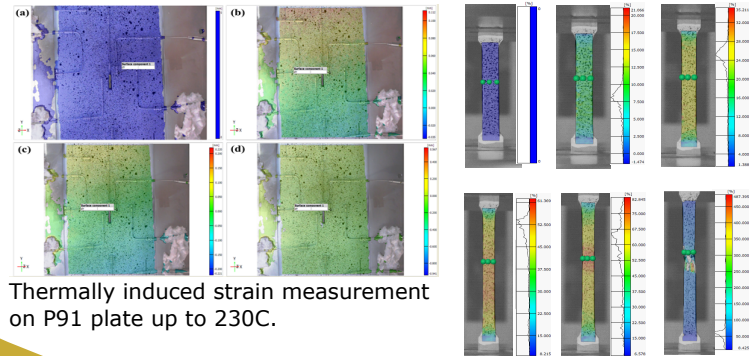


## 2D Digital Image Correlation for strain measurement

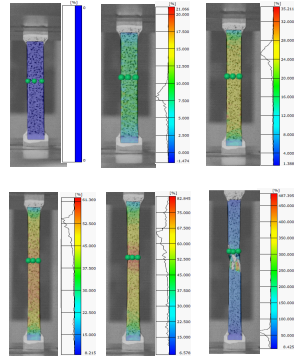
2D-DIC system is consist of single monochrome high speed imaging camera (1280x1024 pixels @ 2000 fps, Make Photron Inc.) and open source software for 2D full-field strain measurement.

- High Speed Camera features
  - 1280 x 1024 resolution up to 2,000fps.
  - 1280 x 720 (720p) resolution up to 3,200 fps.
  - 12 bit Dynamic range.
  - 3.9  $\mu$ sec Minimum exposure time.
  - 8GB Memory configurations.
  - SO Sensitivity: 10,000 monochrome.
  - Fame rate synchronization with external trigger
- Non-contact inspection with immediate full -field displacements results.
- Open source DIC software analyzes strains, displacements, velocities, accelerations, rotations, angles and changes in angle.

## Strain measurement DIC Results



Thermally induced strain measurement on P91 plate up to 230C.

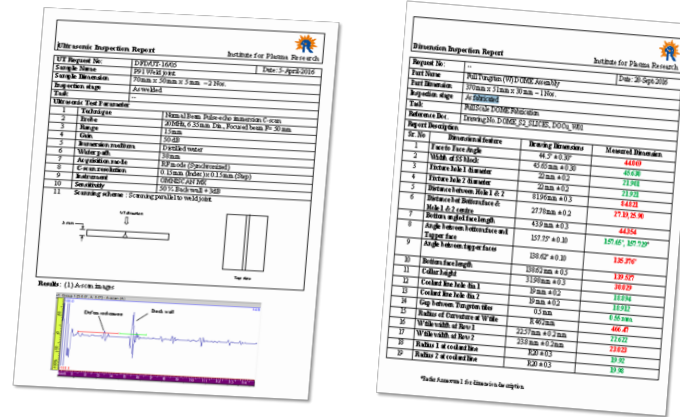


Mechanical Strain measurement on SS304 during tensile testing

## Systems utilisation

- To check the integrity of various joints in Divertor plasma facing components at various stage of manufacturing as well as at in-service inspection
- To optimize the various metal joining processes such as brazing, diffusion bonding, welding etc.
- To characterize mechanical property of materials
- To inspect raw materials
- To inspect Components at various stages of manufacturing
- To compare the shape of components using Laser Scanning technique
- To assist in performing reverse engineering

## Reports



## CONTACT

[www.ipr.res.in/httpd/home.html](http://www.ipr.res.in/httpd/home.html)  
 Ph-No: +91-79-2396 4420  
 Fax.No: +91-79-2396 2277  
 E-mail id: [technology@ipr.res.in](mailto:technology@ipr.res.in)

## ULTRASONIC TEST, DIMENSION & STRAIN (2D DIC) MEASUREMENT FACILITY



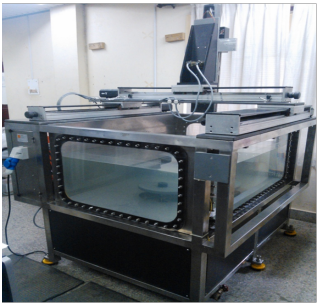
## High Temperature Technologies Division



Institute for Plasma Research  
 Bhat, Gandhinagar, Gujarat,  
 India-382428  
[www.ipr.res.in](http://www.ipr.res.in)

## Ultrasonic testing system

Ultrasonic testing is most promising non destructive testing method which utilized high frequency sound wave to characterize the integrity of structural materials and components



High resolution Scan up to 0.05 mm step for C-scan imaging.

