

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

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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.



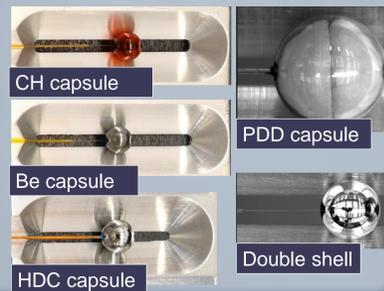
CFTA main assembly components: capsule, fill tube (FT) and polyimide sleeve attached to a VCR female fitting



CFTA installed on aluminum grooved cradle support tooling



Fill Tube and capsule close-up profile



CH capsule

PDD capsule

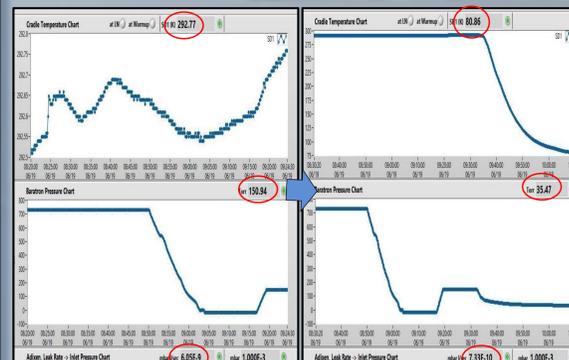
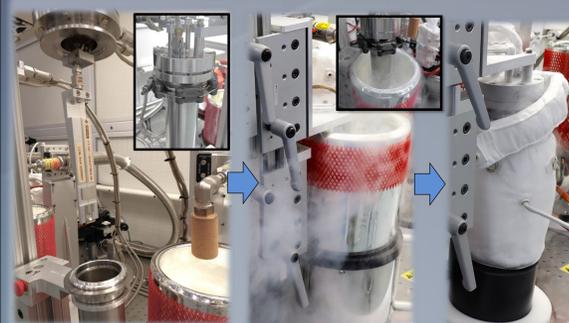
Be capsule

HDC capsule

Double shell

## Leak Test

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

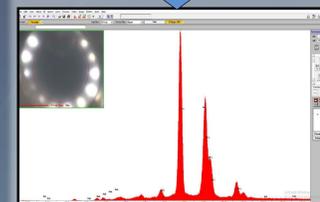


## X-Ray Florescence (XRF)

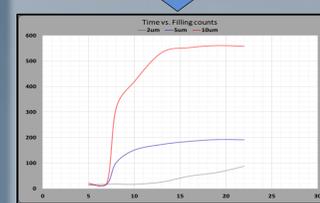
Checking for glue plugs in the Fill Tube



CFTA loaded into an XRF chamber analytical tool kit



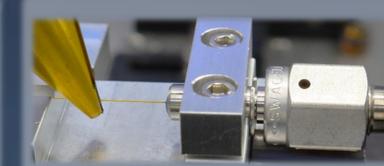
XRF spectrum signal, gas used is dependent on capsule material and dopant



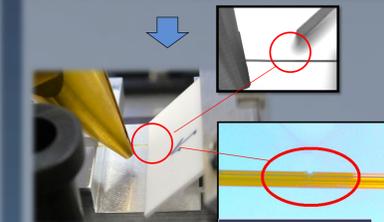
Sample plots of counts as a function of time from a 10um, 5um and 2um unplugged fill tubes (FT)

## VCR Fitting Removal

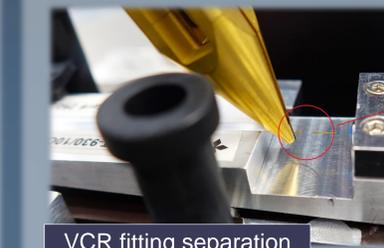
Vacuum Coupling Radius (VCR) fitting is severed after CFTA qualification tests



Securing polyimide FT prior to VCR removal



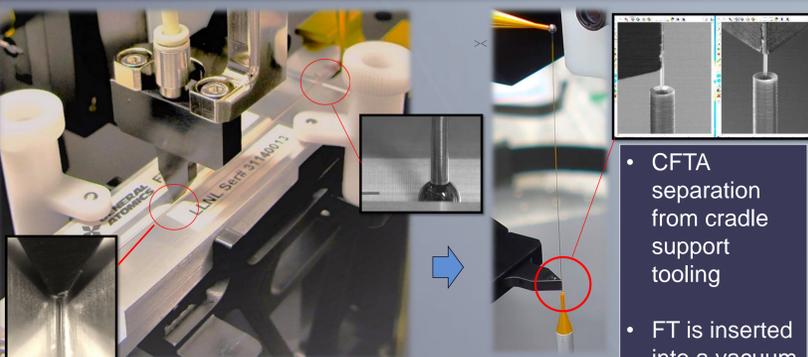
Polyimide fill tube is scoured with a ceramic blade to produce a cutting flaw



