCC) or into martensite, a body centered tetragonal (BCT) phase. Depending on the rate of cooling, some percentage of the steel (typically 0-40%) remains as austenite. Hence, the term “retained austenite”.

Hardening of steels requires heating to an austenitic phase and quenching to room temperature to produce a hard martensitic phase.

Accurate measurement of the retained austenite content is important in the development and control of heat treatment process in steel industry.

X-ray diffraction, providing useful quantitative information about phase content, can be used to analyse all materials with a sufficient degree of crystallinity. This feature is used in retained austenite determination.

X-ray diffraction is considered to be the most accurate method of determining the amount of retained austenite in steels.



# SPIDERX - EDGE

## ABOUT SPIDERX - EDGE

SpiderX - Edge is a portable Theta/Theta X-ray diffractometer: it allows performing reliable measurements on production samples and specimens to determine residual stress, retained austenite and to investigate alloys structure and phase composition.

The instrument is compliant to ASTM E915, UNI EN 15305 (residual stress standard practices) and ASTM E975 – 13 (retained austenite standard practice).

SpiderX - Edge includes everything needed taking advantage of its portability and lightness for making residual stress and retained austenite measurements by X-ray diffraction in a portable manner.

SpiderX - Edge has been designed to be a fast and reliable solution for Quality Assurance and Quality Control practices in manufacturing process for both laboratories and field use. It is easy to use but at the same time it will be able to cover most demanding customer requirements.

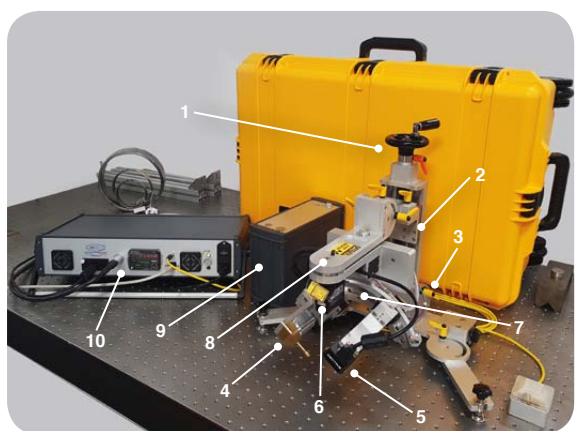


Fig.1 - Overview of the instrument

1. Manual Z stage for accurate laser assisted positioning
2. 90° maximum rotation for horizontal positioning of the goniometer
3. 90° maximum rotation for instrument inclination
4. X-ray tube with motorized independent movement
5. X-ray detector with motorized independent movement
6. Laser for precise alignment of the goniometer
7. Theta/Theta ( $\theta$ ) goniometer
8. Phi ( $\phi$ ) rotation
9. Battery
10. Main unit (power supply, control unit, UPS)

In the standard version, SpiderX - Edge measuring head is mounted on a robust aluminium structure, which holds the XRD goniometer, detector, X-ray tube and laser.

The frame has been designed to allow all the necessary movements to maximize the analytical performances.

It can ensure 4 degree of freedom with Z, Phi and 2 inclinations.

All the related controls are mounted in a separate control box.

The system can operate with standard electrical power supply as well as by batteries.

SpiderX - Edge does not require water cooling for X-ray tube.

## Theta/Theta Goniometer

SpiderX - Edge is equipped with a Theta/Theta goniometer of 80 mm radius.

Psi Scan can be performed from  $-45^\circ$  to  $45^\circ$  degrees (on  $\alpha$ -Fe (211) diffraction peak) with oscillations of  $0^\circ \pm 5^\circ$ .

**The 2-Theta value can be automatically changed in order to perform the proper measurement at the exact angular position.**



Fig.2 - Vertical goniometer



Fig.3 - Horizontal goniometer

**X-ray tube and detector move automatically and independently, making SpiderX - Edge the smallest Theta/Theta diffractometer available in the market.**

### X-Ray Tube

A low power X-ray tube allows to use SpiderX - Edge without any water chiller.

Easy exchangeable 0.5, 1 and 2 mm capillary diameter collimators are supplied as standard. Special collimators with different spot sizes are available as option.

