

Reading Racked 2D-Coded Cryo Tubes directly from -80°C Freezer

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INTRODUCTION

2D-coded tubes are widely utilized for storing and tracking samples at ambient and +4°C temperatures. Predominantly used with small molecular weight compounds dissolved in DMSO for Drug Screening, until recently.

Now the storage of biological samples such as DNA, protein, blood fractions and viable cells, is also becoming commonplace. The need to store them at lower temperatures (e.g. -20°C, -80°C and Gas Phase Liquid Nitrogen) has resulted in reading challenges for traditional rack readers.

FluidX already offer a comprehensive range of 2D-coded Cryo Tubes. These tubes are suitable for storing a wide selection of samples including DNA, proteins, viable cells and other biological materials at a variety of temperatures including -20°C, -80°C and Gas Phase Liquid Nitrogen (-196°C).

The next logical step was to develop a rack reader that was capable of reading multiple racks without the build-up of frost or condensation on the underside of the glass which causes the code to become unreadable.



USING STANDARD RACK READERS WITH CRYO TUBES

The FluidX range of rack readers are perfect for scanning racks at ambient temperatures, and the design of the XTR-96Pro (with 8 CCD cameras and no moving parts) already allows it to operate within a cold environment, as low as -20°C.

Reading the occasional rack of Cryo Tubes with a standard rack reader should not be considered a serious issue. For example, a standard XTR-96 scanner has a reading time of 10 to 20 seconds; therefore the rack is not in contact with the glass surface long enough for the reader to be significantly affected by the cool temperature.

However, when scanning multiple racks the accumulated time the cold racks spend in contact with the reader glass causes a drop the air temperature on the underside of the glass. Condensation and frost can appear which results in poor reading capability and possible damage to the scanning head.

READING CRYO TUBES WITH STANDARD XTR-96

Recommendations when using a standard Xtr-96 2D-code rack reader to scan cryo tubes:

- Remove racks from the freezer. The coded tubes should be cleaned with an ethanol wipe to remove any frost and then placed on the reader.
- Scan the rack and immediately remove from reader to avoid prolonged exposure of the scanner to the cold rack.
- Frost and condensation build up will affect reading performance; the condensation may take up to 20 minutes to evaporate.



Fig 1.
Xtr-96 glass top before scanning cold tubes from
-80 °C freezer

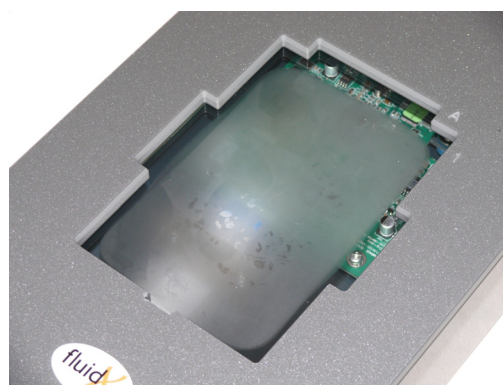


Fig 2.
Xtr-96 glass top after scanning cold tubes from
-80 °C freezer

Decoding Performance

2D-coded tubes that use the Datamatrix ECC200 Symbology, such as those from FluidX, are very robust and able to cope with a large degree of degradation when combined with state of the art decoding algorithms such as those employed in the XTR range of readers.

However, as the condensation builds up the code is obscured and the contrast between the code and the background is diminished leading to unreliable reading.

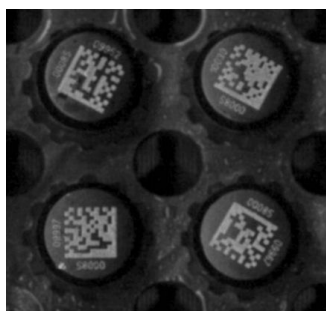


Fig 3. Tube image before frosting of glass surface

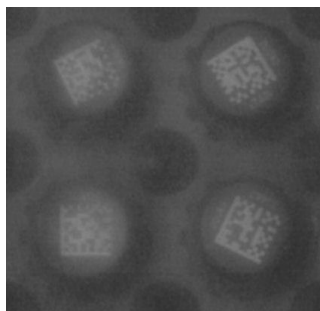


Fig 4. Tube image after frosting of glass surface

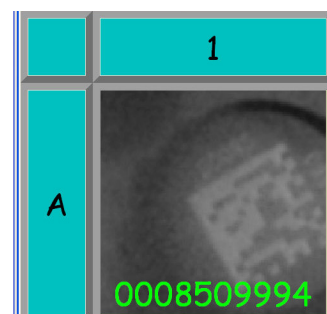


Fig 5. Decoding frosted tubes

DEVELOPING THE XTR-96MKII Cryo

The CJD Resource Centre, NIBSC (National Institute for Biological Standards and Controls) needed the ability to scan up to 40 racks directly from a -80°C freezer.

Initially, a hot block had to be applied to the reader scanning window after only a few racks had been read to clear the mist that formed as the glass cooled to below dew point.

