Refuge Alternative Examinations, Approvals, and Refits

Stakeholder Meeting-MSHA HQ

June 27, 2012

History

- Initial fitting failure in January 2011 at Sentinel mine.
- Alerts published January 25th, February 10th and November 4th, 2011.
- Sherry Labs conducted analysis following a second fitting failure at Flint Ridge mine.
- MSHA sent fittings for analysis to OSHA laboratory.
- Both laboratories identified stress corrosion cracking (SCC).
- OSHA laboratory indicated brass fittings are on path to failure.
- Dimensionally incorrect fittings are also problematic.

October 14, 2011 WVOMHS&T Order

- Responds to determination that brass valves and fittings are subject to corrosion and cracking over time in underground coal mining environments and that some fittings are not appropriate for use with 4500 psi cylinders.
- Mandates examination of existing valves and fittings and determination about ability to remain in service until replacement with alternative type of valve and fitting.
- The examinations were to include physical examinations designed to detect signs of corrosion, stress-corrosion cracking, and dimensionally incorrect fittings.
- Mandates replacement of brass valves and fittings with pieces that are not subject to corrosion or cracking.
- Creates reporting requirements for refuge manufacturers and mine operators to include number of brass fittings and valves examined and a listing of the above deficiencies.
- Contemplates that breathable air, harmful gas removal, and air monitoring components will have current MSHA approvals when the fittings and valves are replaced and before the units are placed back into service.

MSHA Policy -- PPL P11-V-17

- Acknowledges the problem and the ultimate solutions consistent with the manner that WV did in its October 14 Order.
- Recognizes that currently most refuge units in use are approved by the State of WV and accepted by MSHA in ERP plans.
- The ultimate goal is the replacement of existing brass valves and fittings with valves and fittings not subject to corrosion and cracking AND transition to MSHA approved breathable air, harmful gas removal, and air monitoring components by the December 31, 2013 deadline.

Implementation Stages:

- Step 1: Examination of Refuge Units to Ascertain Damage to Valves & Fittings and to Measure Fitting Dimensions.
- Step 2: Determine whether Existing Valves and Fittings are Safe and Reliable for Use until Non-Brass Fittings and Valves are Commercially Available. If Not, Remove Unit or Replace Existing Fittings and Valves.
- Step 3: Establish a Schedule for Replacing Brass Fittings and Valves
- Step 4: Replace Brass Fittings and Valves and upgrade to MSHA part 7 approved components.

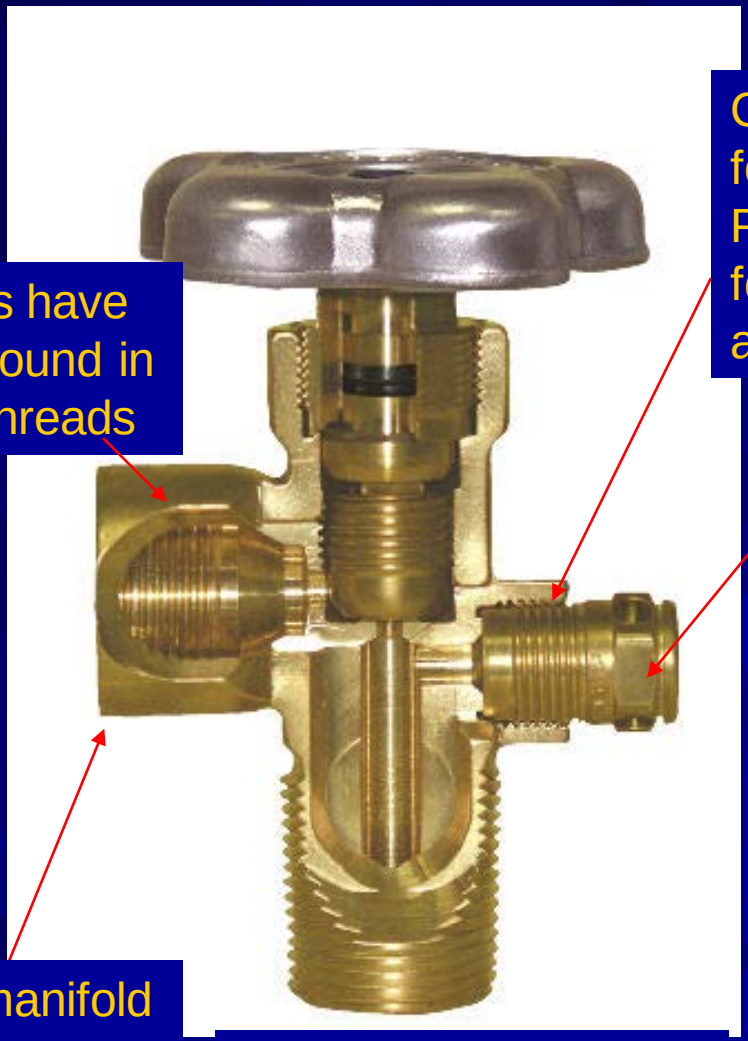
Refuge Alternative Manufacturer Examination Results so Far…