The user can easily change the X-ray tube without any special tools.

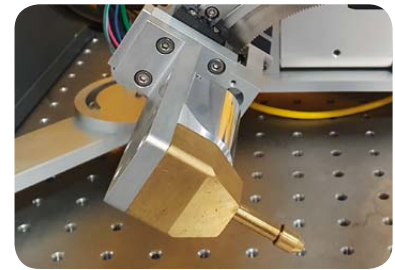


Fig.4 - X-Ray Tube

### Detector

SpiderX - Edge is equipped with a Multi Strip Detector. GNR adopts DECTRIS Mythen X-ray detector.

Mythen, linear silicon strip detector, based on single photon counting technology, provides noise-free performance, high intensity measurement and fast data acquisition.

The high efficient 1-dimensional multi strip detector simultaneously capture a large angular range and reduces the measurement time from hours into minutes. Compact size, air cooled and a maintenance-free detector.

Fluorescence background suppression by setting an appropriate energy threshold.

MYTHEN2 R	1D
NUMBER OF STRIPS	640
SENSOR THICKNESS [μm]	320
STRIP WIDTH [μm]	50
STRIP LENGTH [mm]	4
ENERGY RANGE [keV]	5-40
MAX COUNTING RATE [counts/s/strip]	1x10 <sup>6</sup>
FRAME RATE [Hz]	25
COOLING	Air
DIMENSIONS [WHD mm]	38x62x22



Fig.5 - Detector

### Laser

The laser allows aligning the sample avoiding collision between sample and measurement system.

Main advantages of this set up are:

- minimal time consuming for instrument alignment procedure.
- possibility to measure components with non-conventional geometries without any sample preparation.

The laser accuracy is better than 10 microns with a measuring range of 100 +/- 25 mm.

### Batteries

The portability of the SpiderX - Edge system is also ensured by means of a system of batteries that allows an autonomy of about 2 hours of full operation mode, without being plug to the main power supply. Battery recharge during operation.

### Trolley Case - Cabin

The trolley case water proof and shock resistant supplied with the instrument provides a safe housing for all the instrument parts.



Fig.6 - SpiderX - Edge as stored in the trolley case

SpiderX - Edge can be equipped with an accessory cabin.

Dimensions: 500 x 500 x 600 mm (customizable).

### Software

GNR proprietary software for SpiderX - Edge supports several tasks of analysis, from Data Acquisition, having the full control of all the process and hardware settings (generator and tube, detector, measurements set up) to Data Analysis, calculating the residual stress or retained austenite values.

An extremely easy to use software for Uni-axial, Bi-axial and Tri-axial residual stress analysis has been developed in compliance with ASTM E915 practice and UNI EN 15305.

