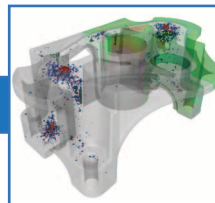
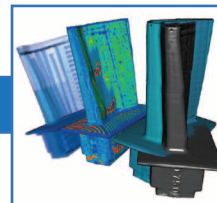


# phoenix v|tome|x c Series

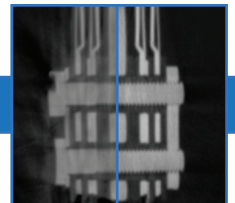
Compact production oriented, high throughput CT for 3D failure analysis *and* precision 3D metrology



3D variance analysis and automatic pore volume analysis in an aluminum casting.

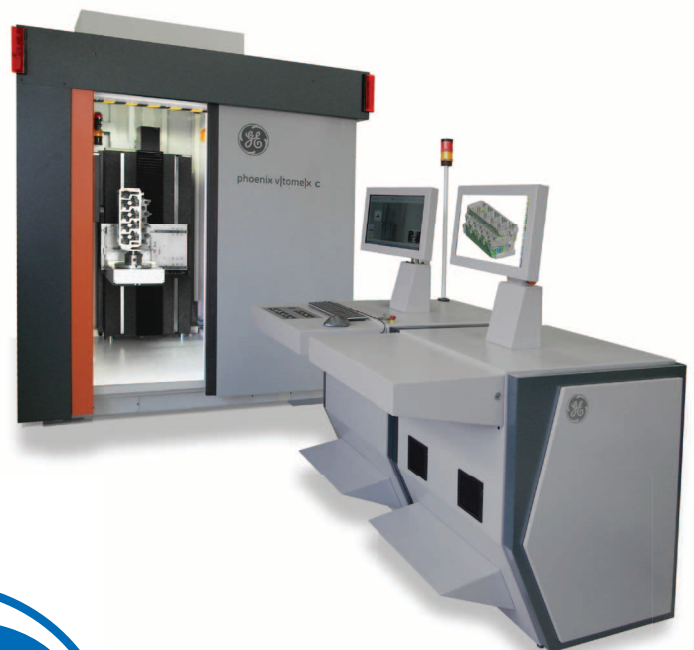


3D analyses of a scanned turbine blade.



Conventional CT scan (left) versus scatter|correct quality.

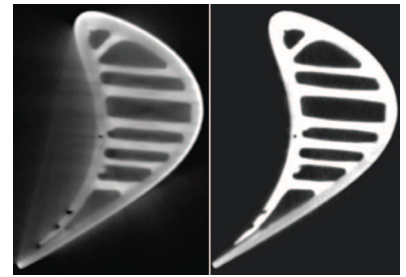
- 450 kV Computed Tomography (CT) system for statistical production process control
- First industrial CT system with scatter|correct to perform fast cone beam CT with the quality of slow fan beam CT
- Max. 3D scanning area max. 500 mm Ø x 1000 mm
- 3D measurements referring to VDI 2630 guideline\*
- CT performance specified referring to ASTM E 1695 guideline
- Robust, small footprint design for production control with low cost of ownership
- High efficiency ease of use due to one-button|CT
- Optional quick|pick manipulator for automated blade inspection



# phoenix v|tome|x c series

CT Scanning up to 100 times faster with scatter|correct

With the phoenix v|tome|x c, GE offers a compact 450 kV CT system specially designed for NDT and quality assurance labs in foundries or aerospace applications allowing both, combined semi-automated NDT and 3D metrology. The low maintenance and production oriented design features like easy loading tools, barcode reader etc., as well as the new one-button|CT automatization functionality make the system a very efficient tool for high throughput industrial quality assurance. The quick|pick manipulator of the high speed configuration HS even allows fully automated CT evaluation of large batches, e.g. to scan up to 25 turbine blades without any operator action. The system offers industry leading sample size, flexibility and maximum penetration power for high absorbing samples at 450 kV. It is the first industrial CT scanner with GE's proprietary breakthrough scatter|correct technology option allowing users to gain a low scatter artifact CT quality level never before reached with flat panel cone beam CT.



Conventional cone beam CT with scatter radiation artifacts

Advanced scatter|correct cone beam CT

## Industrial non-destructive 3D failure analysis

X-ray CT allows the exact 3D location and quantitative evaluation of defects. This provides information on size, volume and density of inclusions and cavities and helps to optimize the production process parameters to ensure increased quality and decreased scrap costs. E.g. at 130  $\mu\text{m}$  voxel resolution, the spatial resolution according to ASTM E 1695 guideline can achieve 2.5 lp/mm  $\sim$  200  $\mu\text{m}$  feature width.



