Window/Viewport Inspections for Navy Hyperbaric Chambers in Protected Service Environments

Ref: NAVSEA/NAVFAC-00C3-PI-006

NAVSEA
NAVAL SEA SYSTEMS COMMAND
Navy Experimental Diving Unit

EXPERIMENTAL DIVING UNIT
UNITED STATES NAVY

Background

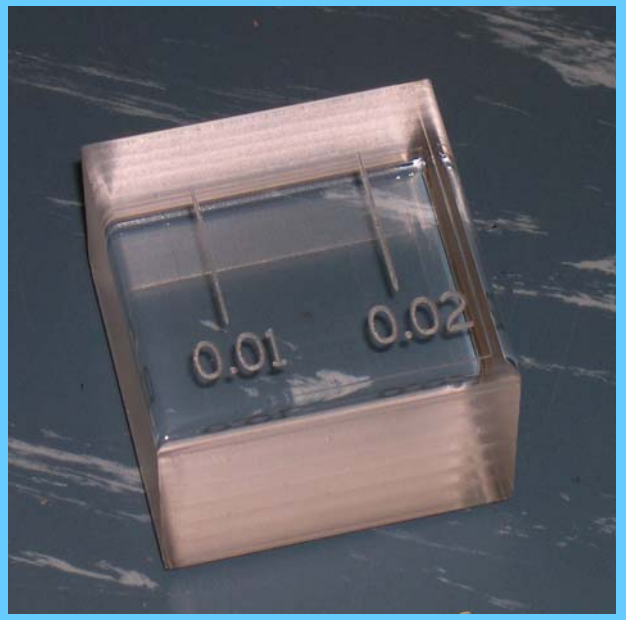
- The “window” is the clear acrylic portion of a viewport assembly
- Windows are designed to the requirements of ASME Pressure Vessels for Human Occupancy (PVHO-1) and have a high factor of safety
- Acrylic windows typically deform prior to failure, the old glass windows did not give a indication prior to failure
- NAVSEA/NAVFAC-00C3-PI-006 is a process instruction that was developed to define window/viewport inspection requirements and allow for the possible life extension of the window beyond it’s original design life

Scratch Comparator for Identifying Scratch Depth

- Comparator developed as a ‘go’-’no go’ gage
- Comparator available for checkout from:

  Jamie Kelly, Facility Mgr
  OCSF Bldg. 252
  St. Juliens Creek Annex
  Portsmouth, VA 23702
  (757) 485-6403

- Comparator to be used by dragging fingernail over scratch making a tactile comparison to scratches in windows
- 0.01 or less is the Pass criteria