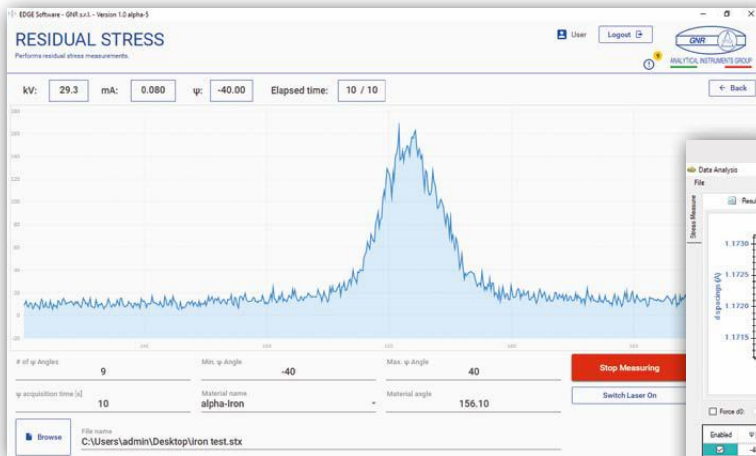


Fig.8 - Residual stress acquisition window

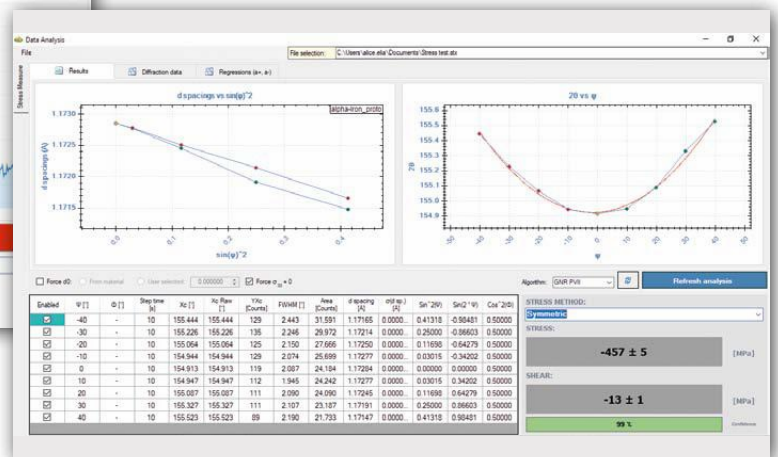


Fig.9 - Stress analysis panel, results tab

Retained austenite measurement consists of a scan over four reflection of ferrite and austenite in compliance with ASTM E975 – 13.

Reflection	Theta (θ) angle	Reflection	Theta (θ) angle
α(200)	39.52°	γ(220)	64.15°
γ(200)	53.06°	α(211)	78.20°

