



# Standardization of industrial residual stress measurement for metallic components

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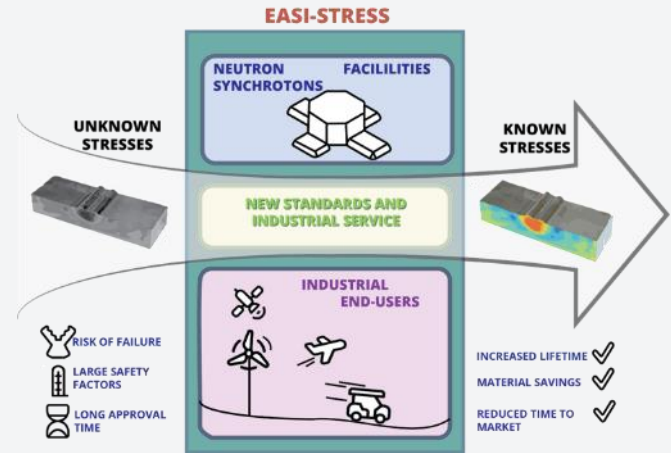
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# PROJECT INTRODUCTION

**EASI-STRESS: European Activity for Standardisation of Industrial residual STRESS** characterisation ([easi-stress.eu](http://easi-stress.eu))

Aims:

Benchmark synchrotron/neutron technique with more widespread methods for residual stress measurement, to enhance industrial access to beamline facilities.



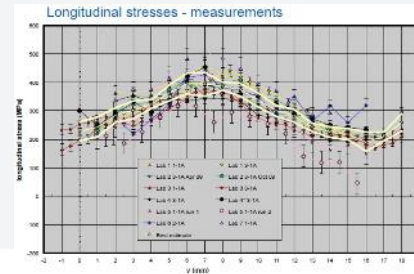
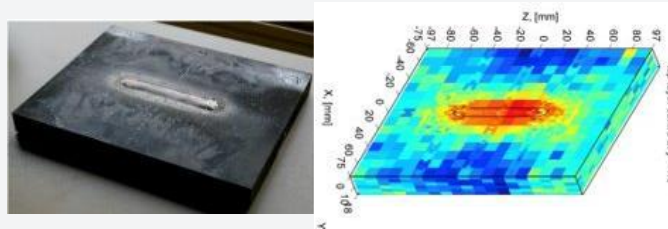
# PREVIOUS ROUND ROBIN ACTIVITIES

## Versailles Project on Advanced Materials and Standards (VAMAS<sup>1</sup>)

- A selection of polycrystalline materials (Al, Ni, ceramic composite, and steel weldment);
- **Neutron diffraction only;**
- Target: Concerns reliability and reproducibility of neutron diffraction.

## Network on Neutron Techniques Standardisation for Structural Integrity (NeT<sup>2</sup>)

- Destructive & non-destructive, high energy diffraction and lab techniques;
- Experimental against numerical models;
- **Structural welds only.**
- Target: concerns stress measurement in welded components.

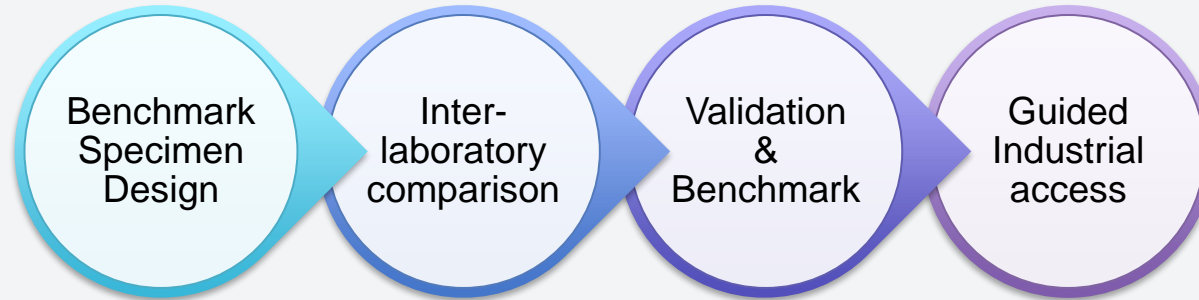


<sup>1</sup> [www.vamas.org](http://www.vamas.org)

<sup>2</sup> [www.net.network.eu](http://www.net.network.eu)

<sup>3</sup> All images from: MC Smith *et al.*: *Int J Pres Ves Pip*, 2018.