Note: Dew point is dependant on the relative starting humidity of the ambient air.

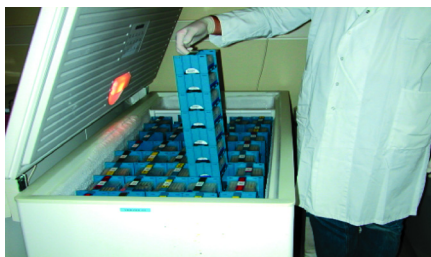
The CJD Resource Centre switched to using the new XTR-96MKII Cryo which controls the temperature and air circulation inside the scanning area. This prevents the formation of localized cold stops and ensures that, even with a cold rack in prolonged contact, there is no frost build up or mist.

“The new Xtr-96 MkII with anti misting scanning window has allowed us to batch scan multiple - 80 frozen racks, unlike the previous model which required scanning to be interrupted by application of a heat block to the scanning window every few racks. The ease and trouble free use has resulted in stock control and quality control being a stress free experience.”

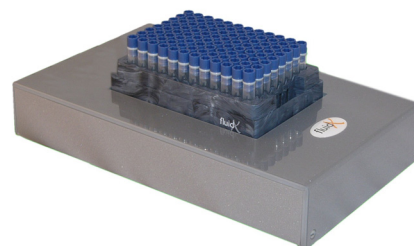
Kaetan Ladhani, CJD Resource Centre, NIBSC, Potters Bar, Herts EN6 3QG, UK

READER PERFORMANCE COMPARISON

Using cryo tubes stored at -20°C



Remove racks from
-20°C and scan
repeat until first tube failure



Reader	Number of Scans before first "No Read"
XTR-96MKII	10
XTR-96MKII Cryo	40+ No deterioration noticed
Competitor	5
Racks should be removed from freezer, the coded tubes should be wiped with an ethanol wipe to remove any frost and placed on the scanner. Scan the rack and remove from scanner.	

Using cryo tubes stored at -80°C



Remove racks from -80°C
and scan
repeat until first tube

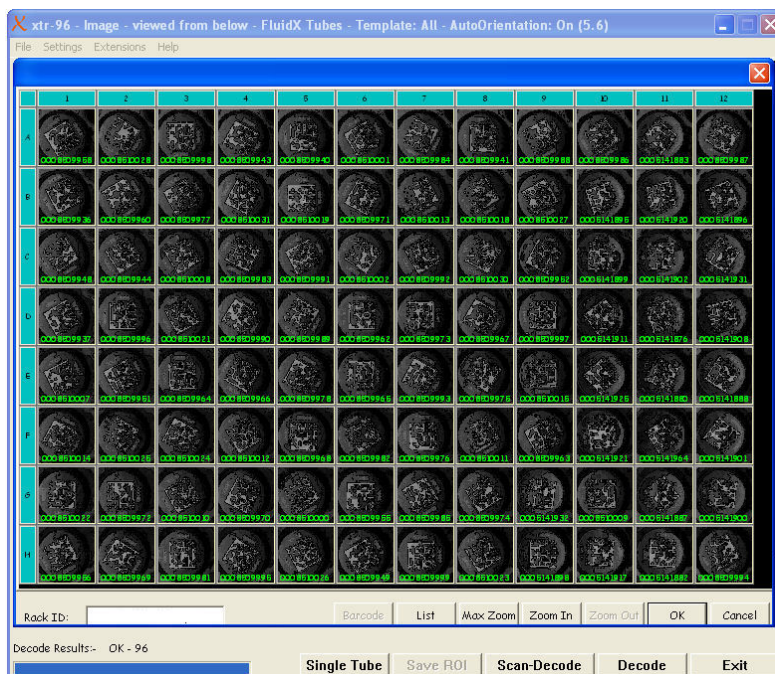
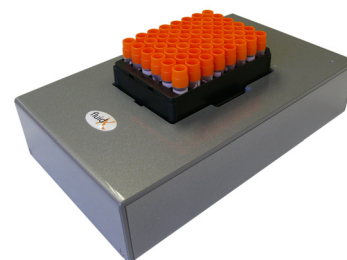


Reader	Number of Scans before first "No Read"
XTR-96MKII	2
XTR-96MKII Cryo	40+ No deterioration noticed
Competitor	1
Racks should be removed from freezer, the coded tubes should be wiped with an ethanol wipe to remove any frost and placed on the scanner. Scan the rack and remove from scanner.	










OVERVIEW

THE XTR-96MKII Cryo

Achieves 100% decoding after reading more than 40 racks from a -20°C freezer.



FLUIDX TUBE RANGE SUMMARY

<div>  <h2>Tube Range Summary</h2> </div>								
Tube Type	PP Screw Cap Tubes				PP Cryo Tubes			
Image								
Volume (Nominal)	0.5ml	0.75ml	1.1ml	1.4ml	1.7ml	2ml	2ml	4ml

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