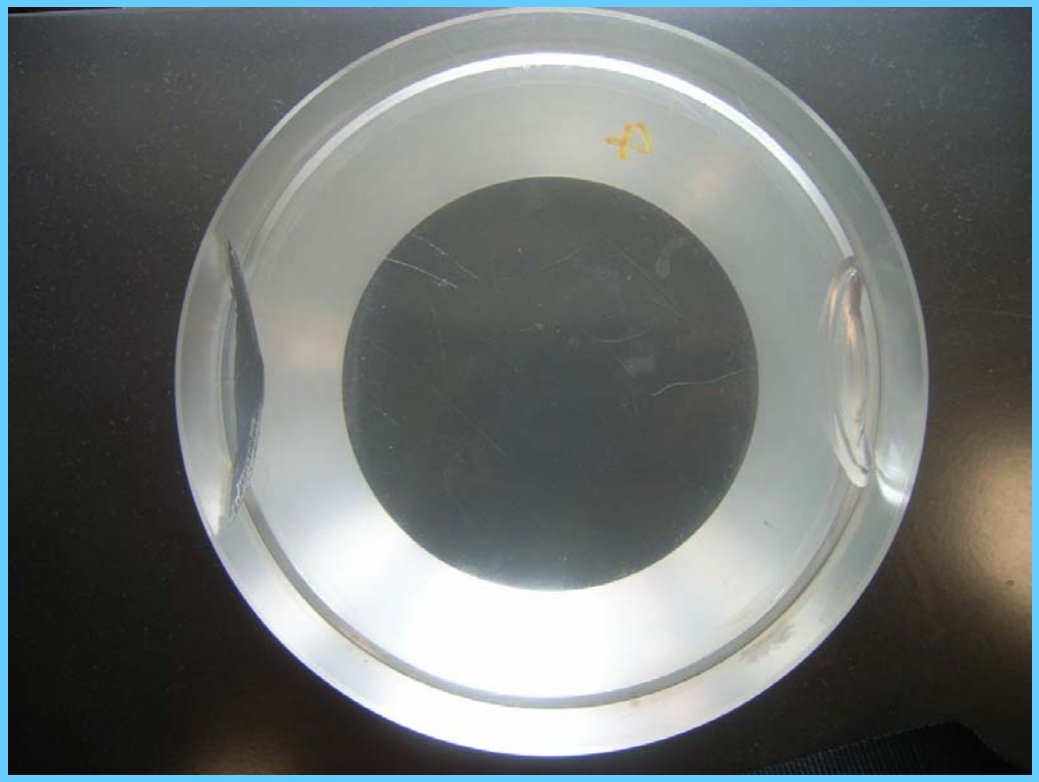
Inspection

- Windows should be inspected IAW NAVSEA/NAVFAC-00C3-PI-006 quantifying scratch depth, and the presence of fractures, crazing, discoloration, etc…
- It is recommended that the Scratch Comparator be utilized to verify ‘go’ – ‘no go’ for the scratch depth
- Fractures, crazing and cracks are best identified using a bright (white light) flashlight and illuminating the acrylic at different angles from the top, side and bottom
- As the light shines through the window the flaw will stand out as the light beam is disrupted
- Lighted inspection should be done by moving the flashlight around all surfaces of the window while tilting the window back and forth to view any flaws