VCR fitting separation

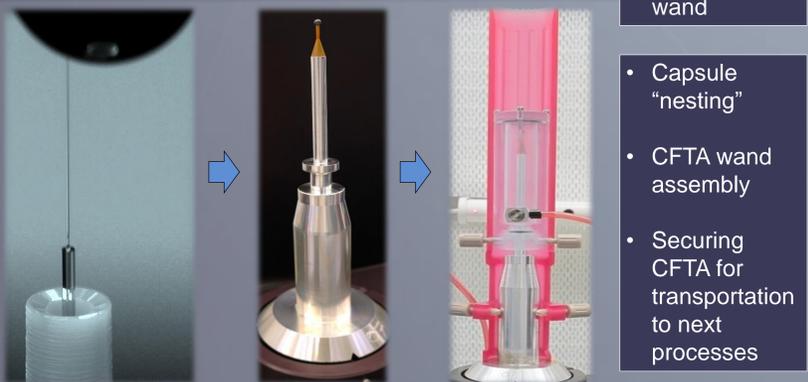
## Threading Process

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

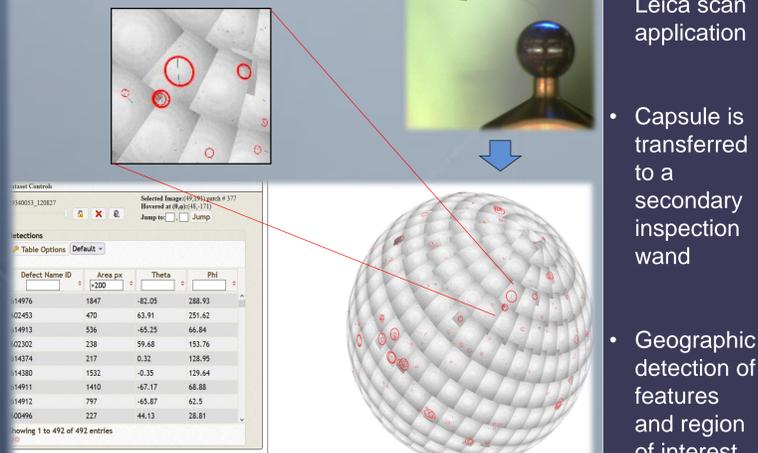
Securing CFTA for transportation to next processes

## 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



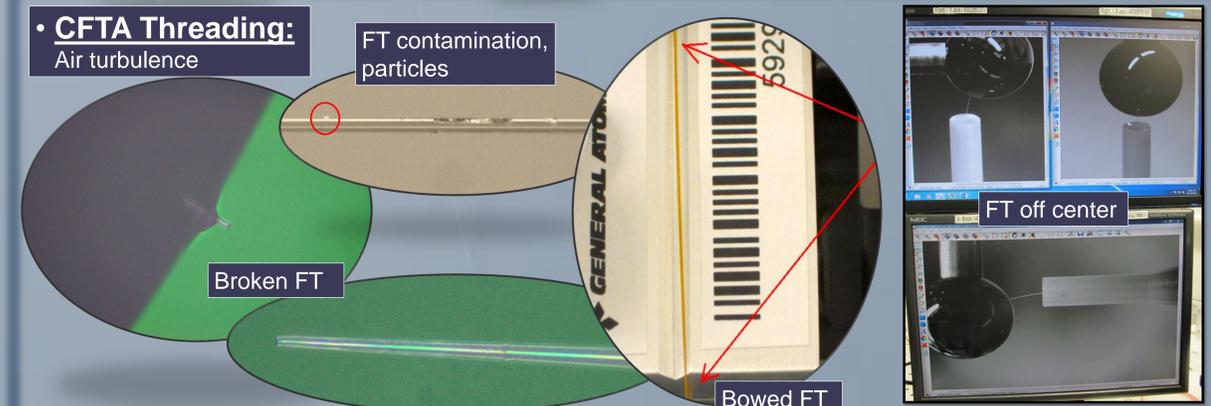
Defective Al seals

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