



# Overview of Capsule Fill Tube Assembly (CFTA) and qualifying processes

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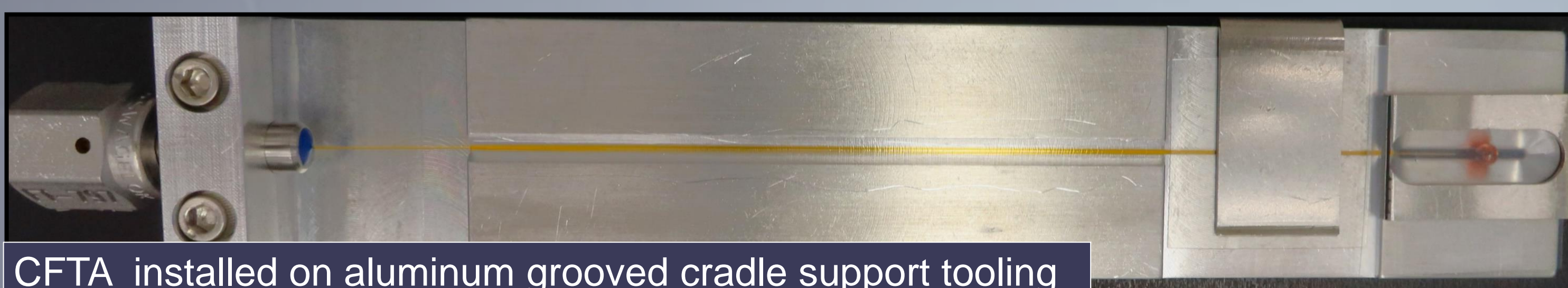
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## INTRODUCTION & BACKGROUND

The National Ignition Facility (NIF) requires targets to be assembled in a very precise and complicated format. These targets contain many special components, one of them being a capsule fill-tube assembly (CFTA). The capsule is a hollow sphere that can be of various sizes and materials as small as 2um, and the fill tube is needed to deliver fuel into the capsule in a completed target. Before the CFTA can be assembled into a target, it must pass several qualifying tests.



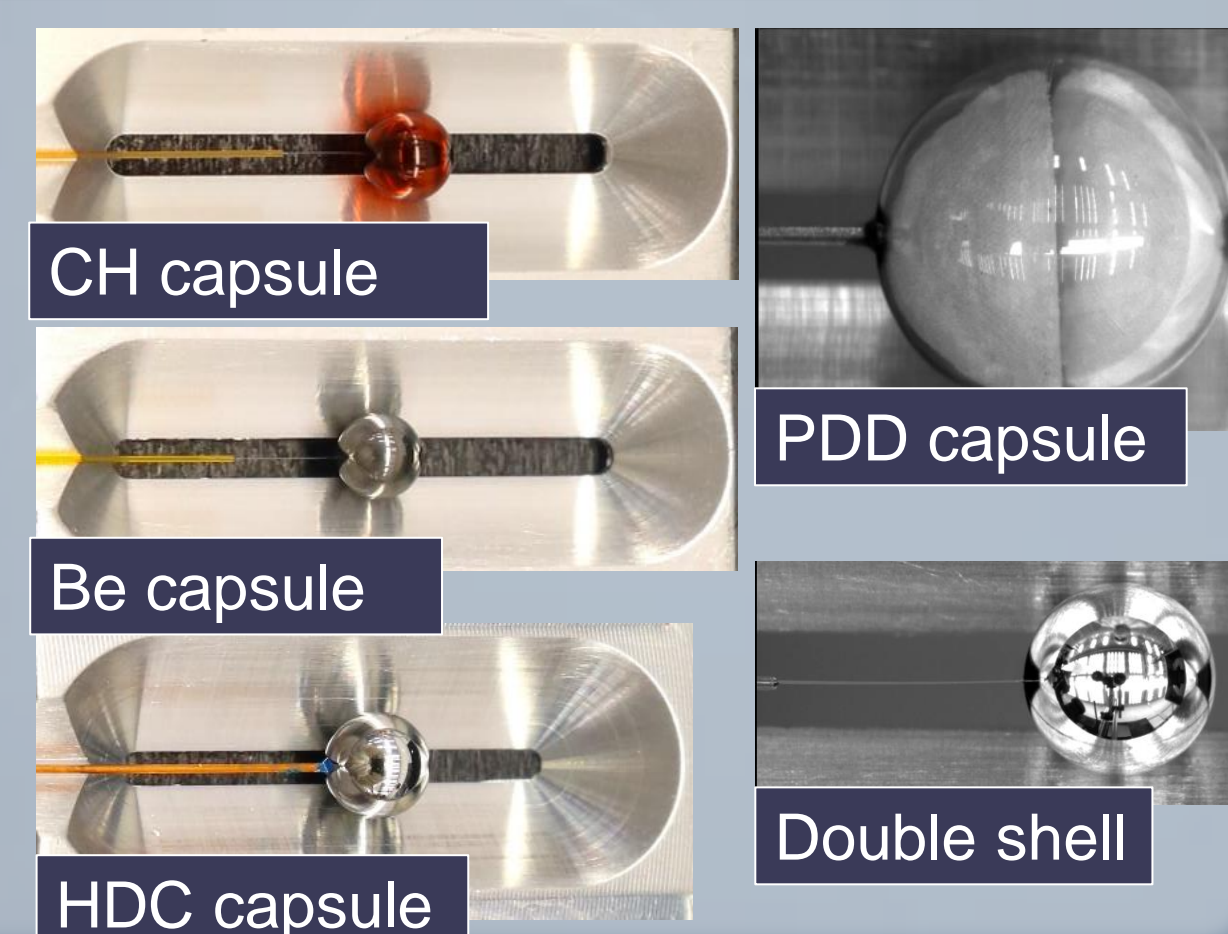
CFTA main assembly components: capsule, fill tube (FT) and polyimide sleeve attached to a VCR female fitting