- Several manufacturers have not completed the required examinations.
- Very few cracked valve and corrosion issues have been reported.
- Hundreds of dimensionally incorrect fittings have been reported.
- When deficiencies were indicated on the manufacturer reports, either the unit was taken out of service or a letter was provided stating that it was safe to remain in service until refit.
- On June 14, 2012 MSHA and WV held a meeting with refuge manufacturers to discuss their examination results

MSHA and WV follow-up

- MSHA and WV stated in August, 2011 at the manufacturer meetings in Charleston that we would conduct follow-up evaluations to check the quality of reporting.
- To date four different brands of refuge alternatives were inspected at four different mines. Additional evaluations are planned.
- The results of the follow-up evaluations revealed deficiencies that were not reported in the original manufacturer examination reports.
- Where present, corrosion and water accumulation were immediately evident.
- MSHA used a borescope with video recording capability to conduct and document the evaluations, however cracks and corrosion were evident without the use of this tool.
- Inspection mirrors with adequate lighting would have been sufficient to detect cracked valves.

Common Valve Section Indicating Crack Locations



Cracks have been found in CGA threads

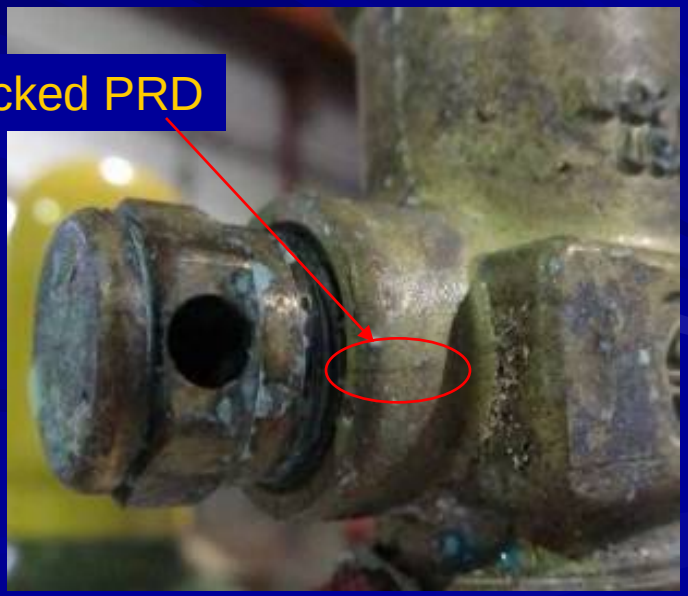
Cracks have been found around PRD boss on forging part line and at 90°

Pressure Relief Device (PRD)