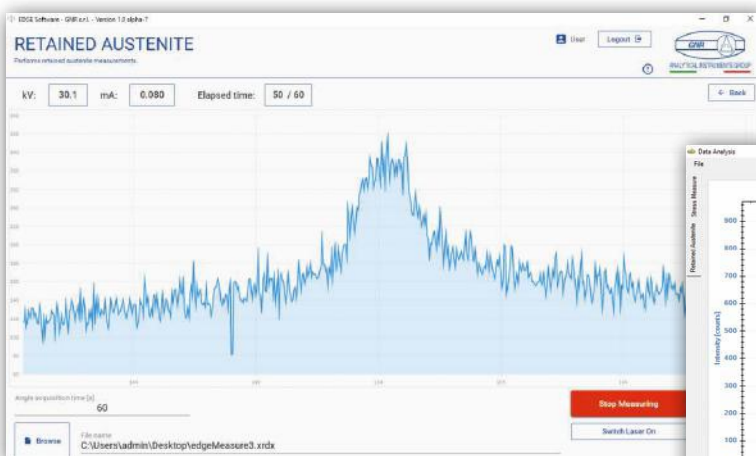


Fig.10 - Retained austenite acquisition window

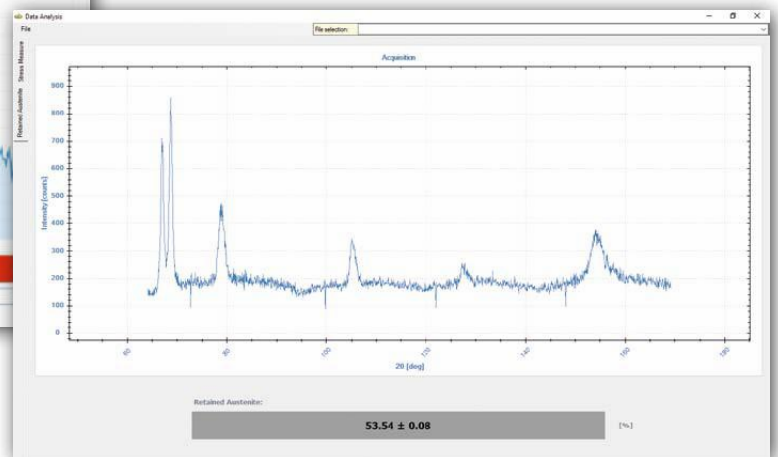


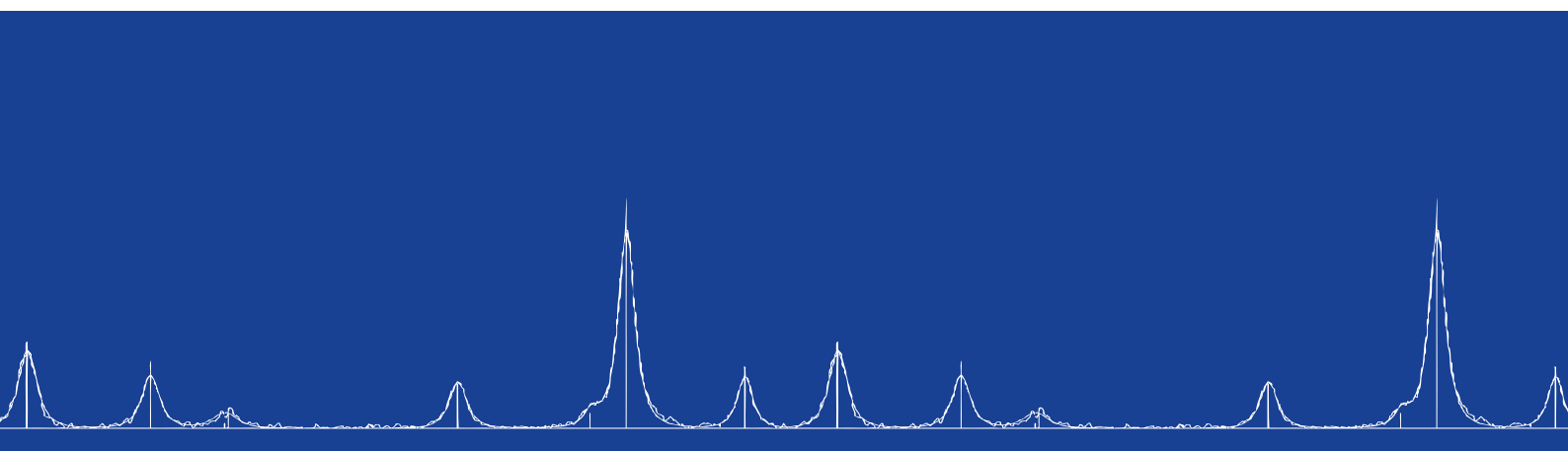
Fig.11 - Retained austenite data analysis window

At the end of the scan, the retained austenite value is automatically calculated and displayed in the analysis window. The results of residual stress measurements can be exported as report by selecting the Export measure report command in the File menu.

<b>Goniometer</b>	Geometry	Theta/Theta
	Radius	80 mm
	Psi ( $\psi$ ) Range	-45° / +45° $\psi$ scan ( $\alpha$ -Iron); oscillation 0° $\pm$ 5°
	Range 2theta Detector	45 - 170°
<b>Generator</b>	Max Power	4 W (40 kV, 0.1 mA)
	Stability	< 1.0% RSD
	Anode	Cr (30 kV, 0.1 mA) (other anodes available on request)
<b>Detector</b>	LPSD	DECTRIS Mythen2R 1D
<b>Optics</b>	Collimator	0.5, 1.0, 2.0 mm (other diameters available on request)
<b>Alignment</b>	Laser	Accuracy 10 $\mu$ m Precision 4 $\mu$ m Range 100 +/- 25 mm
<b>Stage</b>	Standard version	4 axes (Z, $\phi$ and 2 inclinations)
<b>Cooling</b>	Air cooled	
<b>Battery</b>	9 Ah	
<b>Dimensions</b>	Trolley	795 x 518 x 310 mm WxDxH
	Instrument	480/322 x 330 x 450 mm WxDxH
	Cabin	500 x 500 x 600 mm WxDxH (customizable)
<b>Weight</b>	8.5 + 5.5 + 4.5 + 10.5 = 29 kg (Instrument + Main Unit + Battery + Trolley)	

### Safety Assurance

**GNR SpiderX - Edge** complies with the statutory requirements regarding X-ray, machine and electrical safety. Maximum X-ray safety with radiation level significantly below the annual dose limit for general public (1 mSv/year) following ANSI N43.3 - 1993 and other industry standards for open beam X-ray operation.



---

Local Agent

---



**G.N.R. S.r.l.**  
Via Torino, 7  
28010 Agrate Conturbia (NO) - Italy  
Tel. +39 0322 882911  
Fax +39 0322 882930  
E-mail: gnrcomm@gnr.it - gnrtch@gnr.it  
**www.gnr.it**