CFTA installed on aluminum grooved cradle support tooling



Fill Tube and capsule close-up profile



CH capsule

PDD capsule

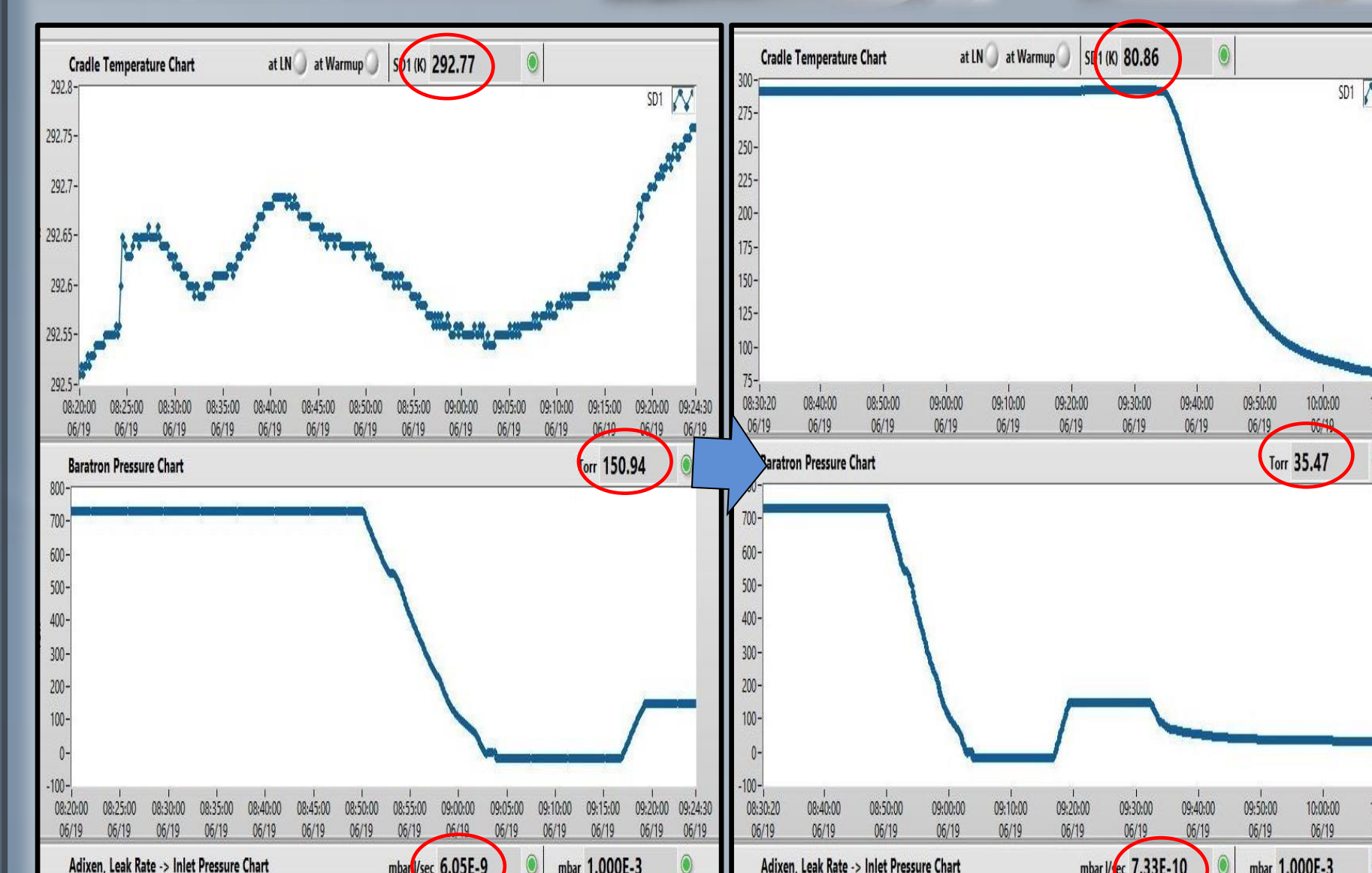
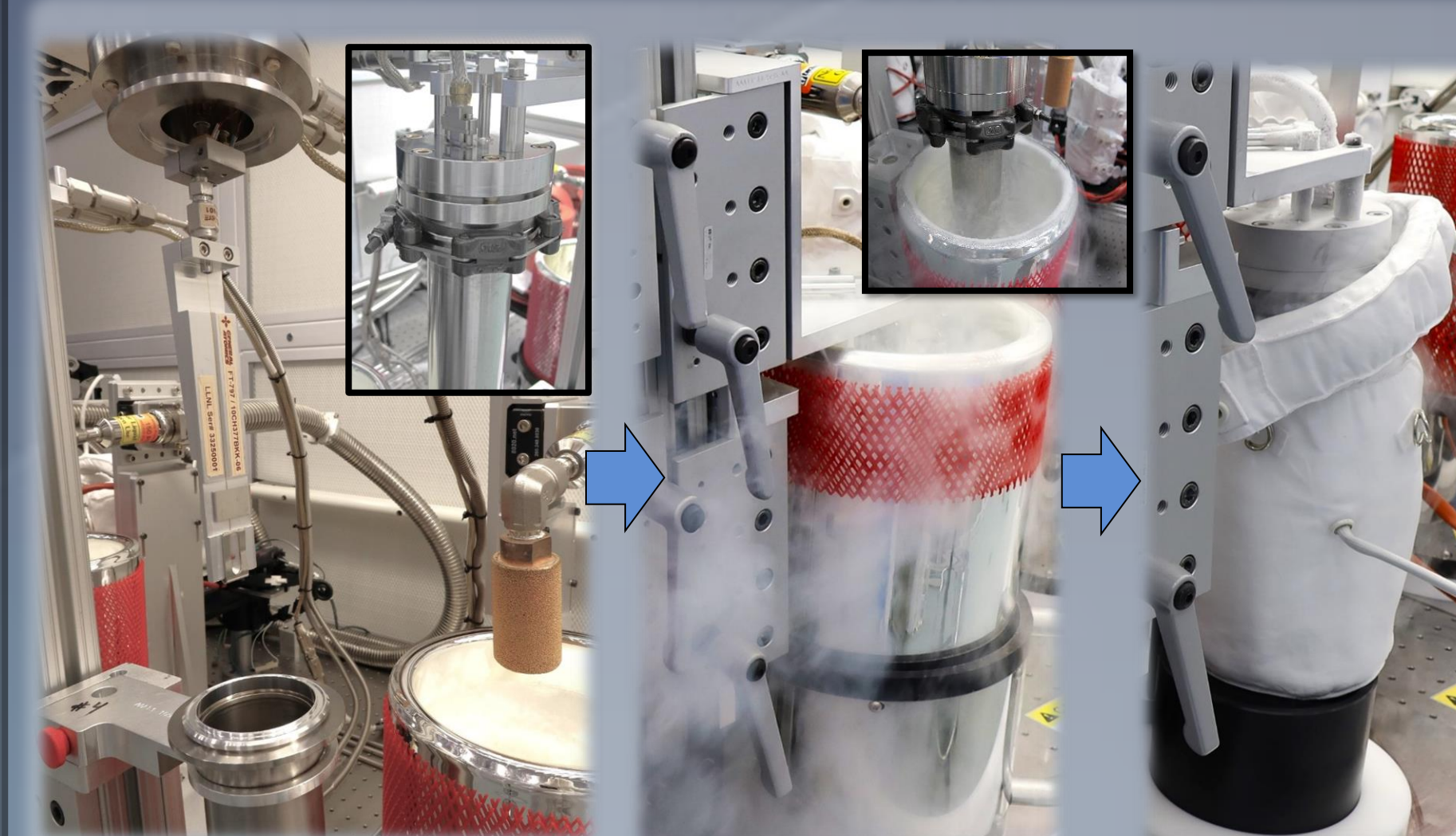
Be capsule