To manifold system

Threaded into cylinder

Cracked PRD

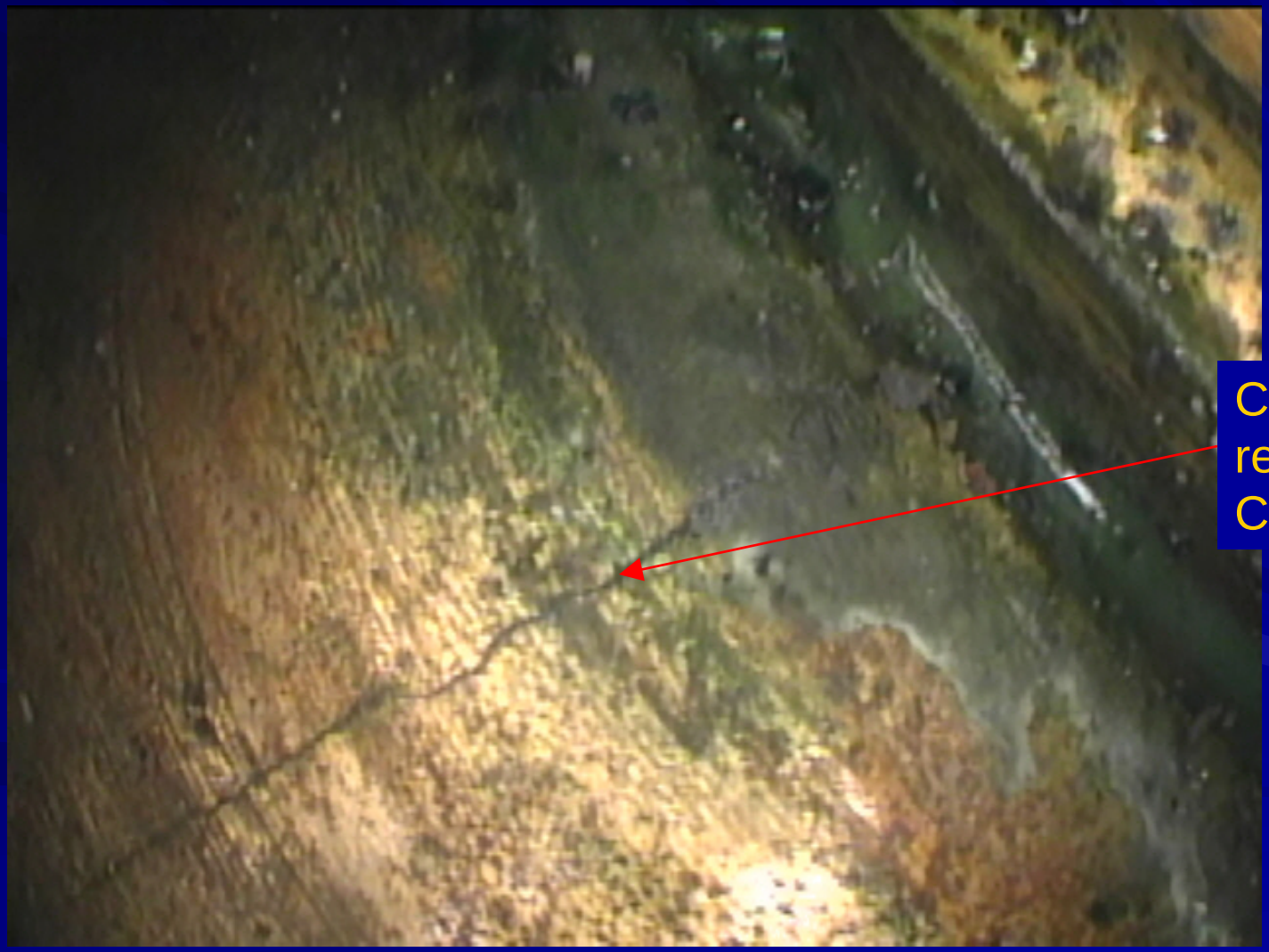


Fitting Dimensions and Crack Locations