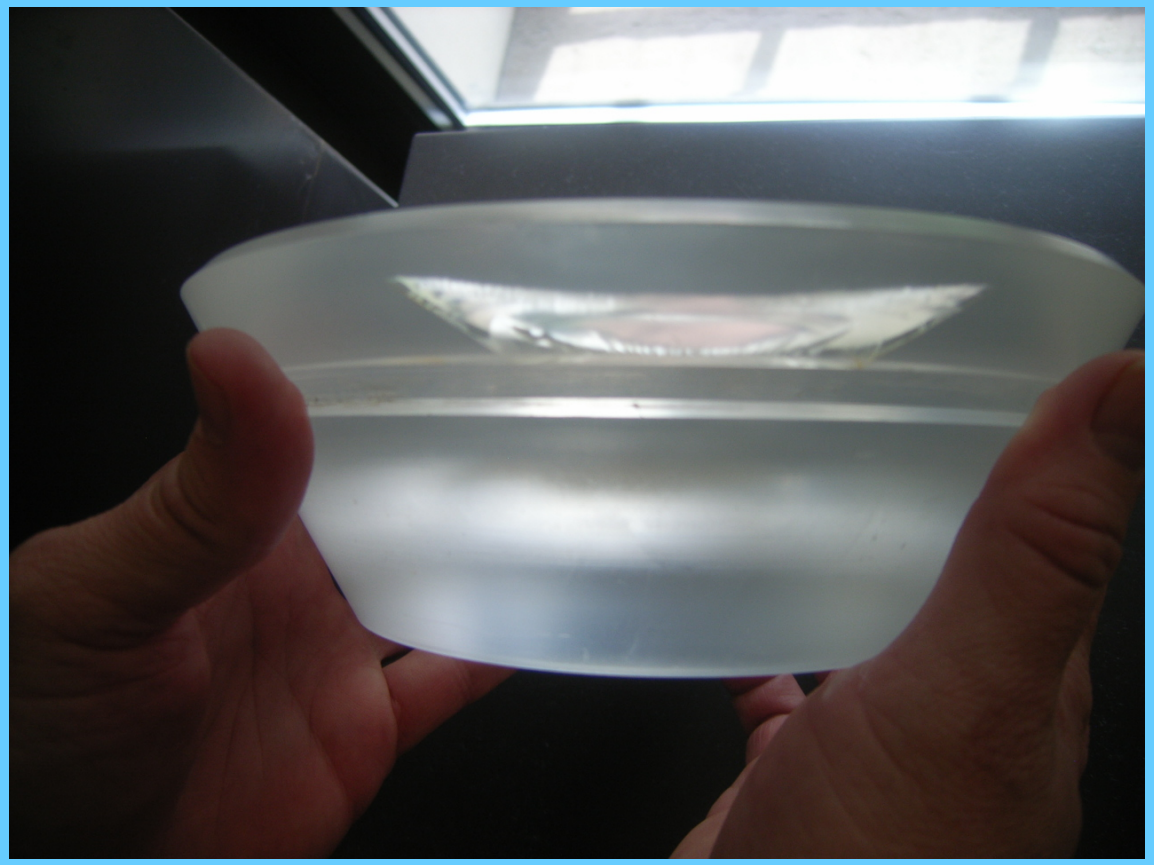
Why Inspect Windows

- Window from ex-Navy Medical Research Institute Wet Pot (Saturation facility)
- Cracks noticed in a Wet Pot window during a manned 1000 FSW Sat Dive

Note: Acrylic shards are not visible on x-rays – avoid them

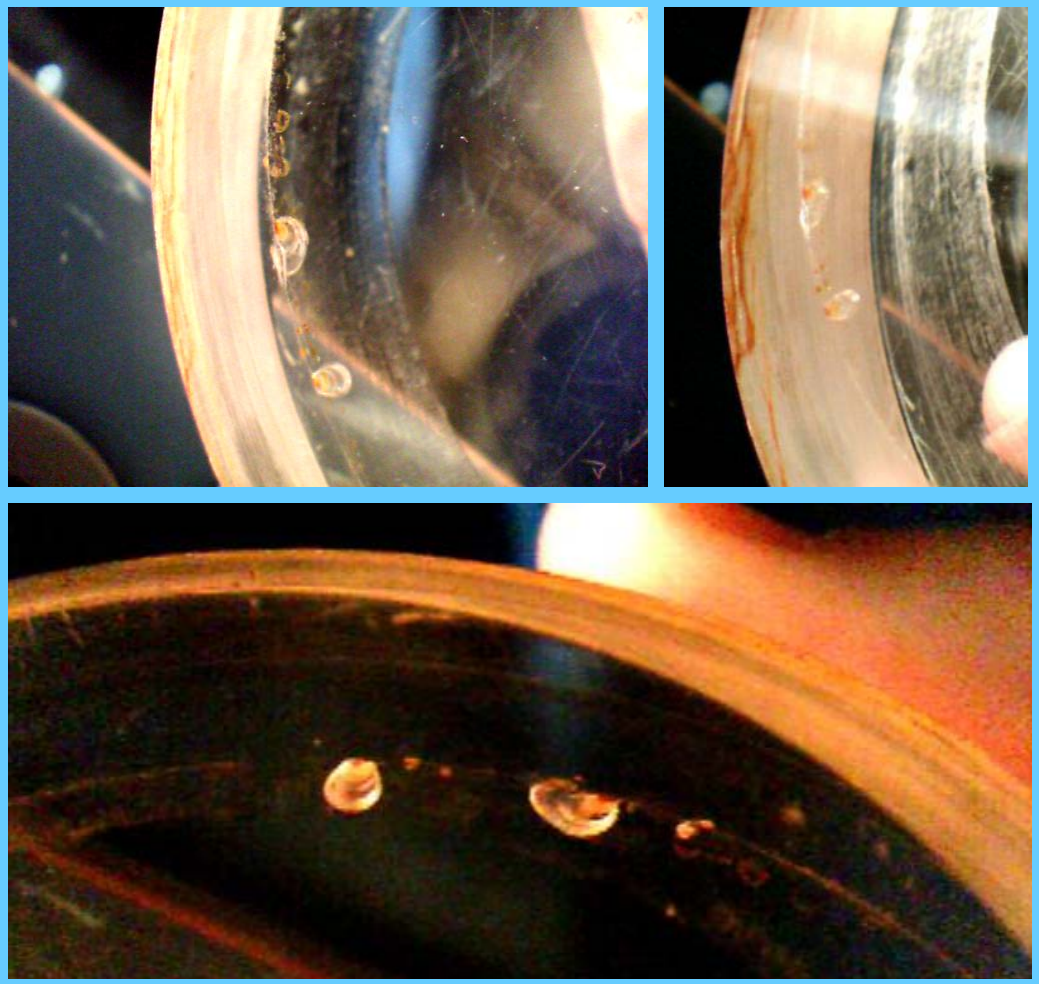


- Saturation complex split and emergent repairs made during the dive
- Note: O-ring grooves in acrylic windows are no longer used