HDC capsule

Double shell

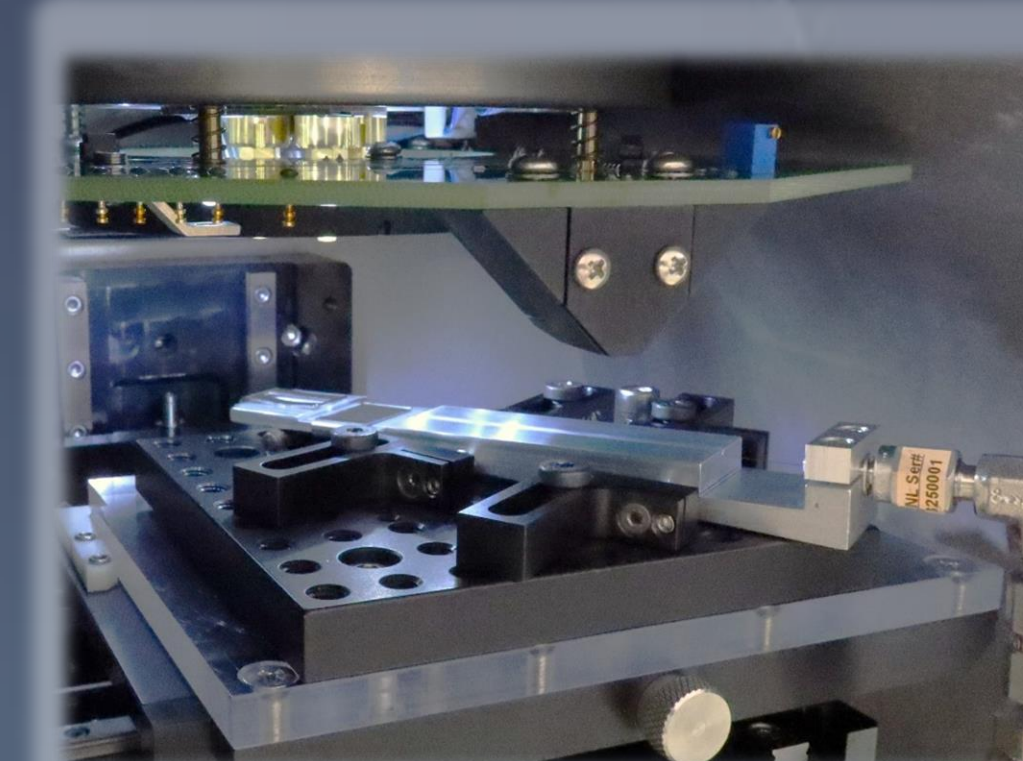
## Leak Test

CFTA glue joint leak rate qualification at room temperature and cryogenic temperature

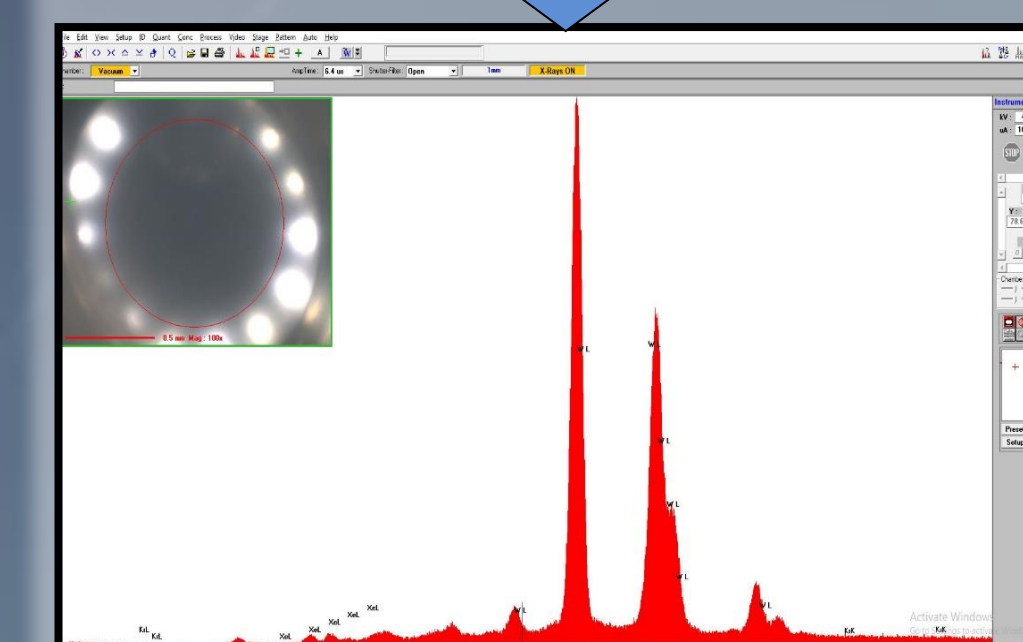


## X-Ray Florescence (XRF)

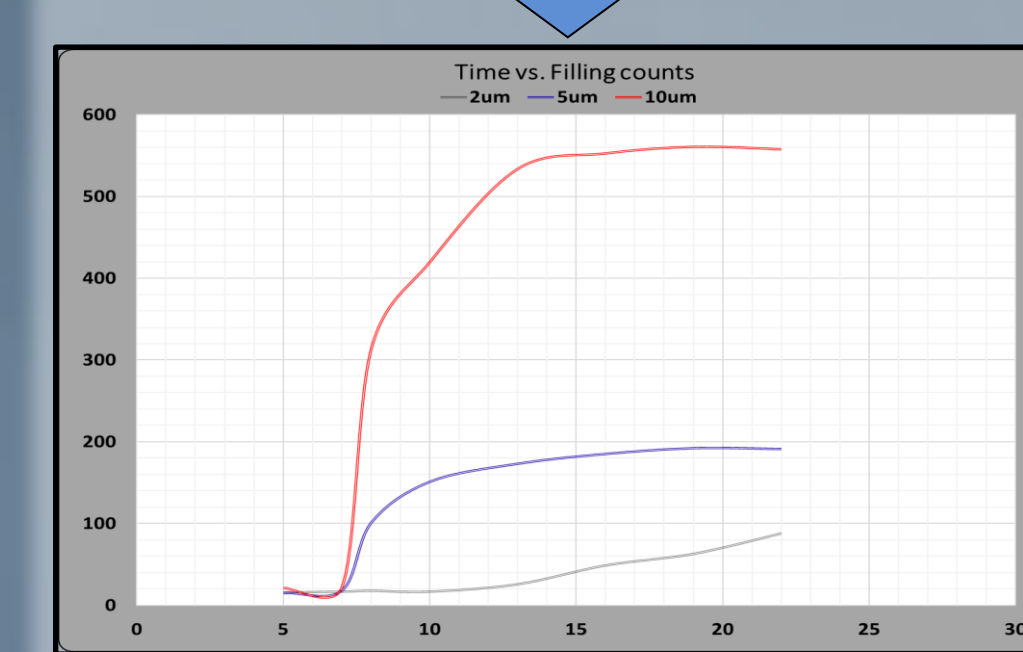
Checking for glue plugs in the Fill Tube