CT scan of a cylinder head

Typical samples to be scanned with the phoenix v|tome|x c are:

- Small and medium sized steel castings (turbine blades, ...)
- Complex composite parts (fan blades, ...)
- Large complex light metal castings (cylinder heads, ...)

Typical 3D NDT inspection tasks are:

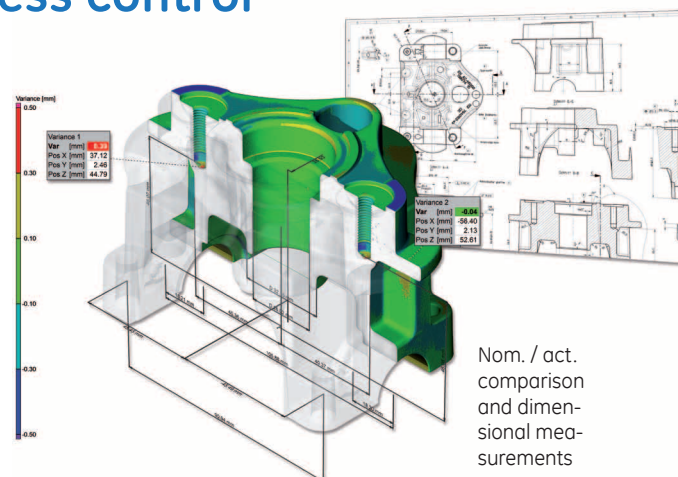
- Internal defect analysis / 3D quantitative porosity analysis
- Porosity/inclusion pre-machining tests
- Assembly control

## Dimensional production and process control

Compared with conventional coordinate measuring machines, CT offers significant time and cost advantages for qualification of work pieces with complex internal geometries as well as for production process control tasks like surveillance of the dimensional accuracy trend.

Typical 3D metrology tasks are:

- Nominal-actual CAD comparison
- Reverse engineering / tool compensation
- Dimensional measurements / wall thickness analysis



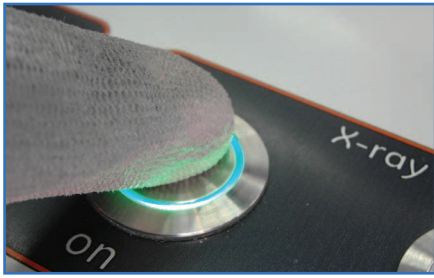
Nom. / act. comparison and dimensional measurements

With its granite based manipulation and specific 3D metrology package, the phoenix v|tome|x c includes all essential features for CT measurements with a measurement accuracy of  $20+L/100 \mu\text{m}^*$ .

\* Measured as deviation of sphere distance in tomographic static mode SD (TS), method details referring to VDI 2630 guideline on request.

# one-button|CT & quick|pick manipulation

Highly automated batch CT driving inspection productivity



GE's one-button|CT functionality for very effective operation in production environments

With GE's new one-button|CT functionality, the entire CT process chain can be fully automated minimizing operator time and influence, while highly increasing the repeatability and reproducibility of CT results.

In HS (High Speed) configuration, the v|tome|x c comes with the quick|pick manipulation functionality for fully automated blade batch inspection with additional box axis & pneumatic gripper manipulation.

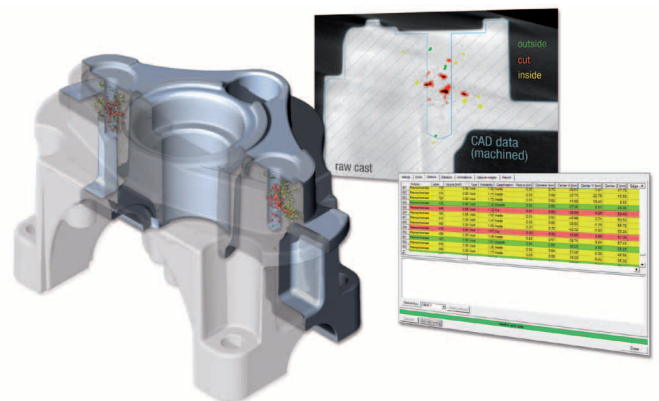
- High throughput batch CT possible – scans up to 25 turbine blades in ~2 hours without requiring any operator action
- Minimized operation costs: one operator can run 3-4 CT systems parallel instead of just one
- High flexibility due to additional use of the normal precisions rotation axis for conventional CT scans
- No additional robot arm required