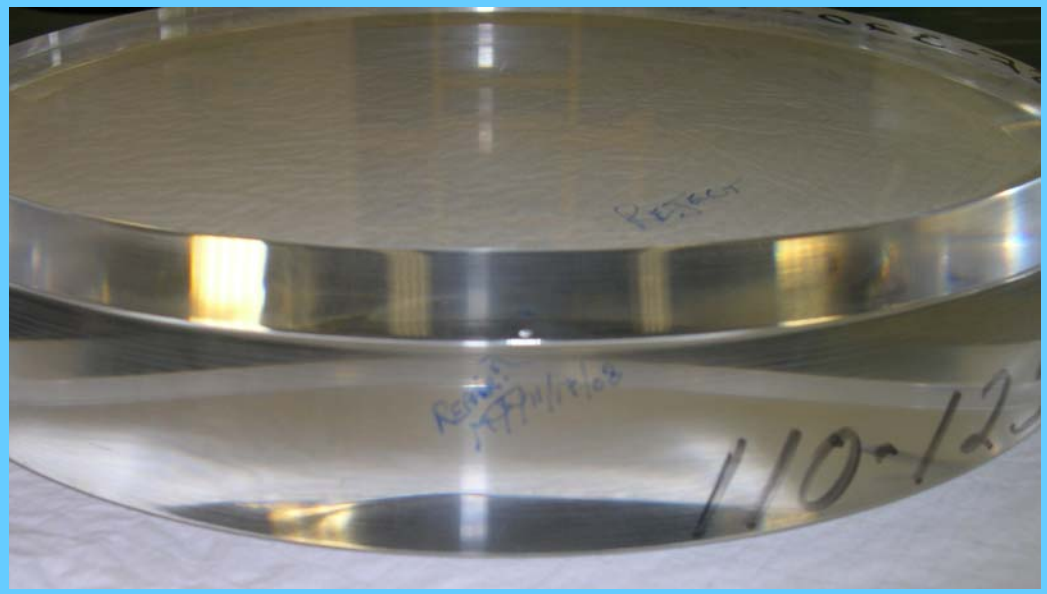
Concoidal Fractures

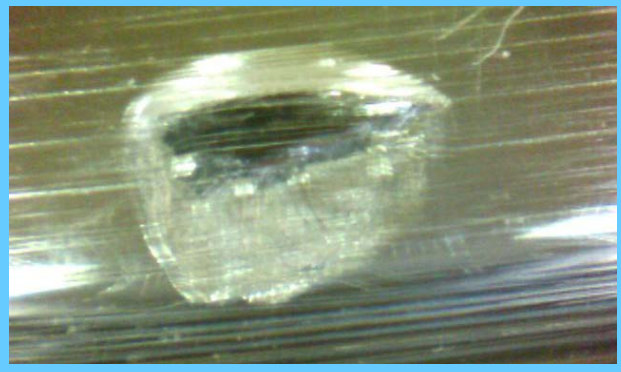
- These Fractures are inside the window or along an edge
- Appear similar to arrow head (flint) flaking



Concoidal Fracture/Chip

- Typically occurs from a mechanical impact or point loading to the edge/side of the window