- CFTA loaded into an XRF chamber analytical tool kit



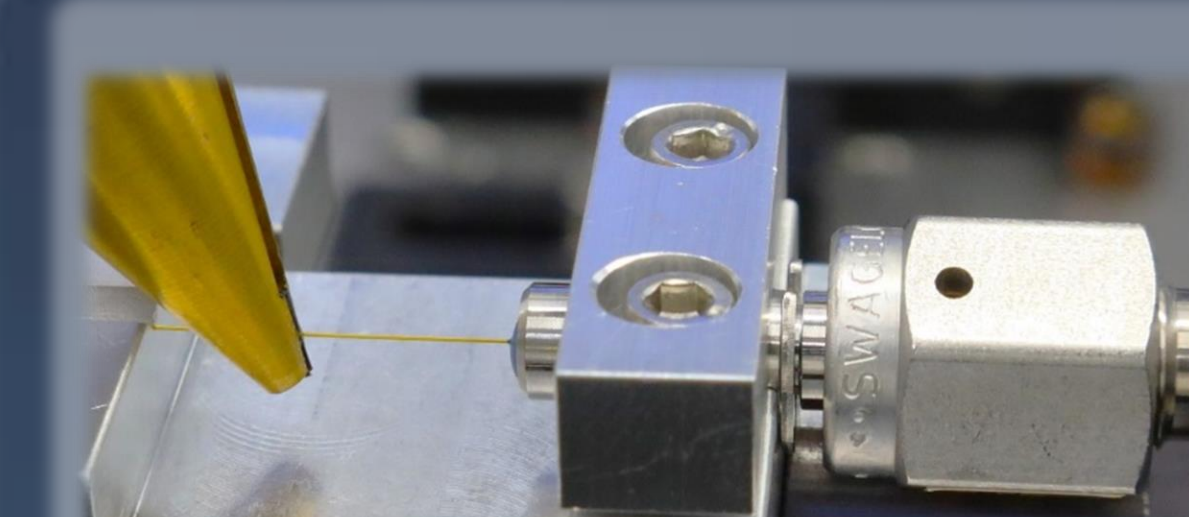
- XRF spectrum signal, gas used is dependent on capsule material and dopant



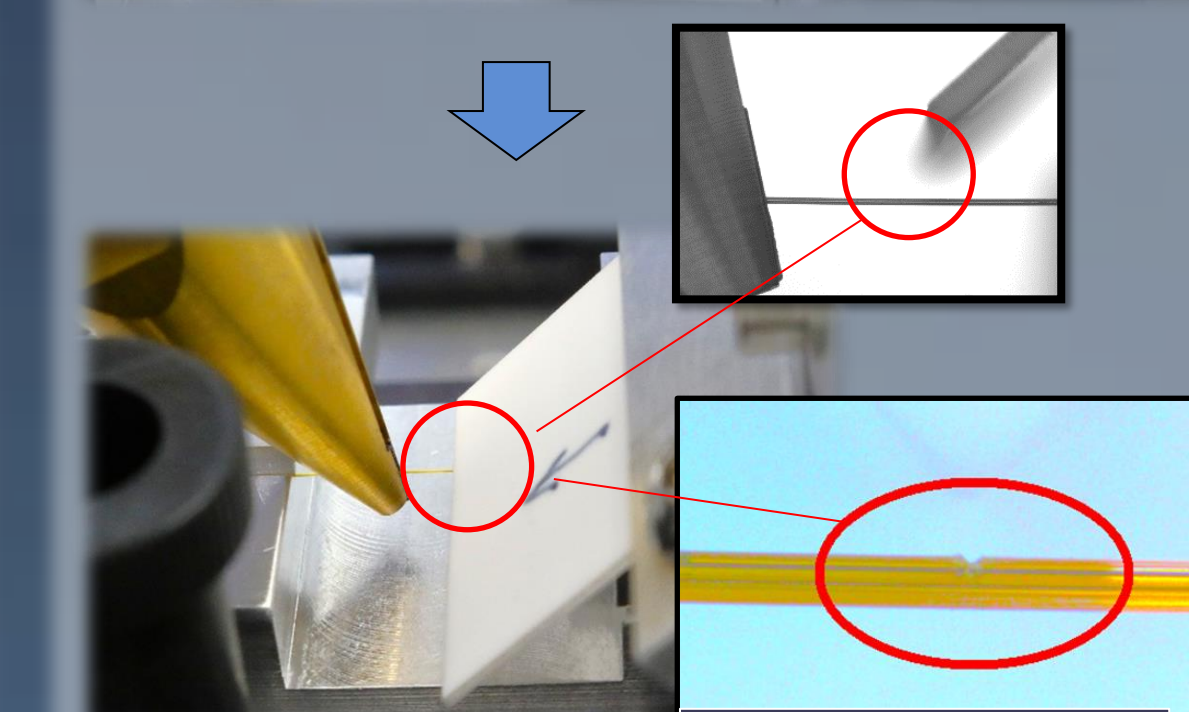
- Sample plots of counts as a function of time from a 10um, 5um and 2um unplugged fill tubes (FT)

