“Ageing” or conditioning of laboratory xray sources

Method note

MCT-132

1. Before you scan

This method note explains the “ageing” or conditioning of the xray sources in SkyScan desktop microCT scanners.

First however, here is a checklist of actions and checks that should be done either routinely or before starting a scan with the Bruker “SkyScan” laboratory micro-CT scanner.

1.1 Perform the ageing (conditioning) of the xray source – as described in the next section.

1.2 The scanner and its immediate vicinity should be in a clean condition and clear of dust, particularly dust with any metallic or other content of dense material – such dust can potentially be problematic if it finds its way into the scanner, or onto scanned samples. Make sure that the air vents through which air is drawn in and blown out of the scanner, for cooling, are not obstructed. Don’t neglect to dust and clean the computer monitor, keyboard and mouse, and when necessary replace batteries of cordless components. (**Never** put a magnet anywhere on the scanner – e.g. don’t use a magnet to fix notes to the scanner!)

1.1. No part of the scanner should be in direct sunlight. Air conditioning is a good idea in the scanner room, particularly in hot weather. If you scan 24/7, air conditioning should also be 24/7.

1.2. The computer which controls the scanner should be kept in good working order. Keep at least 15% of the disc space free on the C drive (with the SkyScan control software), and at least 15% free in the other data disc drives also. Perform **defragmentation** of all the hard disc drives every month or two. If the computer is internet-connected, make sure Windows Updates are installed promptly.

1.3. Make sure **flat field corrections** are up to date for all scanner settings which are in use. It is recommended to take a new flat field at the start of each day's scanning, for each used scan mode (filter / resolution combination). Less frequently but also regularly, the **alignment test** should be done every 2-4 weeks. For the SkyScan 1272 (only) there is the additional trajectory calibration that should be carried out at intervals of 2-4 months.

1.4. Have a glance at the Bruker Support website for any **upgrades** to the control software of your scanner. The same applies for reconstruction software NRecon and the analysis programs CT-Analyser (CTAn), and visualisation programs CTvoxel (CTVox) and CT-Volume (CTVol); and also other utilities such as DataViewer.

1.5. Remember that the micro-CT scanner is a sensitive high-precision instrument, and treat it accordingly. Insert and remove the sample holders at the stage with the minimum force possible, and never subject the scanner to jolts or strong vibrations. It is also not there to be leaned on, or used as a shelf for books, papers etc.

2. Conditioning or "ageing" of the xray source

Laboratory xray sealed sources (that are kept in a permanent vacuum) have a finite lifetime. After several years of operation they will require replacement, due to failure, or to a decrease in either intensity or stability to unacceptable levels.

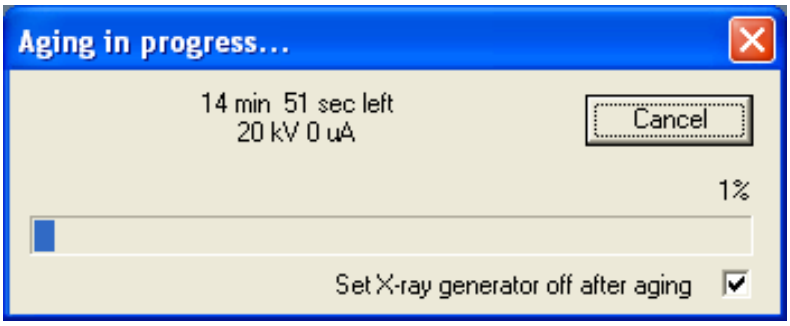
Xray sources of SkyScan desktop systems operate at very high voltages up to a maximum between 100-130 kV. It is detrimental to a lab xray source for such high voltage to be applied in a short time of a few seconds after a long period of inactivity (being turned off). Once a source is "warmed up" however, such quick application of normal high operating voltage is well tolerated.

For this reason the “ageing” system is built into SkyScan xray sources. When the scanner and the source are turned on for the first time each day – after 12:00 midnight – the first powering up with increase of voltage to the maximum (100 or 130kV) is slow, extended over 15-24 minutes (depending on the model of scanner and source).

2.1. The ageing procedure

(a) After turning on the scanner, click on the yellow circular x-ray button under the top menu, to start the x-ray source.

(b) When it is the first time in the day that the x-ray source has been turned on, then the process of “**aging**” will run. A progress bar will appear, showing the gradual increase in x-ray source voltage and current. This will take 15-24 minutes to run, depending on scanner model. Aging takes place only the first time the source is turned on each day; after that, turn-on will take only a few seconds. The purpose of aging is to protect the X-ray source and prolong its working life.



You can choose whether or not to set the x-ray source to turn off after aging, with (in some models) the tick box below the progress bar. *Hint:* Before ageing set the thickest (copper) filter, to reduce xray exposure of the camera during the ageing process.

(c) THE TIME SCHEDULE OF X_RAY SOURCE AGING

The aging as described above will take place over 15-24 minutes, in the case that the source has not been on for of a period of up to 2 weeks.

If the source has not been turned on for between 2 weeks and 2 months, then the source aging process will take 40 minutes.

If the source has not been turned on for longer than 2 months, then the aging will take 2 hours.

IT IS STRONGLY RECOMMENDED that you do not allow aging to take 40 minutes or 2 hours, by ensuring that the source is not left inactive for more than a week or two. This can be achieved by turning the source on every week at least once, and allowing the aging to run, even if the scanner is not being used e.g. during holiday periods.

There are two reasons for this. One is that it is inconvenient for the user to have to wait 40 minutes or two hours before starting scanning. The other is that long periods of non-activity are harmful to the micro-focus x-ray source, and can shorten its lifetime, causing failure of the source (requiring its expensive replacement) to occur sooner.

Therefore it is recommended that the user turns the x-ray source on routinely once per week, at all times. When the scanner is not being used, just wait until the aging has finished, then turn off the scanner.

3. Turning off the scanner

(a) It is recommended to remove any sample object from the scanner sample chamber (although the base can be left in place), and to close the scanner door, before turning off the scanner.

(b) First turn off the scanner control software, either by the red cross in the top right corner of the software window, or under Actions menu / Exit (bottom of list). A progress bar will run briefly during scanner software shut-down.

(c) Please note: if any flat field corrections have been taken while the scanner has been on, then you may be prompted (depending on scanner model) to save the flat fields in a configuration file. It is recommended that you do save the configuration file as prompted.

(d) After the scanner control software is fully shut down, optionally you can turn off the PC. In one old scanner model, the SkyScan 1172, the instrument should be switched off with the key, at the right end of the instrument, by anti-clockwise turning.