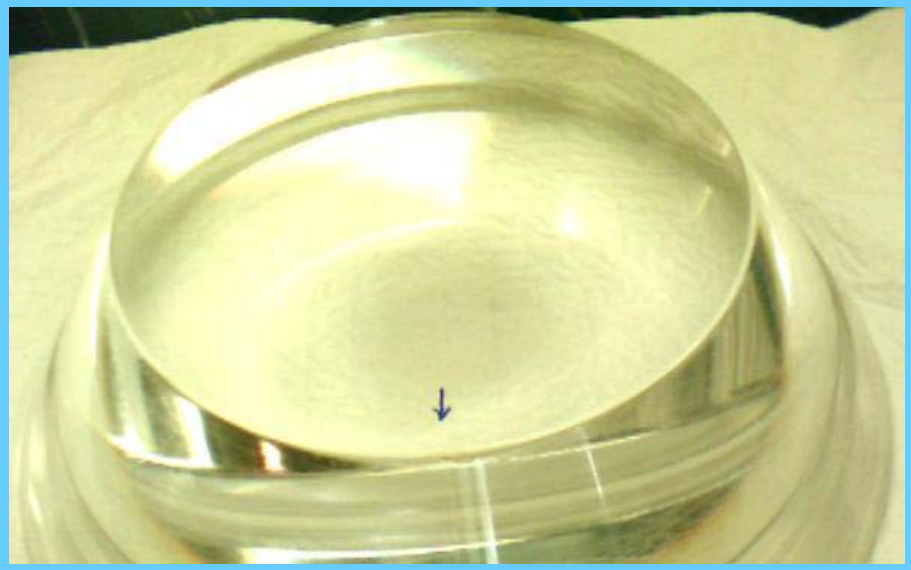


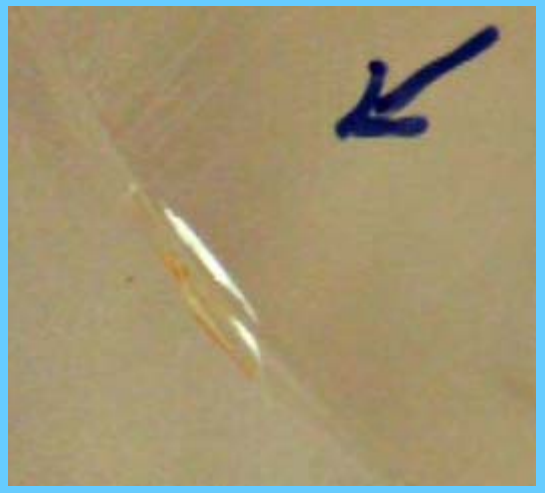
In-Plane Fractures

- Sub-surface fractures
- Probable cause is point loading

In-Plane Fractures

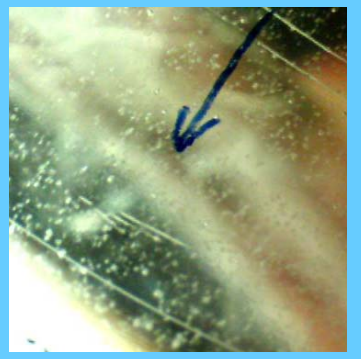
- In plane fractures on edge of window. Note that scratches are within specifications.





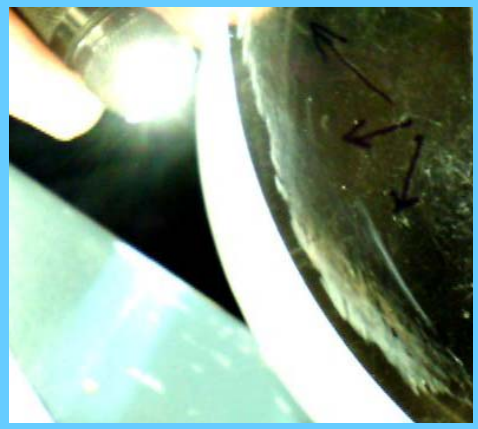
Discoloration, Scratches, and Heavy Pitting

- Pitting may be caused from transfer of mating surface roughness to window under load



Crazing

- Crazing is micro cracking that can occur on the window’s surface or sub-surface