## VCR Fitting Removal

Vacuum Coupling Radius (VCR) fitting is severed after CFTA qualification tests

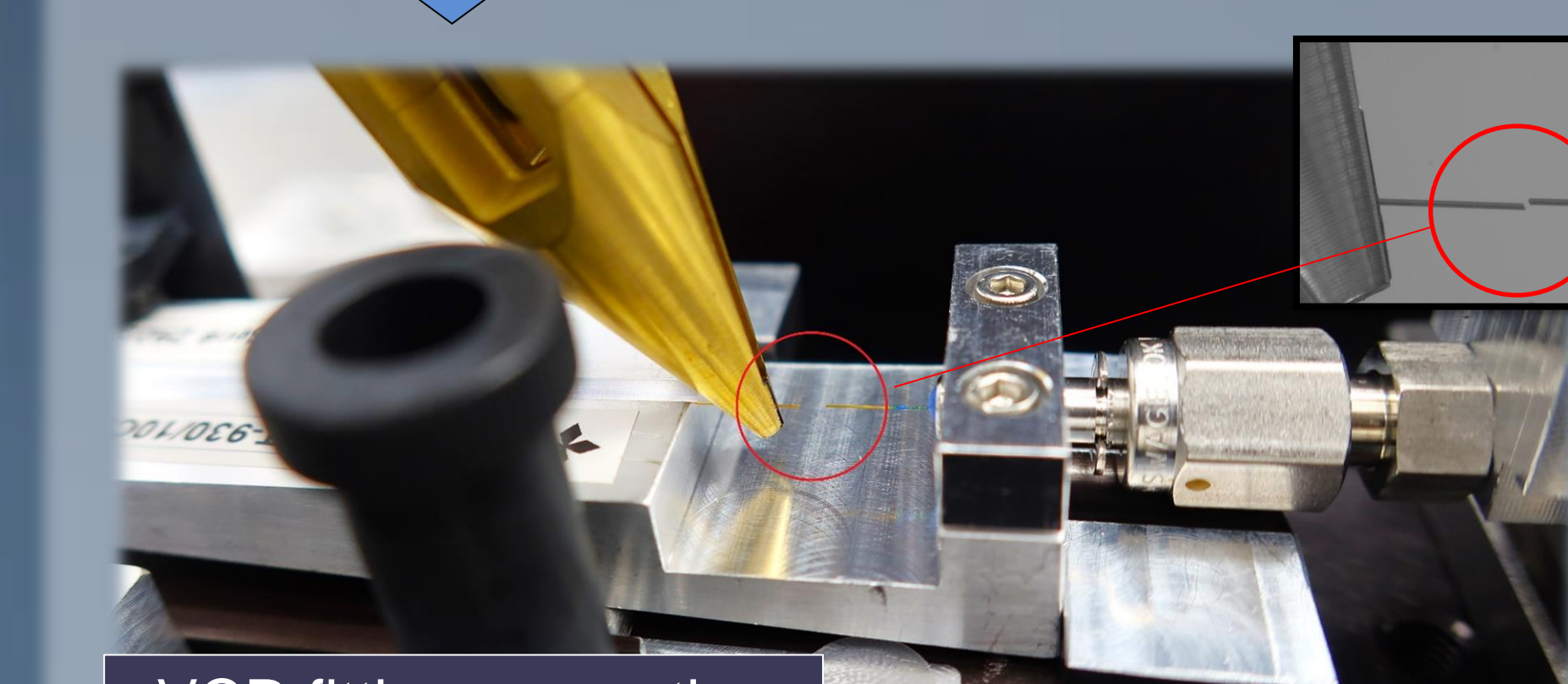


- Securing polyimide FT prior to VCR removal



- Polyimide fill tube is scoured with a ceramic blade to produce a cutting flaw

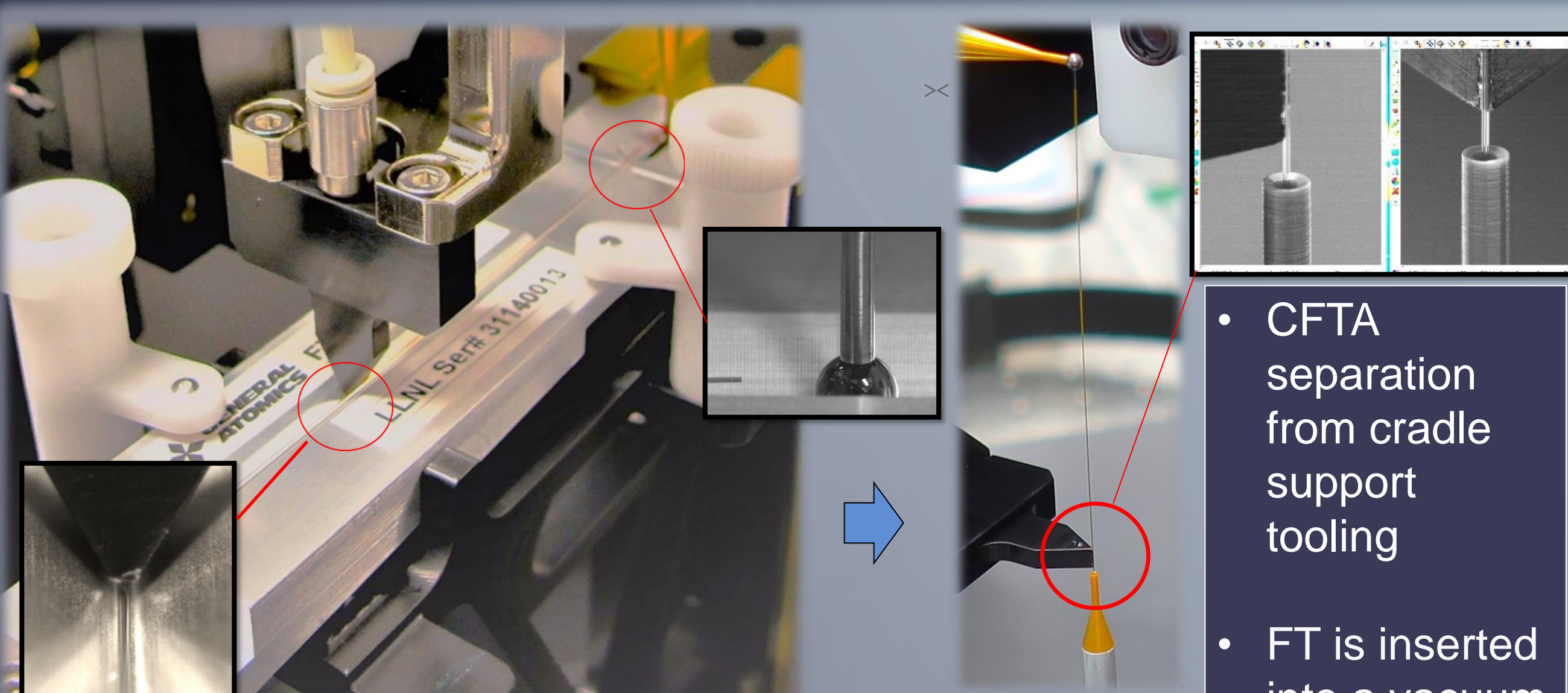
Scouring flaw



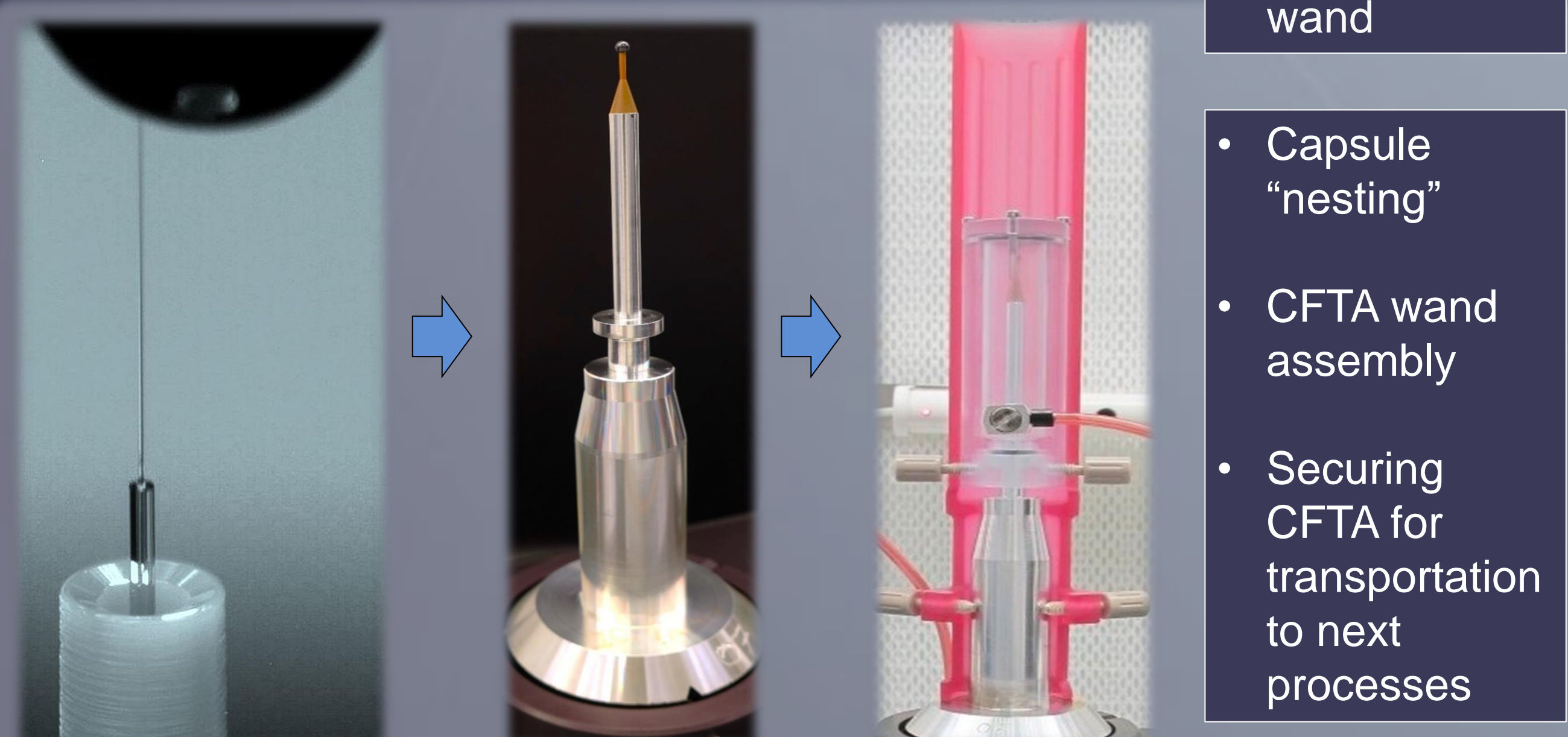
VCR fitting separation

