

Metris UK (X-Tek Systems Ltd) have developed a high brilliance, high energy microfocus X-ray source. It is suitable for the radiographic inspection of a broad range of engineering components using a wide variety of digital detectors. It enables image quality comparable with that realised using traditional film based techniques. Although digital detectors offer many advantages they tend to have lower sensitivity and larger pixel (grain) size than film. This can be offset by using a new generation of X-ray sources with very small focal spots and very high brilliance. A draft specification for the new source was drawn up following extensive discussions with partners in the consortium and based on published information supplied by digital X-ray detector manufacturers. This specification was subsequently agreed by the consortium and issued.

The source consists of a bi-polar demountable (un-sealed) electronic vacuum tube with rigid mounting suitable for installation in a user provided shielded X-ray bay. The source is powered by a pair of high stability high voltage power supplies through standard 32mm diameter cables fitted with industry standard connectors. The generators are computer controlled via separate interface and control units. The control unit also houses power supplies for the vacuum pumps, vacuum gauge and electron lens. The X-ray source is cooled by the circulation of purified mineral insulating oil.

The following has been achieved:

- Specification drawn-up, agreed and issued.
- Detail design completed for 1st prototype.
- Prototype source and ancillaries built.
- Prototype installed in shielded cabinet, commissioned and debugged.
- Prototype used for demonstrations and trials.
- Design improvements identified.
- A detailed engineering design for the X-ray generator has been created.

Figure 1 shows the prototype tube.



**Figure 1** Prototype 450kV microfocus X-Ray source.

Work on a revised design for a production unit began in Q2 2006. The latest system is now available as part of a fully integrated cabinet system the details of which are as follows:

# XT H 450 LC

## Data sheet



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### PRODUCT DESCRIPTION

The XT H 450 LC is a system designed to give industry leading performance in the scanning and metrology of turbine blades. The system consists of a 450 kV microfocus source delivering up to 450 W of power. A Linear Diode Array and collimator to collect scatter free images and a precision CT manipulator. The system is controlled by Inspect-X software which makes the collection of CT data and setting up of measurements simple and easy. The software can make automated measurements of blades with a pass/fail criterion to accept or reject. The results are stored in a database or output in a standard format for integration in other systems.

### TECHNICAL SPECIFICATIONS

#### X-ray source

Operating voltage	100 - 450kV
Beam current	0 - 2 mA max
Power Rating (continuous)	1,200 W max
Focal spot size 320kV	30µm wide x 50µm up to 100 watts 200µm diameter at 400 watts
Focal spot size 450kV	80µm diameter up to 200 watts 200µm diameter at 400 watts
Spot position	50 mm from output window
Beam angle	30° included angle, conical
Filament type	Quick change, long life tungsten hairpin
Filament life	200 hours typical, replaceable by operator
Target type	Solid Tungsten, User indexable, field replaceable
Target Lifetime	10,000 hrs (if operated within the above power limits)
Target cooling	Oil in re-circulating system. 2 L/min @3 Bar
Vacuum system	Turbo-molecular pump, backed by 2 stage rotary vane pump
Pumping time	30 minutes typ. from atmospheric pressure (2m backing hose)

## Detector

The detector offered for this system had been developed by Metris and is optimized for high kV microfocus sources. This is a high efficiency linear detector with > 80 Quantum Detection Efficiency. The detector has a 400 µm pitch.

Type	Curved Micro Linear Diode Array
kV rating	450kV
Pixels	2,000
Pixel resolution	400 microns
Quantum Detection Efficiency	>80%
Converter	Cadmium Tungstate
Shielding	Interpixel shielding

## Manipulator

The component manipulator has joystick and CNC control and is precision stepper motor driven with precision ball screws/linear slides.

Vertical axis	600mm travel, speed up to 25mm/sec
Magnification axis	600mm travel, speed up to 25mm/sec
Rotate axis	Continuous, speed up to 15 deg/sec
Turntable diameter	150 or 200mm with location points for generic tooling
Max load	50 kg

## X-ray cabinet

The X-ray cabinet is fully compliant with International Ionising Radiation Regulations and supplied with dual independent safety switches to protect the operator when the doors are open. Cabinet side service doors house the generator(s), safety system, power distribution and pneumatics.

In cabinet colour CCTV system with external viewing monitor (desk mounted).

Cabinet dimensions	3240 x 1590 x 2500 mm L x D x H
Access door dimensions	1145 x 850 mm H x W, air actuated
Shielding	less than 2.5µSv/hour. (0.25mR/hr)
Weight	11,000 kg

## Operator console

The controls, including Joysticks and twin monitors, will be mounted on an arm attached to the cabinet. The control platform will swing to a position that will allow the operator to see through the viewing window while operating the joysticks. One monitor will be used for viewing the image of the sample the other screen will display the Inspect-X X-ray control & user interface. An additional LCD screen can be fitted and connected to the CCTV camera inside the system to give a real-time view of the sample within the cabinet.

## Environmental conditions

Operating Temperature range	10-30 Degrees C
Maximum Relative Humidity	95%
Shielding	less than 2.5µSv/hour. (0.25mR/hr)
Weight	11,000 kg