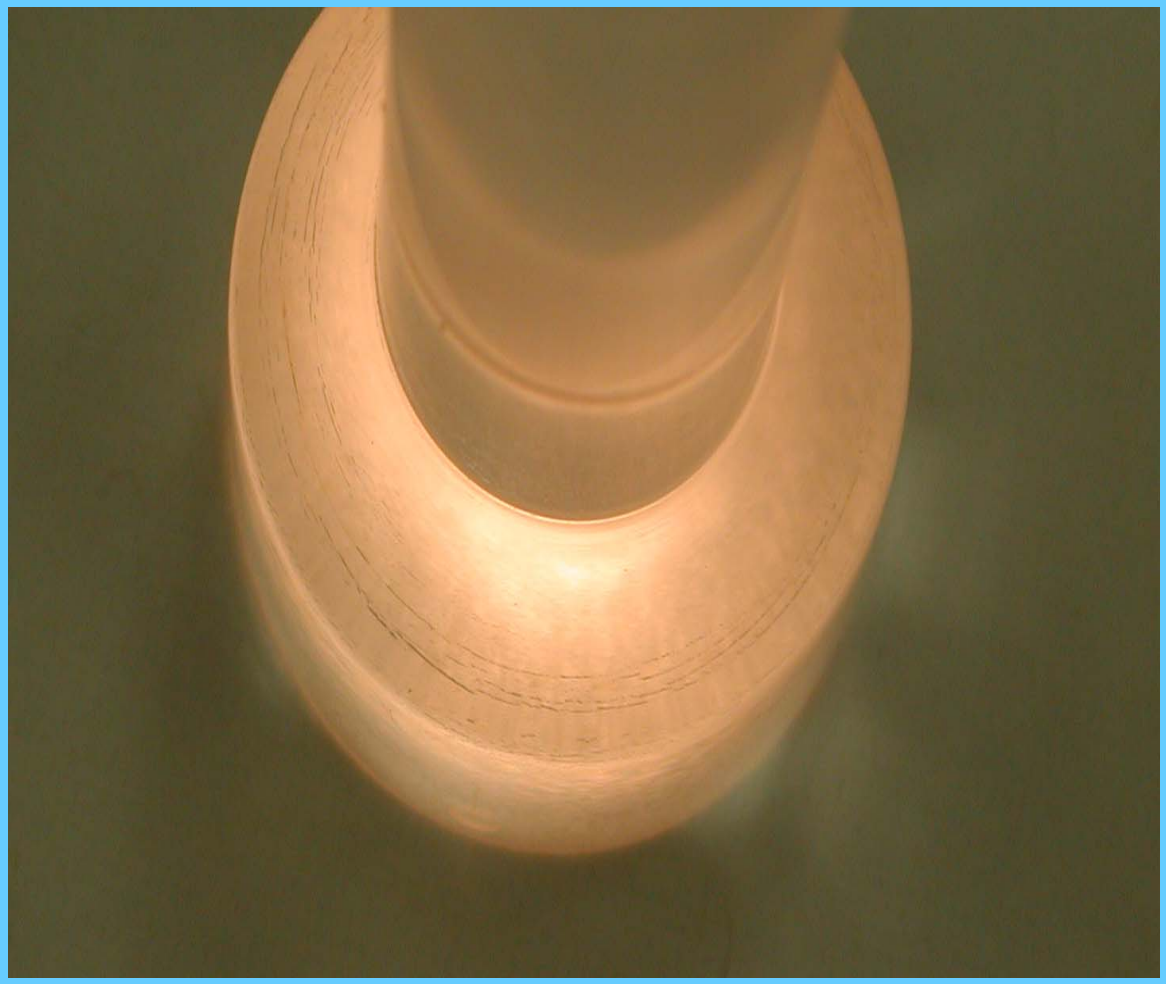
Causes of Crazing

- Unbalanced stresses, either applied or residual tensile stress
- Temp differential across the thickness of the acrylic window
- Weathering
- Sorption (uptake) and desorption of moisture generating surface stress
- Contact with organic solvents (unapproved cleaners and chemicals)