# EASI-STRESS OBJECTIVES & UNIQUENESS



- Polycrystalline metals
- Industrial relevant
- Represent current metal processing trend

Large research facilities:

- Neutron diffraction
- Synchrotron diffraction

Lab techniques:

- LXRD
- Contour method
- Hole drilling
- (Numerical Modelling)

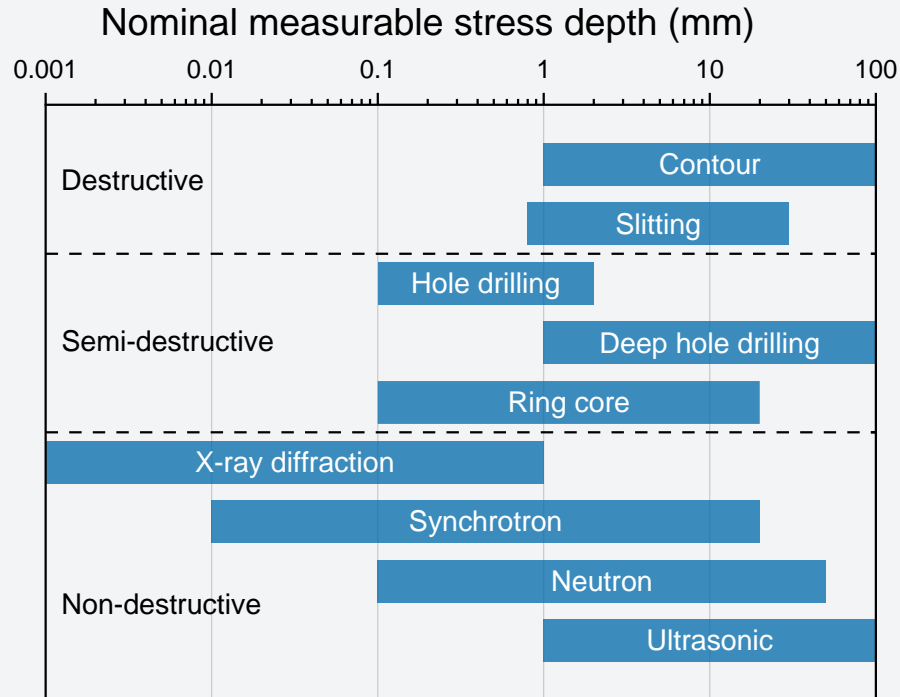
- Protocols
- Data exchange procedures
- Technical specification
- Standardisation (ISO, ASTM)

# OVERVIEW BENCHMARK SAMPLES

- Well-characterised properties
- Suitable for all technique
- Metal manufacturing industrial relevant
- Represent wide range of stress origins
- Reproducibility

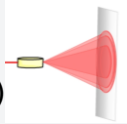


# STRESS MEASUREMENT TECHNIQUE

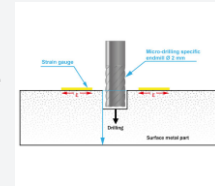


# KEY TECHNIQUE FEATURES

**Diffraction technique**  
(XRD, Synchrotron, Neutron)



**Destructive technique**  
(Hole drilling, contour)



## Resolvable stresses

- Type I, II, III stresses
- Elastic and plastic stresses
- Full stress tensor from single part (S/N)
- High stress resolution (S/N)

- Type I stress only
- Plastic stress
- Multiple samples for full stress tensors

## Sample & Environment

- Small and large samples, complex geometry
- Struggle with grain size and texture
- Reliable stress-free reference sample needed (S/N)
- In situ environment

- Prefer simple geometry
- No specific requirement on microstructure
- Highly dependent on cutting quality