## Threading Process

CFTA assembly to be threaded into a vacuum wand



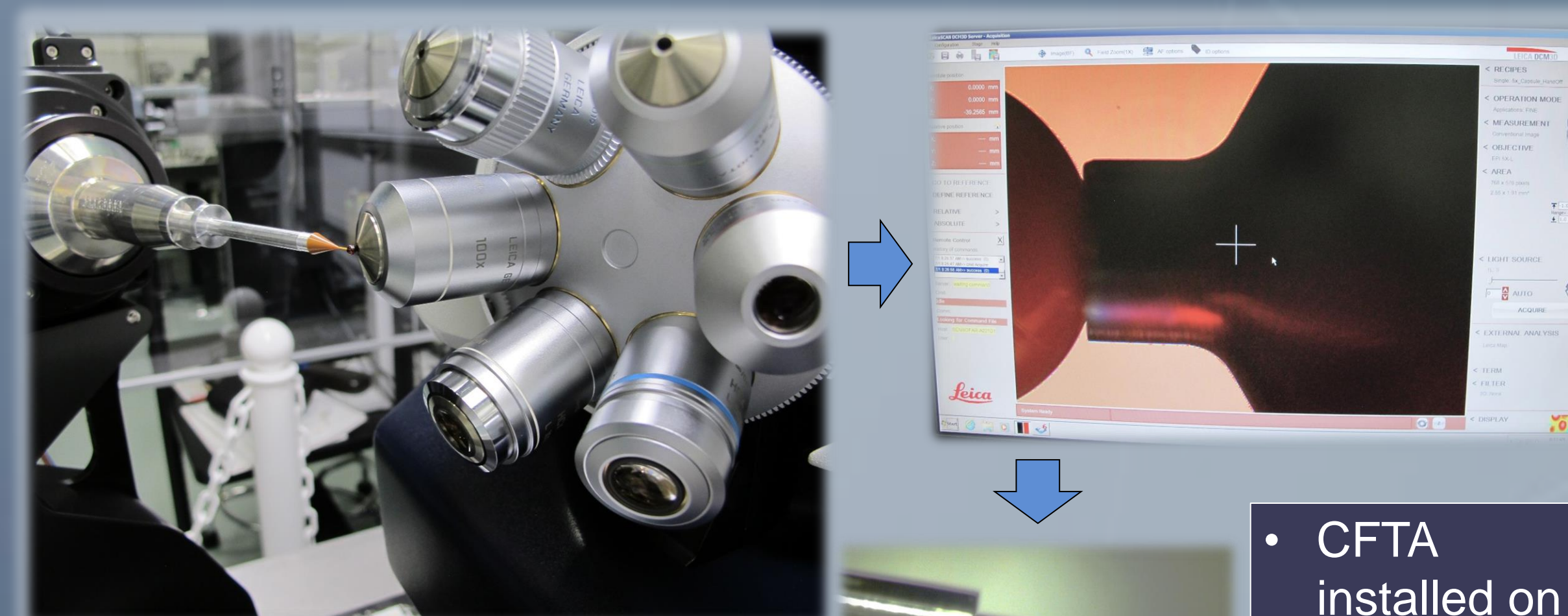
- CFTA separation from cradle support tooling
- FT is inserted into a vacuum wand



- Capsule "nesting"
- CFTA wand assembly
- Securing CFTA for transportation to next processes

## Capsule Inspection Visualization

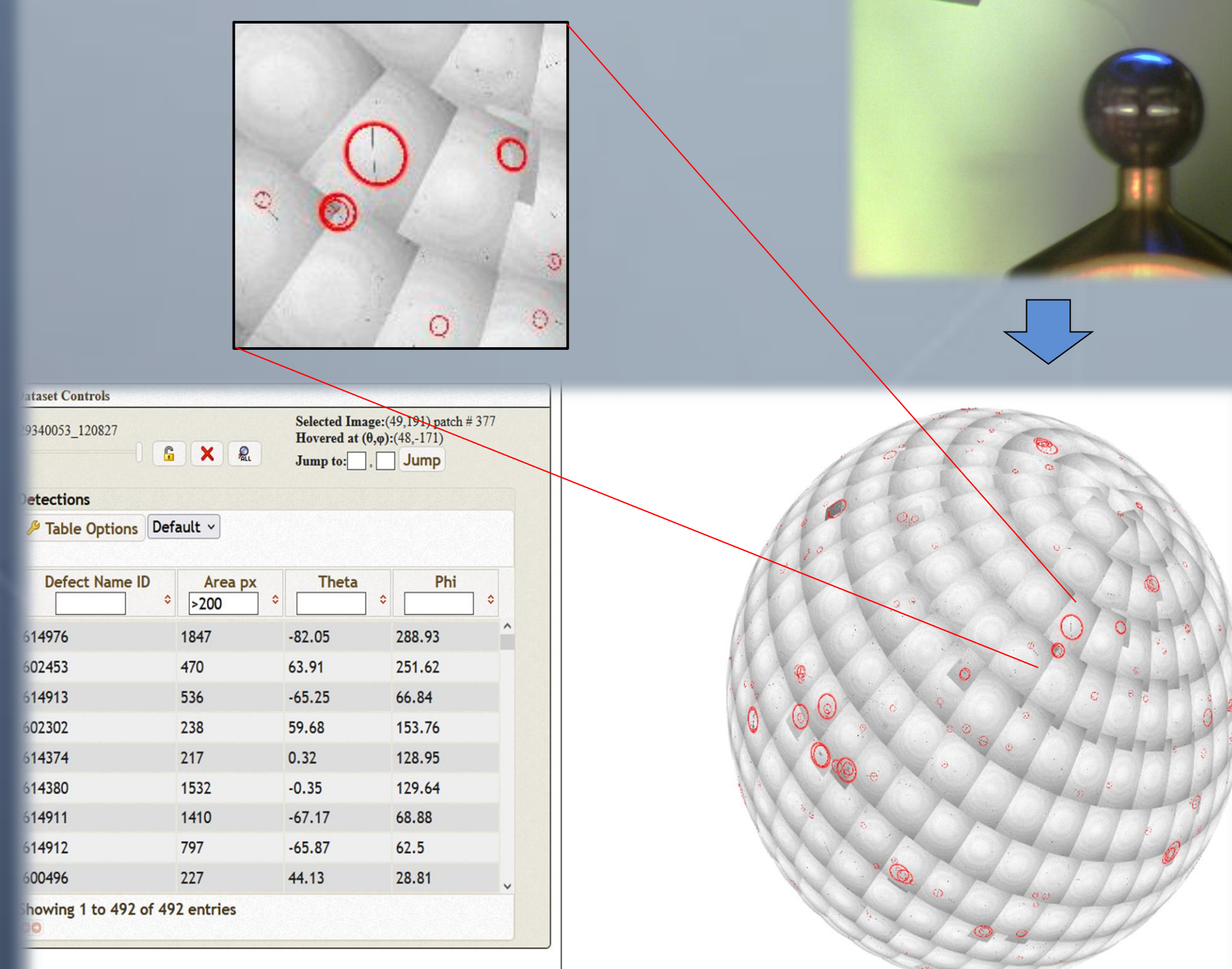
Detection of capsule cleanliness and surface integrity



