

Focus topics

Keep cool and carry on

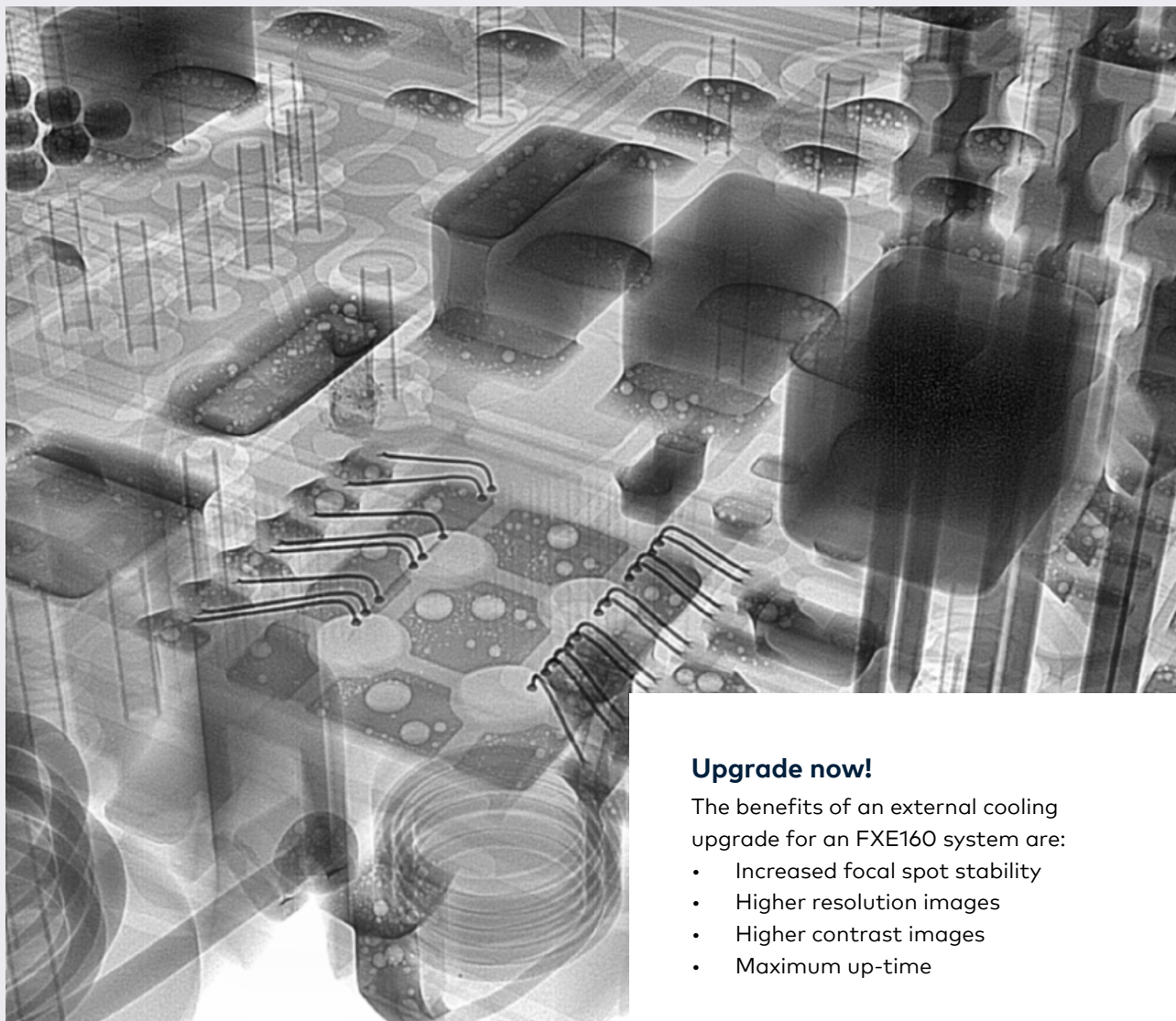
Take your X-ray imaging to the next level
with the FXE Cooled Tube upgrade.

Balancing power and resolution

X-ray imaging provides a powerful method for non-destructive testing in a wide range of industrial and laboratory applications. A significant challenge is to balance fast inspection requirements with high-resolution stability, especially in the sub-micron range.

High electric currents are used in the electron optics to produce focused X-ray spots, and this current generates considerable heat. Without suitable dissipation methods, the thermal load can cause instabilities in the X-ray beam which can reduce imaging quality. In particular, beam drift over time can significantly affect the obtainable resolution in a final image.

