

# SNT 4045

## New shearography technology with new aspects and potentials in nondestructive testing



NDT of large and  
small structures



SNT 4045

*no vacuum or thermal loading necessary*  
*improved accessibility - testing at corners and edges*  
*highly improved testing speed*

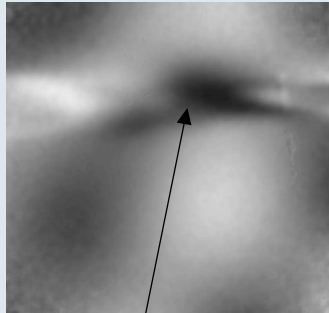
- Uses surface nanowaves to detect debonds and structural inhomogenities
- Fast, accurate and efficient
- High resolution
- Testing of large and small structures
- Non contact and long distance testing
- **Debonds**
- **Delaminations**
- **Cracks**
- **Impact damages**
- **Other structural inhomogenities**
- **Aerospace**
- **Ship industry**
- **Automotive**

The SNT 4045 measures surface waves in the nanometer scale from long distances, even in relatively noisy environments. These surface waves gives a unique ability to detect material defects in a range of materials, including composite materials. The SNT 4045 provides fast, reliable and accurate detection of defects, where large areas can be tested in short time.

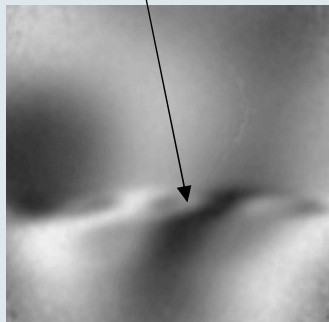
The SNT 4045 can test surfaces ranging from a few centimeters to several meters in a single recording. The surface is excited with a single frequency at one or more points, giving non-modal, surface waves propagating across the surface. The optical head can be located several meters away from the object, and measurements can be done on curved surfaces and at corners and edges.

Compared to methods like traditional shearography and ultrasonic scanning, the SNT 4045 is both fast and easy to use, and results are very well documented.

# SNT 4045 in nondestructive testing



Sub surface  
debonds



## **Modern technology**

The SNT 4045 has been developed by Optonor together with naval industry in Europe for fast and efficient testing of large composite ships. It is based on the well proven technology of electronic shearography, but new and modern features from holographic systems are incorporated in the optical configuration. These features provide unique averaging and lock-in based recording principles, giving very high resolution recordings even in relatively noisy environments.

## **Speckle averaging**

One of the key features in the SNT 4045 is the speckle averaging module. When laser light is reflected from rough surfaces, interference effects gives speckle noise, which is a limited factor in laser interferometric measurements. In addition, since laser systems are very sensitive, environmental noise and disturbances complicate the analysis of the measured signals. Both these problems are overcome with the new technology used in the SNT 4045.

## **Numerical vibration data**

The SNT 4045 provides numerical data in terms of vibration amplitude- and phase maps, and the amplitude resolution is down to the nanometer scale. Animated graphics show how traveling waves with amplitude in the nanometer scale (nanowaves) are

propagating across the object surface. When sub surface defects like debonds, delaminations etc. are present within the imaged area, they are easily seen in the nanowave pattern.

## **Large areas tested in few seconds**

The SNT 4045 illuminates and images a full field part of the object under investigation. Depending on surface reflectance properties and size of imaged area, lasers ranging from less than 100 mW and up can be used. A single recording takes from a few seconds and up to a couple of minutes or more, depending on the averaging level selected.

## **User friendly**

The SNT 4045 is mounted on a tripod and directed towards the object, while a shaker unit is put in contact with the object surface. The computer then controls the whole recording algorithm, and presents the result on the screen. A separate computer algorithm helps the operator to mark defected areas directly on the object surface.

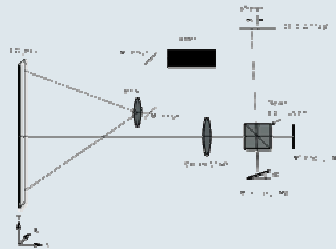
## **Comparison with ultrasonic testing**

Tests are showing that the SNT 4045 detects the same defected areas as methods like ultrasonic scanning, but with somewhat higher contrast. A main difference is that testing with the SNT 4045 takes only a fraction of the time required for the ultrasonic testing