The v|tome|x c comes with the additional high speed quick|pick manipulator for high throughput automated large batch CT e.g. of turbine blades



## phoenix v|tome|x c series: Your Advantages

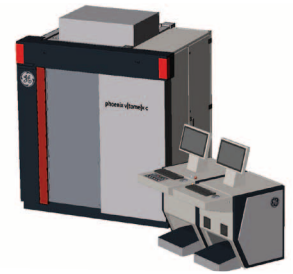
- Affordable, compact design for 450 kV scanning of large objects
- High precision 3D metrology and non destructive testing tasks performed with minimal operator training
- First industrial CT system with scatter|correct to perform cone beam CT scans with the quality level of up to 100 times slower fan beam CT
- Significant quality improvement not only for high scattering materials such as steel and aluminum, but also for composites and multi material samples
- Increased throughput batch CT with minimized operation costs
- Significant reduction of required operator time by using the one-button|CT and quick|pick CT functionality
- Robust and compact design for CT in production environment
- Attractive price/performance ratio
- Low maintenance efforts and low costs of ownership



CT - measure and control with insight

Porosity / inclusion analysis: pre-machining tests in an automotive die pressure casting

# Technical Specifications & Configurations



	phoenix v tome x c	v tome x c scatter correct / HS
Minifocus X-ray tube /	Closed ISOVOLT 450 M2/0.4-1.0HP	
Max. voltage / power	450 kV @ 700 W/1500 W	
Focal spot	0.4 mm (max. power 700 W) / 1.0 mm (max. power 1500 W)	
Focus Detector Distance (FDD)	1300 mm	1150 mm
Voxelsize range	100- 146 µm	87-139 µm
Geometrical magnification (3D)	1.37-2x	1.44-2.3x
Spatial CT resolution	2.5 lp/mm at 130 µm voxel resolution referring to ASTM E 1695	
Detail detectability	Down to ~100 µm	
Measurement accuracy	20+L/100 µm referring to VDI 2630-1.3 guideline*	
Fan beam CT line detector array (LDA)	LDA detector package "fan": 16 bit Linear Detector Array 820 mm sensitive width, 2050 pixels, 400 µm pitch. Linear subpixel-shift axis for resolution improvement and quality enhancement**	
Cone beam CT flat panel detector (option)	Alternative detector package „cone“: 14 bit high-contrast GE DXR 250 detector with 200 µm pixel size, approx. 400 x 400 mm (16" x 16") sensitive surface, 2000 x 2000 pixel (4 megapixel). Virtual detector enlargement** for large samples	
dual detector configuration (option)	Alternative detector package „cone & fan“: Combination of LDA and flat panel detector, each with detector shift and easy switching between fan beam and cone beam CT mode**	
Granite based high precision Manipulation	2 axes (R,Y), manual Z axis (300 mm)	3 (R, Y, Z) or 4 (R, Y, Z, XB) in HS base Z-automatic or HS quick pick configuration + detector shift axis
Max. 3D scan area d x h / max. weight	500 x 1000 mm (270 x 1000 mm scatter correct) / up to 50 kg (110 lbs.)	
Max. 3D scan area d x h / max. weight HS		270 x 310 mm / up to 10 kg (rotation unit HS) 100 x 125 mm / up to 3 kg (quick pick gripper)
Focus object distance	650-950 mm	500-800 mm
System dimensions W x H x D	2,310 mm x 2,750 mm x 2,870 mm (91" x 108" x 113") excluding console	
System weight	~15,000 kg / 33,070 lbs.	
phoenix datos x CT software	For highly automated one-button CT including multiple modules for CT data and workflow optimization. Different 3D evaluation software packages for 3D metrology, failure or structure analysis on request	
phoenix datos x metrology package (option)	surface extraction – automatic generation of surface data   easy calib – module for CT system calibration   calibration object – 1 calibration tool with certificate	
velo CT II package (option)	For ultrafast volume reconstruction	
Cabinet crane (option)	For ergonomic handling of heavy samples up to 50 kg (110 lbs.)	
Barcode reader (option)	For easy sample identification	
Radiation protection	The radiation safety cabinet is a full protective installation without type approval according to the German RöV. It complies with French NFC 74 100 and the US Performance Standard 21 CFR Subchapter J. For operation, other official licenses may be necessary	

\* Measured as deviation of sphere distance in tomographic static mode SD(TS), method details referring to VDI 2630 guideline on request

\*\* Not available for scatter|correct and HS configuration

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Die pressure casting evaluation images courtesy of Volumegraphics. NLR-EAR99 export classification for the blade images.

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