Immersion tank area: 900 x 700 x 700mm with 300mm Dia. Turntable Rotating Chuck.

A 6 - axis manipulator for maneuvering the probe head.

Scanning speed : 100mm/sec

Ultrasonic water immersion tank

Overall dimensions (W x H x D)	244 mm x 182 mm x 57 mm (9.6 in. x 7.1 in. x 2.1 in.)
Weight	1 kg (2.2 lb)
Connectors	LEMO 00 (2, 4, or 8)
Pulse output	50 V, 100 V, 200 V, 300 V $\pm$ 10 % (variable pulse width)
Pulse width	Adjustable from 30 ns to 1000 ns $\pm$ 10 %, resolution of 2.5 ns
Quantity	3: I (synchro), A and B (measure)
Synchronization	I, A, B referenced on main bang; A and B referenced on gate I (post-synchronization)
A-scan recording (TOFD)	6000 A-scans/s (512-point A-scan) (3 MB/s transfer rate)
C-scan type data recording	12 000 (A1, A2, A3, T1, T2, T3) (3 gates) 12 kHz
Aperture	16 elements*
Number of elements	128 elements

ONISCAN MX fIAW Detector with Phased Array and 2 channel modules

Omniscan MX UFD can be used with Immersion scanner and also can be used as stand lone system for site inspection

## Ultrasonic Probes



- Ultrasonic Immersion probes : 5,10,15,20,25 MHz Focused and unfocused
- Contact Probes: 2,4,6 MHz for 0°, 38°, 45°, 60°, 70° angles
- Phased array probe: 2.25 MHz, 64 elements
- special probe: side looking immersions probe

## Calibration and Reference Standards

- IIW V1 and V2 Block are used as calibration standards



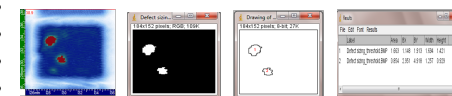
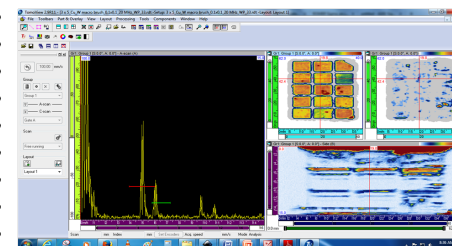
Calibration standards

- Known defect samples are used as reference standards for various metallic joints



Reference standard for various metallic joints

## Ultrasonic Data acquisition, Display and Post Processing



Tomoview Software and Data Post Processing

Aqu-UT enables the data acquisition and Tomoview enables powerful Tools for Detection, Sizing, and Characterization of Flaws

Flexible Data Display as A,B,C and D scan

Drives R/D Tech UT and Phased Array Systems

Data can be extracted in any format for Post processing

Post Processing of C-scan images provide information of Defect size, location, area and its distribution which improve the validity of ultrasonic testing

## Dimensional Inspection system- ROMER ARM 2000 SIGMA Portable CMM

- The Exclusive Portable Measuring Arm For a Precise and Simple Dimensional Measurement of Components up to 2.5 meter length
- 3D Laser Scanning probe compatible
- Touch trigger, contact or non-contact (infrared) probes (quick change and automatic detection)
- Specifications

- Measurement Accuracy :  $\pm$  100 microns
- Measurement Repeatability :  $\pm$  140 microns
- Measurement Range : Spherical Volume of 5.2 meters
- No of axes for arm movement : Six Axis Movement
- Allows precision 3-D coordinate measurements of solid objects with complex 3D shapes and longest dimensions ranging from few centimeters to few meters

### Non-Contact Type Measurements Using Laser Scan Probe

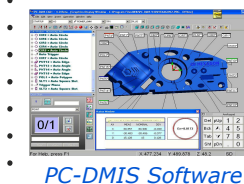
- Measurement Accuracy :  $\pm$  44 microns
- Measurement Repeatability :  $\pm$  44 microns
- Laser Scanning Width : Max 110mm
- Maximum speed measurement = 30 laser lines per second
- Max. no. of points per measured line = 640 points



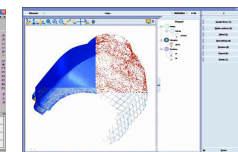
Touch Trigger Probes



G-scan Laser Probe



PC-DMIS Software



G-Scan Software

The main functions of G-Scan are:  
To measure points  
To create surfaces (triangles) and sections  
To export data

G-Scan can also be used for reverse engineering by exporting points to inspection software.

- PC-DMIS software enables following features
- Use of CAD models in the inspection process
- Digitally simulating measurement in an offline virtual CMM environment
- Easily aligning complex contoured parts using breakthrough iterative alignment technology