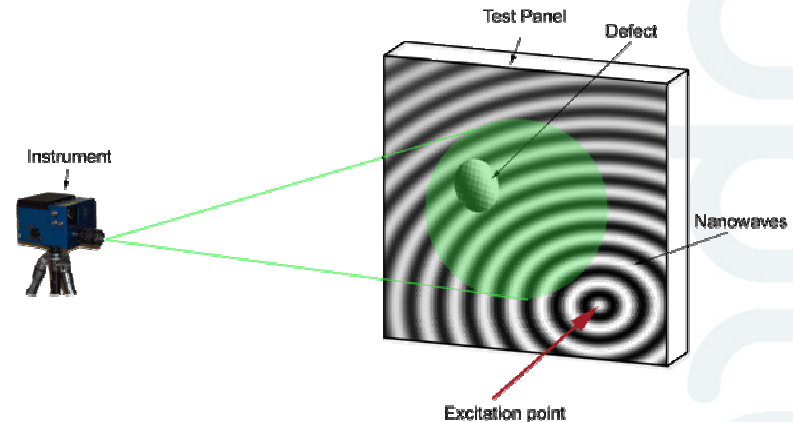
# SNT 4045 system description

## Standard system units

- Optical head with laser, mounted on a tripod
- Object excitation unit (shaker) mounted on a balanced and flexible post
- Computer
- Signal generators
- Software for vibration measurements



SNT 4045 basic configuration



## How it works

The object field is illuminated by an expanded laser beam, and the object is imaged by a zoom lens onto a ccd array. The SNT 4045 measures the spatial derivative of the surface deflections, as the deflection of all points are measured relatively to a neighboring point on the surface. The distance to the neighboring point is given by the shear level. The shear level and direction is adjusted using adjustment screws on the optical head. Distance between optical head and object surface can be up to 5 meters or more.

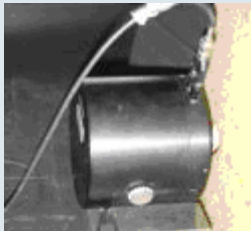
The SNT 4045 computer uses a signal generator for object excitation, meaning the object is vibrating with one frequency at a time. The object can be vibrated by sources like e.g. electronic shakers or pzt based units. Vibration amplitude fringes can be displayed real time, while a unique recording algorithm is used to calculate numerical amplitude and phase maps within a few seconds or up to a couple of minutes or more, depending on the averaging level selected. For numerical measurements, the object is excited steady state with constant frequency and amplitude during the recording period.

The result can be displayed different ways, including animated displays where the surface nanowaves are seen as they propagate across the object surface, to reveal sub surface defects.

# Accessories



Optical head

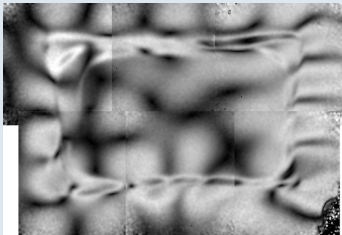


Shaker

## Standard system

Part #	Unit	Description
SNT-HS-xxxx	Optical head including laser	Including 12.5 – 75 zoom lens xxxx indicates laser power, for example xxxx = 0400 (mW)
SNT-TP-A	Tripod	For optical head
SNT-C-A	Computer	
SNT-DC-A	DAC coupling unit	DC signal transmission to optical head
SNT-SG-A	Signal generator (2)	Two signal generators, one for object excitation
SNT-VibraLab	Software for vibration analysis	Numerical and real time mode measurements
SNT-OEU-A	Object excitation unit (shaker)	Up to > 5 kHz
SNT-OEP-A	Object excitation post	For flexible support of object excitation unit
SNT-DC-A	Dust cover	For optical head

## Specifications



Testing of a large panel with debonding along lines forming a rectangle. Assemblies of recordings. Two different frequencies (upper and lower assembly), excitation point is in lower right corner

Maximum object size in a single recording	2 x 2 meter
Minimum object size (full screen)	< 0.1 x 0.1 meter
Vibration amplitude resolution	1-50 nanometer
Defect size resolution	Appr. 1/10000 of imaged area
Maximum frequency	5 kHz or higher
Minimum frequency	< 30 Hz
Laser class	Depending on laser used in optical head
Laser	Nd:YAG laser from < 100 mW and up
Data export formats	Standard export formats for both vibration amplitude data and vibration phase data
Animations	Available for vibration displays as 3D, line etc.
Graphics displays	3D plots – line plots – contour plots – image displays
Speckle averaging module	Included in optical head
Phase shifting	Included in optical head

## Dimensions

*See also brochure for SNT 4040*

Optonor also provides a high resolution shearography system for static deflection measurements, the SNT 4040. This instrument can be used with thermal loading, vacuum loading etc. The SNT 4040 is presented in a separate brochure.

Dimensions optical head	140x170x200 mm (H x W x D)
Weight optical head	4 kg
Dimensions mounting stage	Tripod height up to 1.5 meter
Weight mounting stage	4 kg
Dimensions shaker unit	Diameter 200 mm x 250 length
Weight shaker unit	8 kg
Length of object excitation post (holding the shaker unit)	Up to 5 meter