Crazing

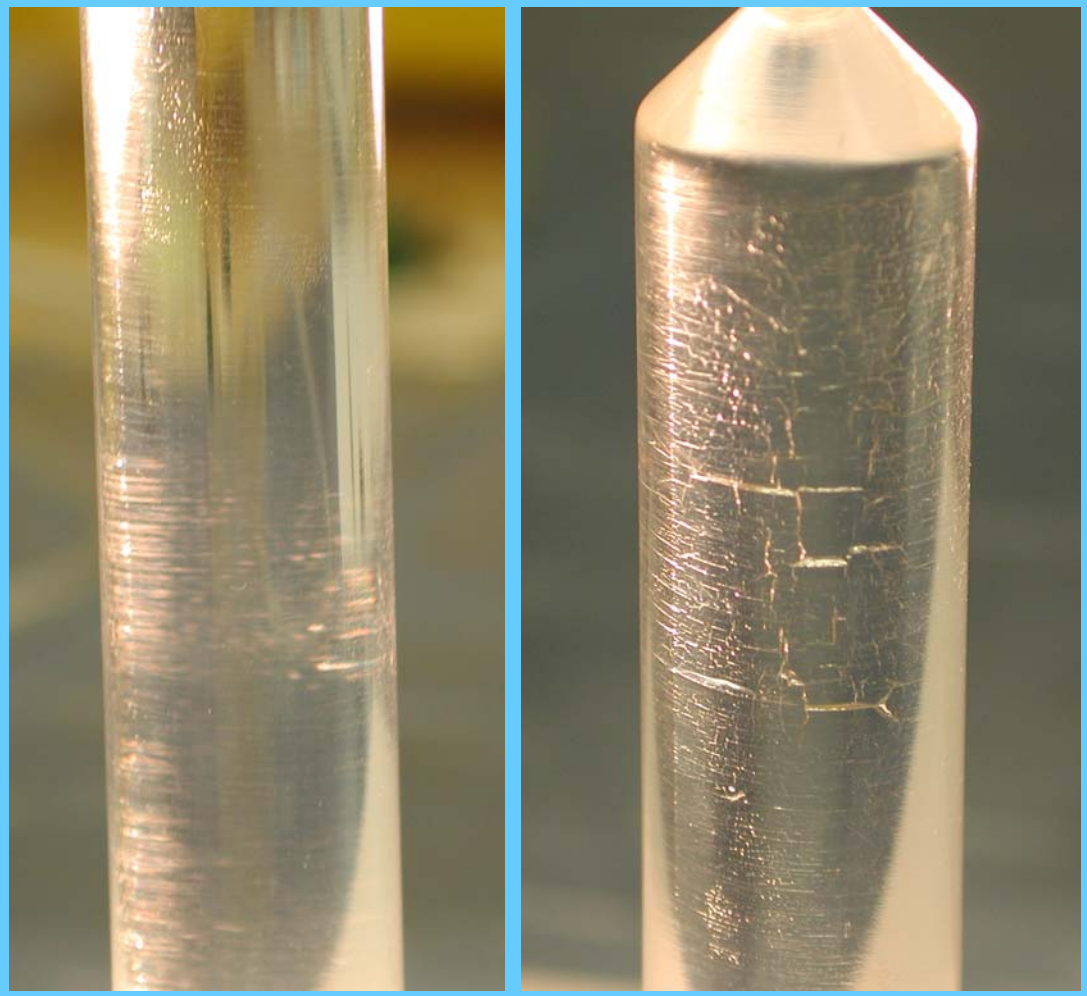
Crazing on Light Pipe

- Circular crazing caused at O-ring contact point.
- Probable cause localized stress with chemical reaction



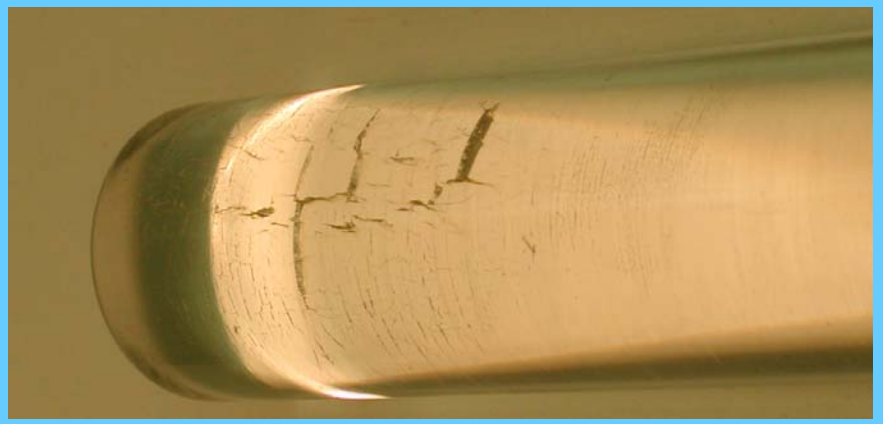
Crazing on Light Pipe Shaft

- Probable cause chemical reaction (cleaners)