- CFTA installed on Leica scan application

- Capsule is transferred to a secondary inspection wand

- Geographic detection of features and region of interest

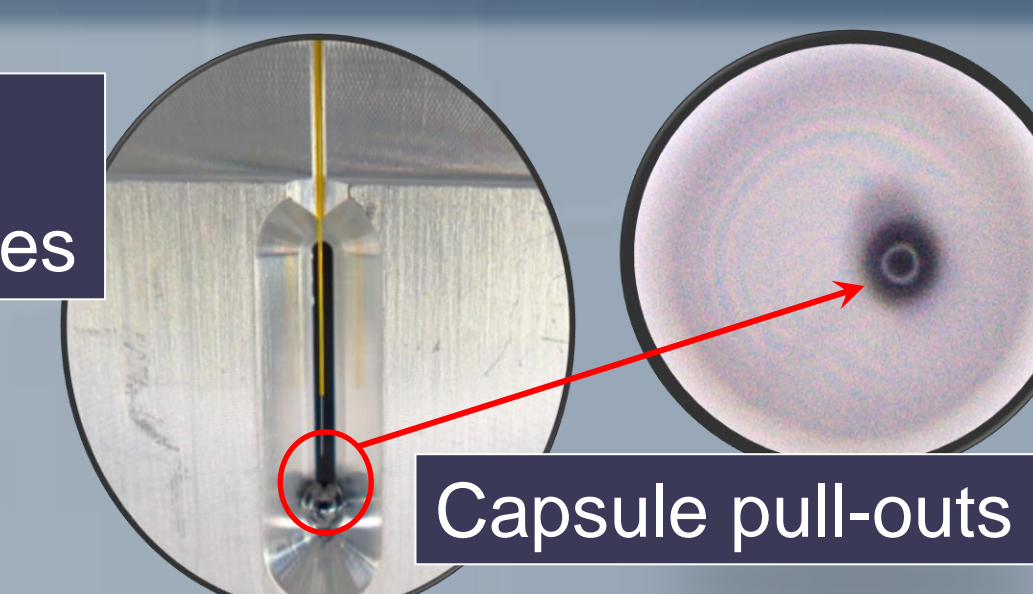


## TYPICAL/Common TESTING CHALLENGES

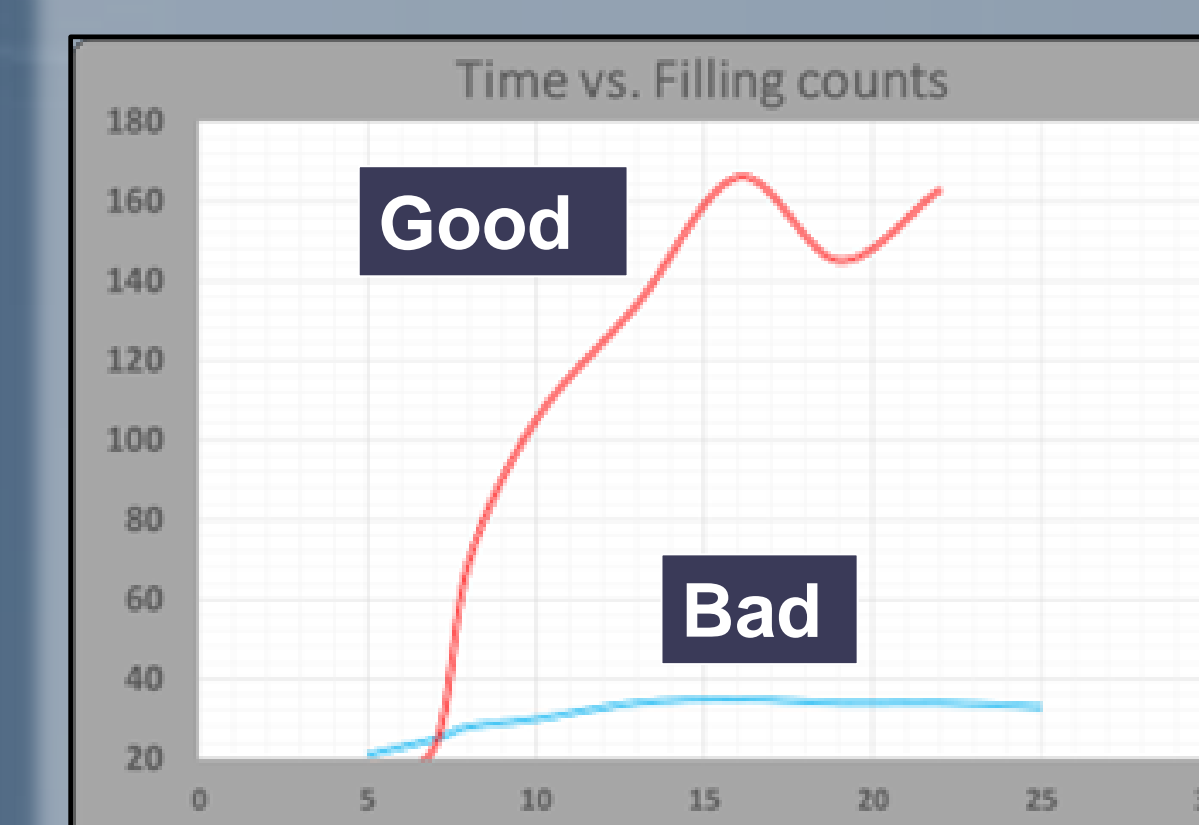
- Leak Metrology:** Out of specification leak rates