CGA 701 Fittings have been found with incorrect dimensions

Cracks have been found on rear face and hex flats

Example of cracks found during follow-up evaluations



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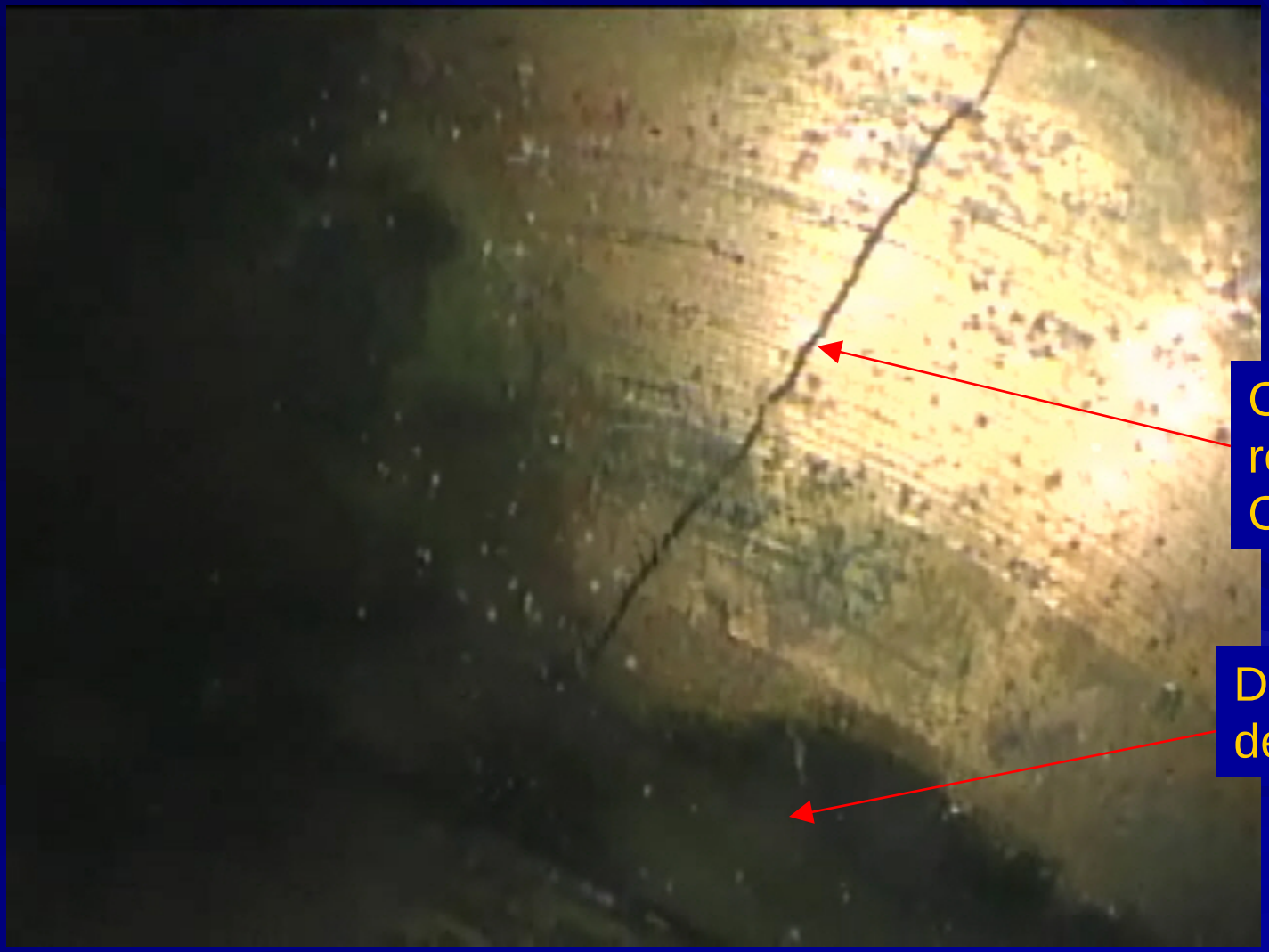
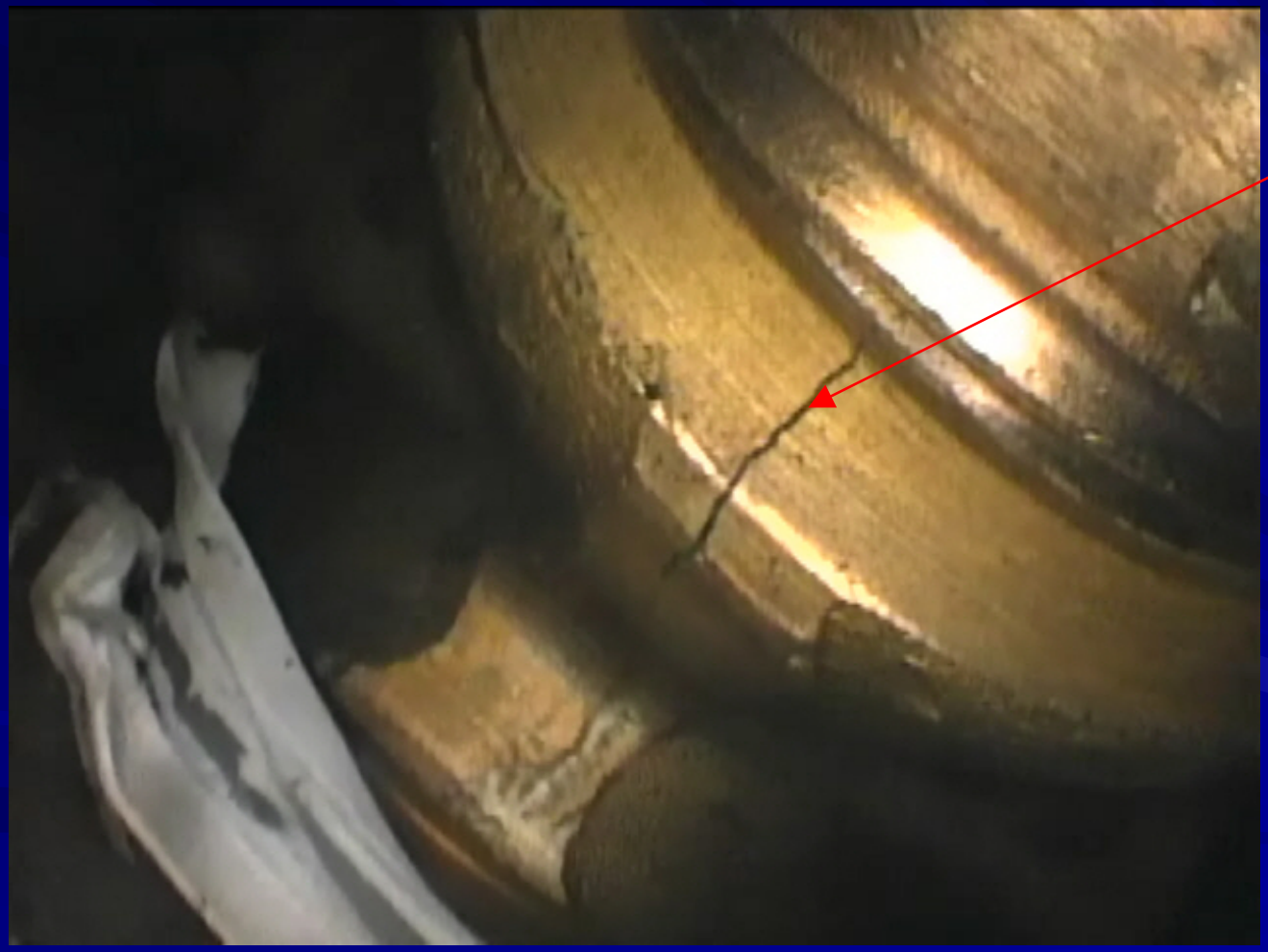