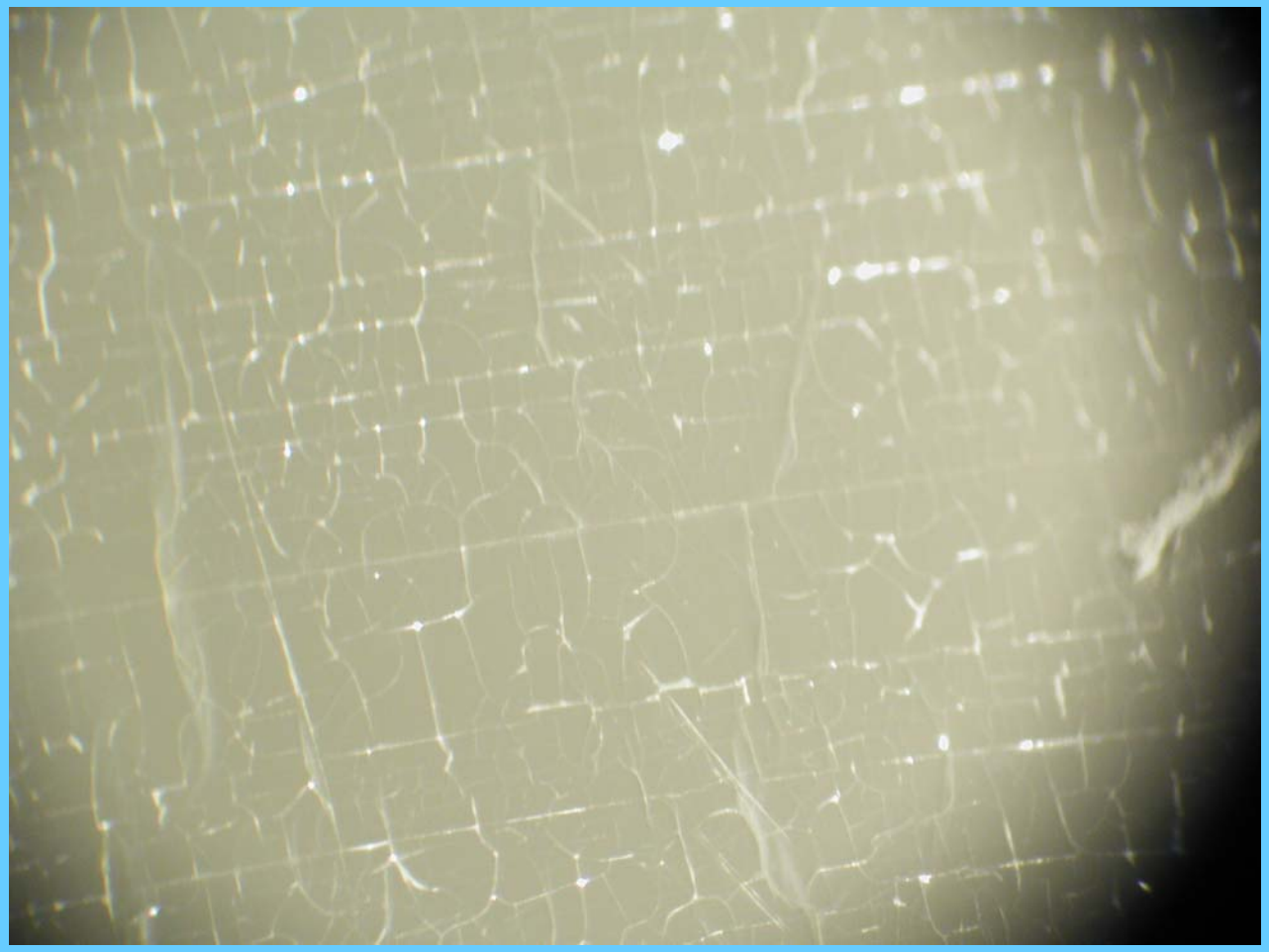
Crazing on Light Pipe

- Some crazing can be fairly deep



Close-up of Deep Crazing

Surface Crazing



Conclusion

- Window/Viewport inspections need to be meticulous
- A Window Maintenance Inspection Form (NAVSEA/NAVFAC-00C3-PI-006 Appendix A) needs to be completed for each window
- If the window inspection reveals anything questionable contact your appropriate System Certification Authority (SCA) for clarifications