We have developed a complete cooling system for FXE 160 modules that dramatically improves tube performance. A system of water-cooled pads is attached to the focusing section of the tube, thereby allowing excess heat to be removed efficiently from the critical area near the electron optics. The dedicated cooler unit and interface kit provide everything necessary to upgrade the FXE 160 module into a powerful micro-CT X-ray source.



Upgrade now!

The benefits of an external cooling upgrade for an FXE160 system are:

- Increased focal spot stability
- Higher resolution images
- Higher contrast images
- Maximum up-time

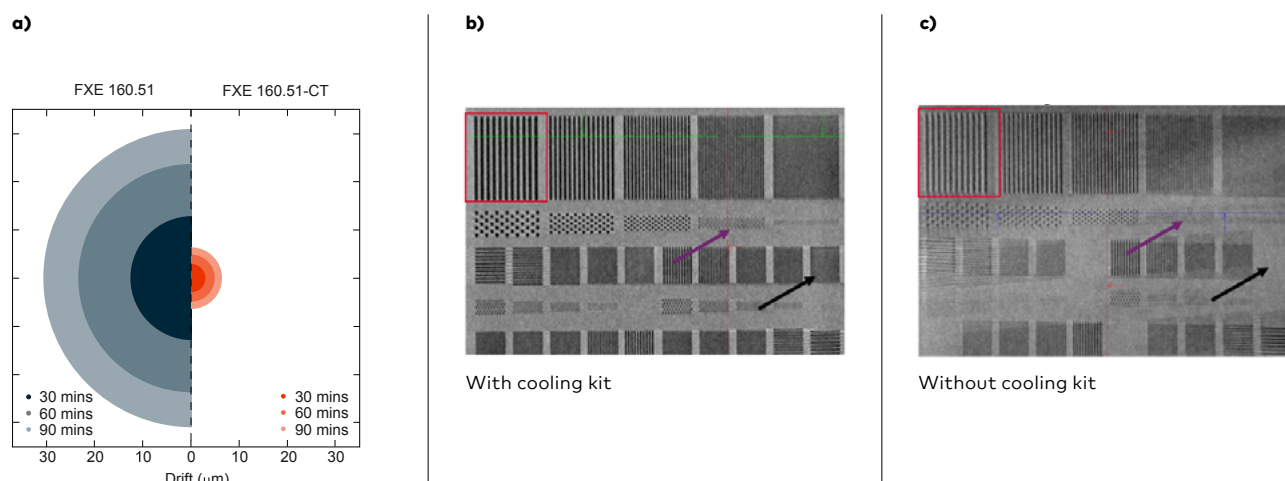


Fig. 1 comparative cooling results

a) Drift measurements for FXE 160 nano (left) and a cooled FXE 160 nano CT module (right). **b)** Test images obtained with and **c)** without the cooling kit, highlighting a significant performance enhancement with cooling.

Maximizing X-ray tube performance with external cooling

To highlight the benefits of external cooling on imaging performance we have performed measurements of the X-ray focal spot position as a function of time. The results are obtained using FXE 160 nano and FXE 160 nano CT modules respectively, in the microfocus mode.

The differences between cooled and uncooled tubes on all measured time scales is immediately apparent in Fig. 1a. The size of the circles represents the spatial extent of focal spot drift after the corresponding time, which is indicated by the different colors. A cooled tube produces a five-fold reduction in spot drift, corresponding to a total drift of only 2 μm after a warmup period of 30 mins (or 6.5 μm including the warmup period). In comparison, for the uncooled tube the values are 18 μm after 30 mins warmup (or 31 μm including the warmup).

The value of this increased stability in the X-ray spot position is directly visible by comparing the test images shown in Fig. 1b and 1c. In the image taken without the cooling kit, the 2 μm dot pattern (purple arrow) is completely blurred out. The 1 μm rectangular block is not visible at all (black arrow) due to the large shift of the focal spot position. In

contrast, the cooled tube produces an image where the 2 μm features are clearly resolved, and the 1 μm features are stable. Furthermore, the contrast between features is significantly increased, even for larger feature sizes of 10 μm (red rectangle).

An additional advantage of increased cooling efficiency is the increased uptime. Cooling of sensitive components removes the need for cooldown interruptions of operation. This means you can work for longer, both in microfocus and nanofocus operation modes.



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