Example of corrosion found during follow-up evaluations

Corrosion and reddish dezincification are apparent on these fittings and valves

Example of cracks found during follow-up evaluations



Crack around PRD boss (view looking down onto PRD)

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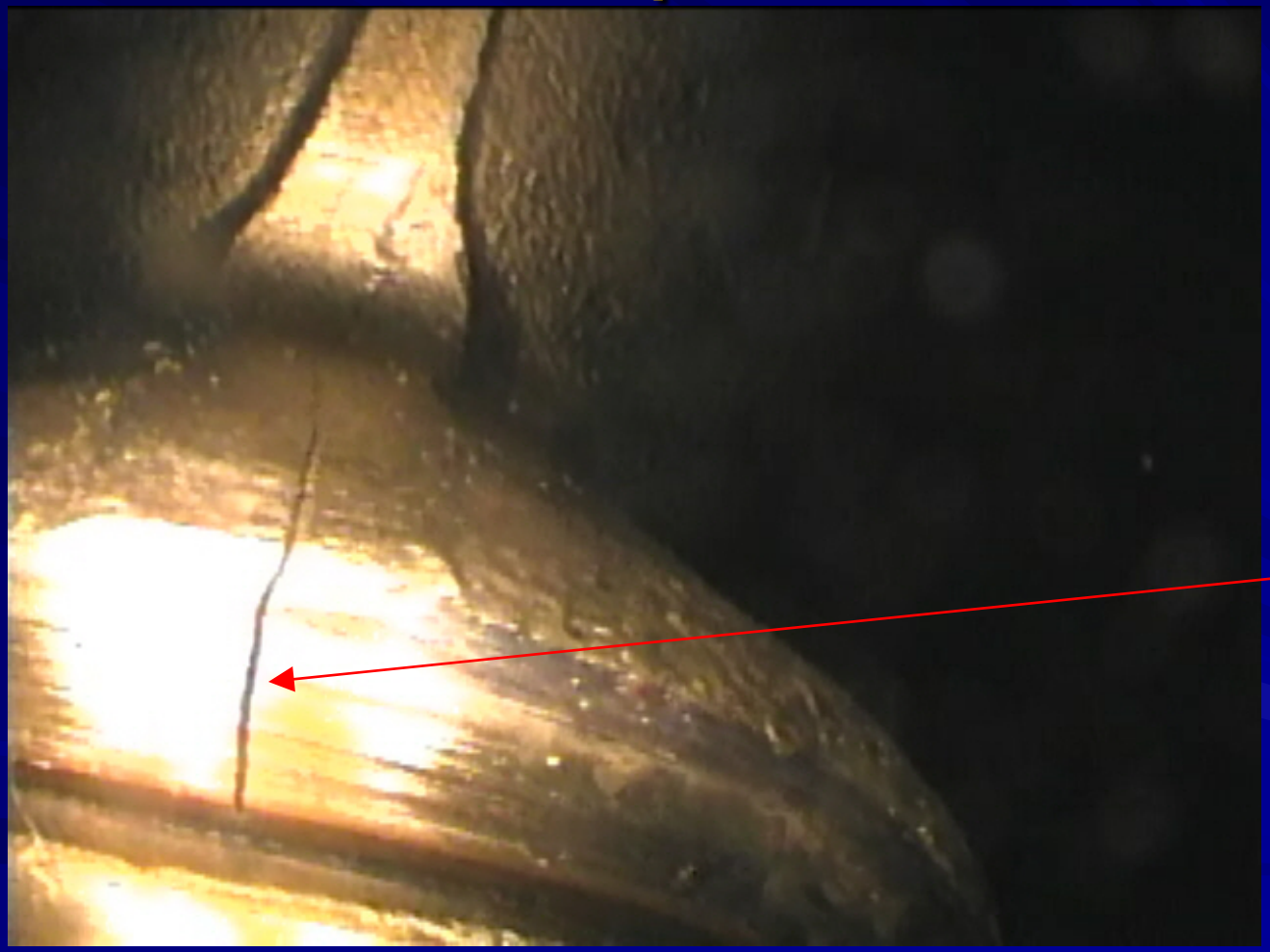