Defective Al seals

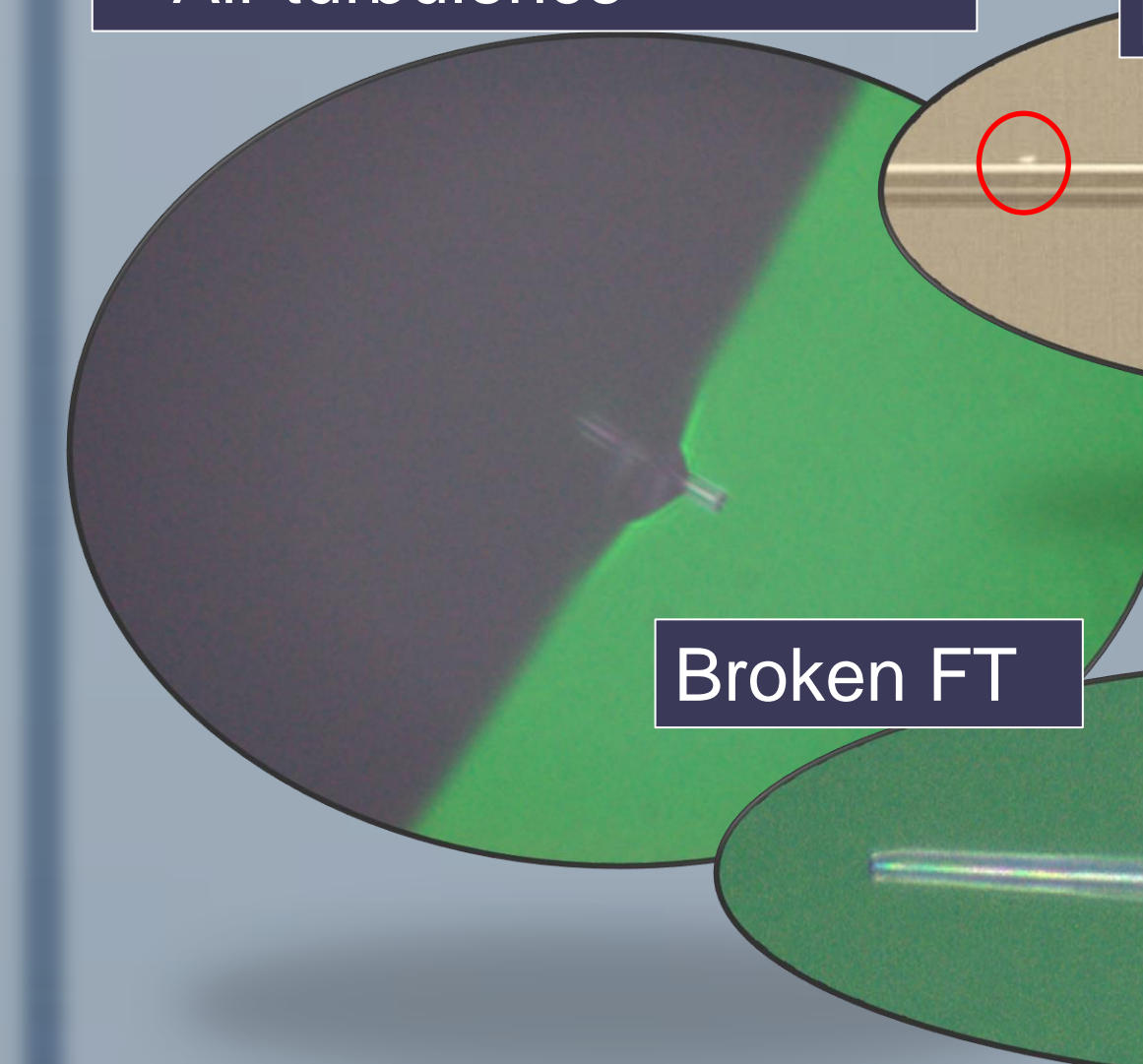


Capsule pull-outs

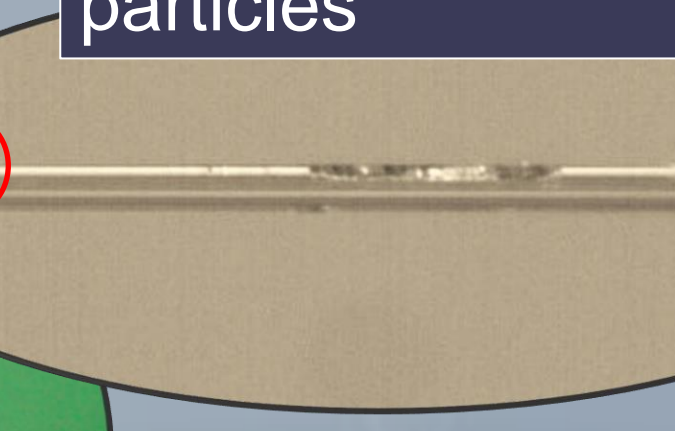


- XRF:** Sample plots of typical unplugged and plugged capsule

- CFTA Threading:** Air turbulence

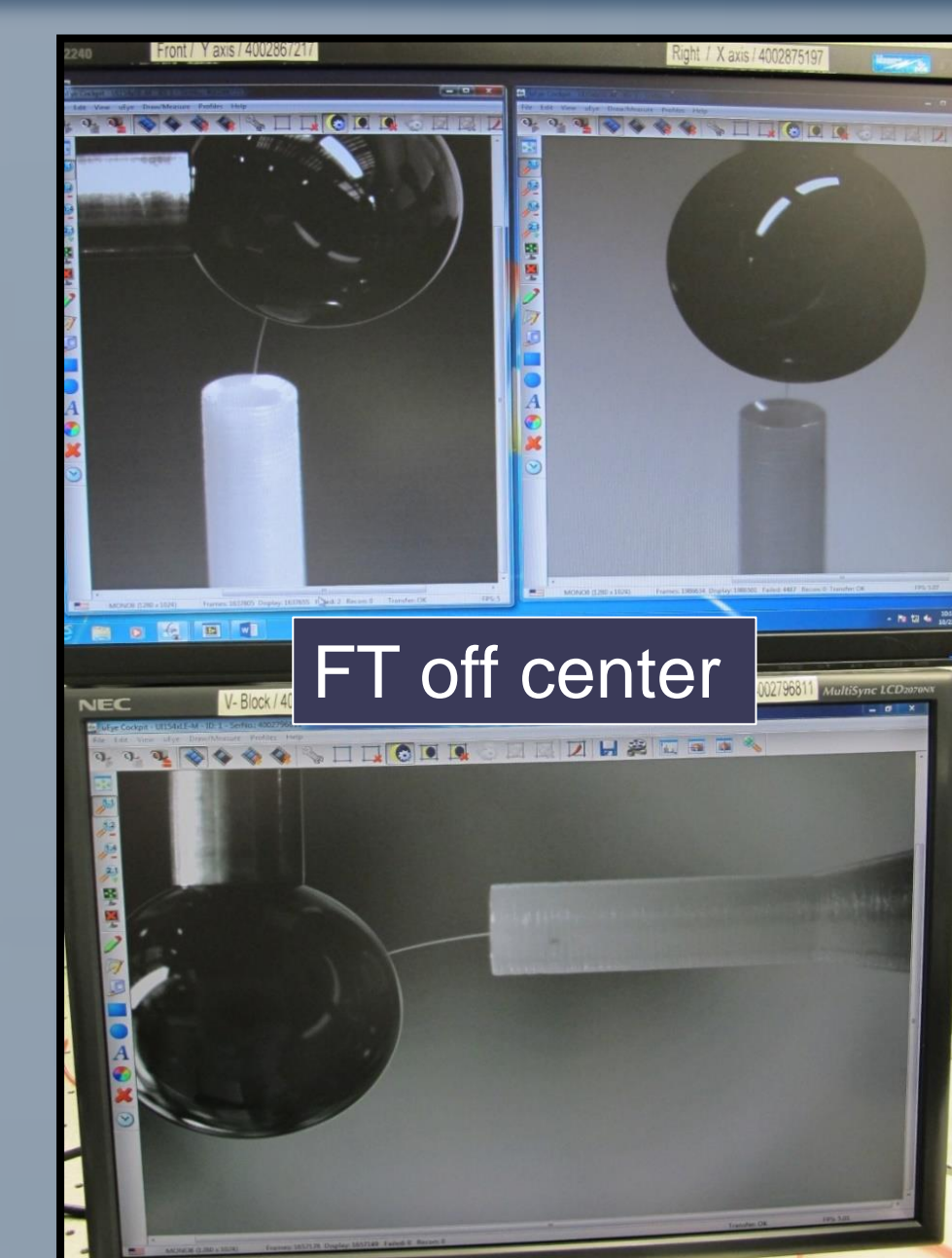


- FT contamination, particles



Broken FT

Bowed FT



FT off center