## Accessibility


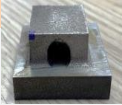


- Expensive and less accessible (S/N)
- High level of expertise needed

- Easy machine access
- Cost efficient



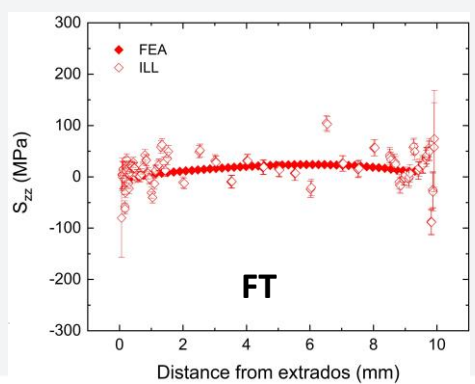
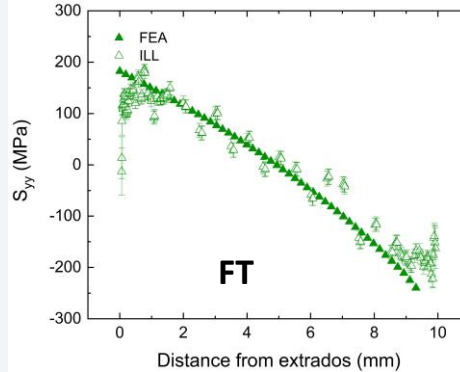
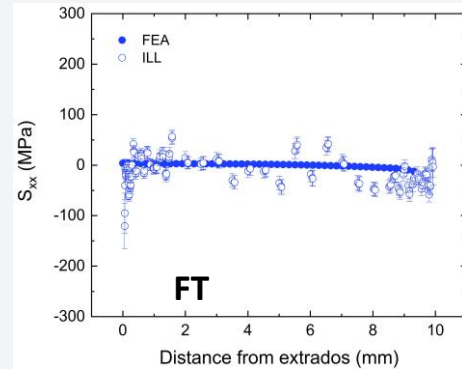
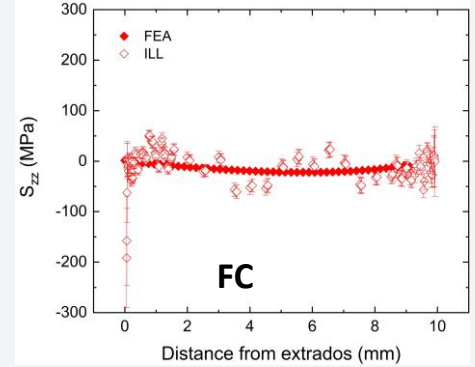
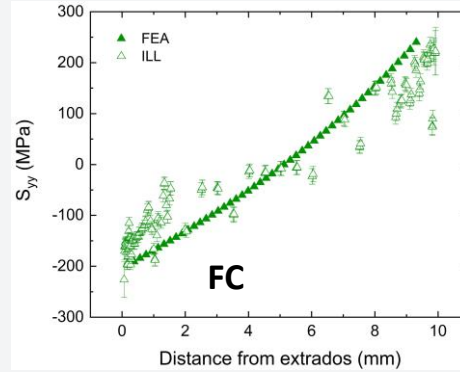
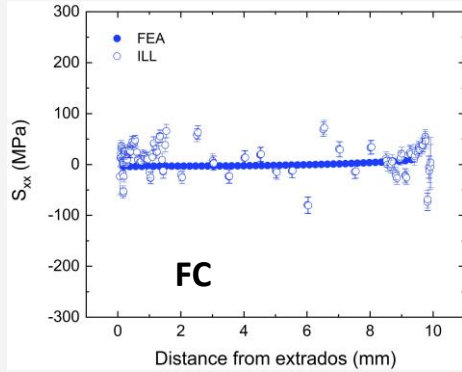
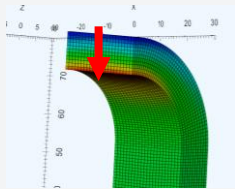
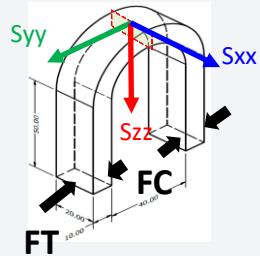
# ROUND ROBIN ACTIVITIES

Beamline	Method	Beamline	Method	Beamline	Method	Beamline	Method
<b>ILL</b>	<b>N, SALSA</b>	<b>ILL</b>	<b>N, SALSA</b>	<b>ILL</b>	<b>N, SALSA</b>	Hereon	S, P61A
<b>ECR</b>	<b>N, ATHOS</b>	ESRF	S, ID15A	<b>PSI</b>	<b>N, POLDI</b>	ESRF	S, ID15A
Hereon	S, P61A	Hereon	S, P61A	Hereon	S, P07	ILL by NeT	SALSA
Hereon	S, P07	Hereon	S, P07				
ESRF	S, ID15A	<b>ECR</b>	<b>N, ATHOS</b>				
<b>ANSTO</b>	<b>N, KOWARI</b>						

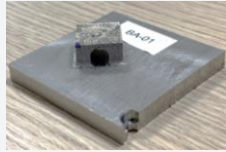
Lab	Method	Lab	Method	Lab	Method	Lab	Method
UoM	Contour 	OU	Contour 	UoM	Contour 		
UoM	LXRD	UoM	Contour	Cetim	Contour		
UoM	FEA	Cetim	LXRD	Cetim	Hole drilling		
Cetim	LXRD	Cetim	Contour	Nemak	FEA		
Cetim	Contour	Cetim	Hole drilling				
Cetim	Hole drilling	VE/AM	FEA				
EDF	LXRD						
DTI	LXRD						



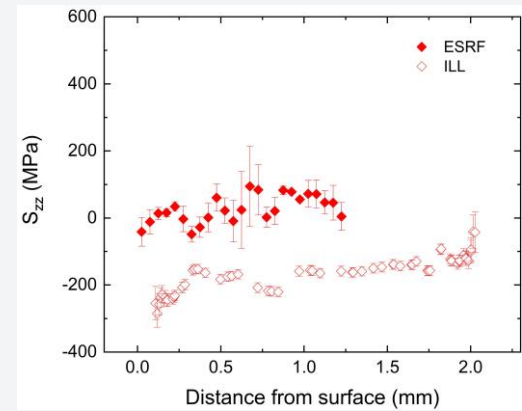
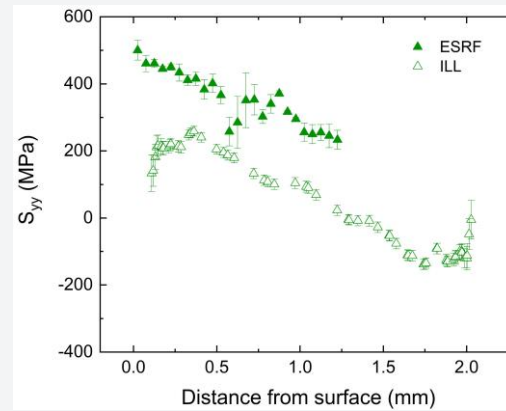
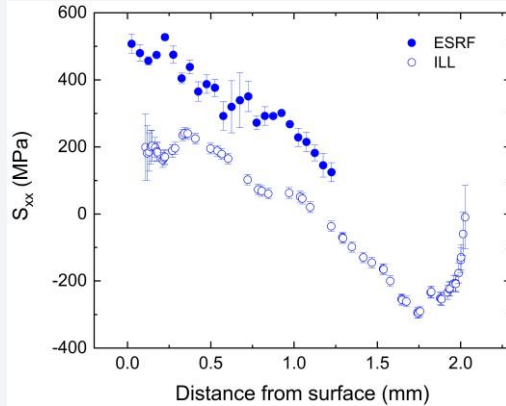
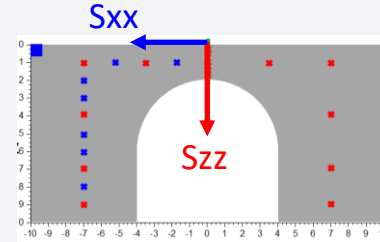
# PRELIMINARY RESULTS




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Thank you for your attention!



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