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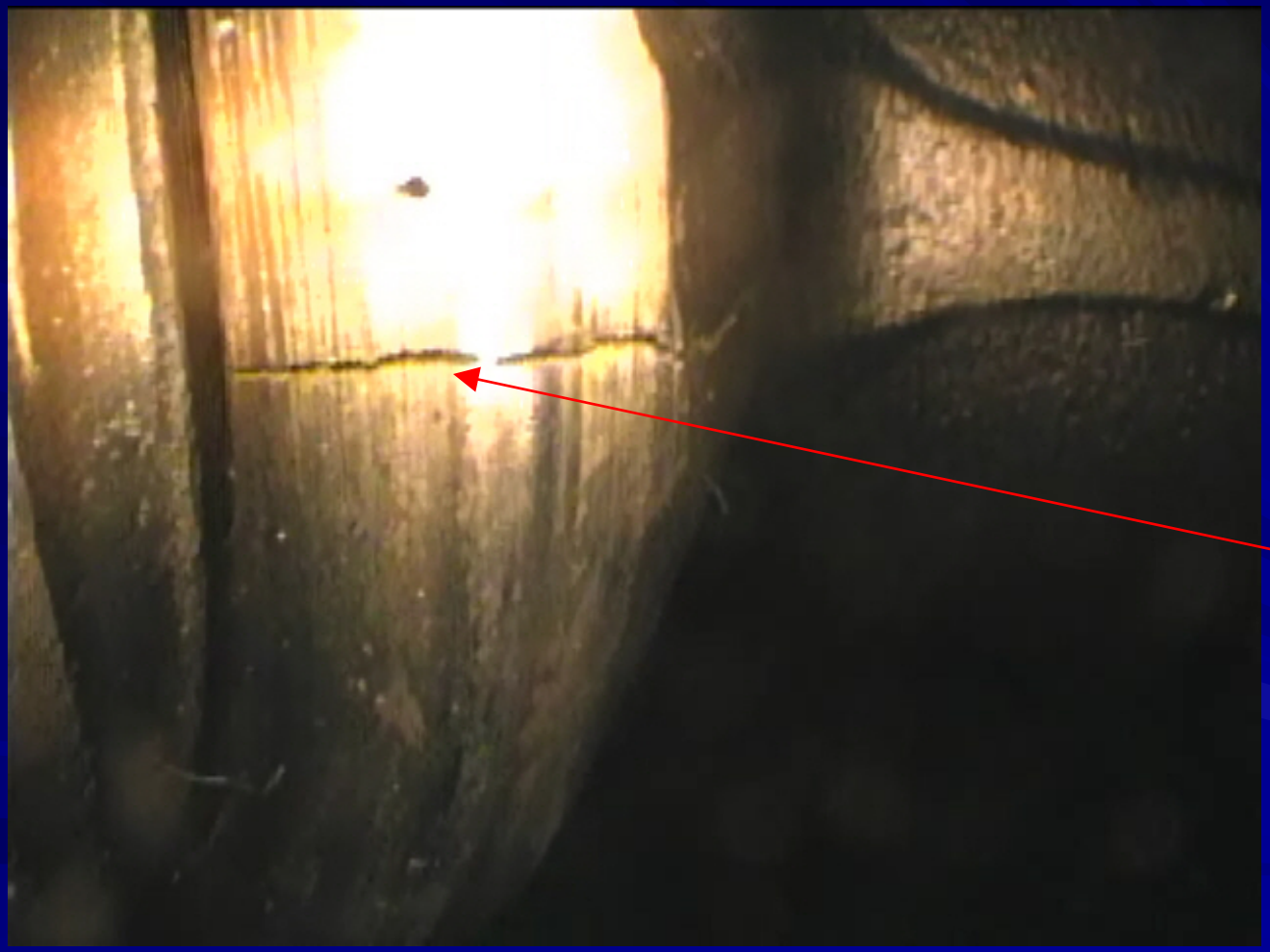

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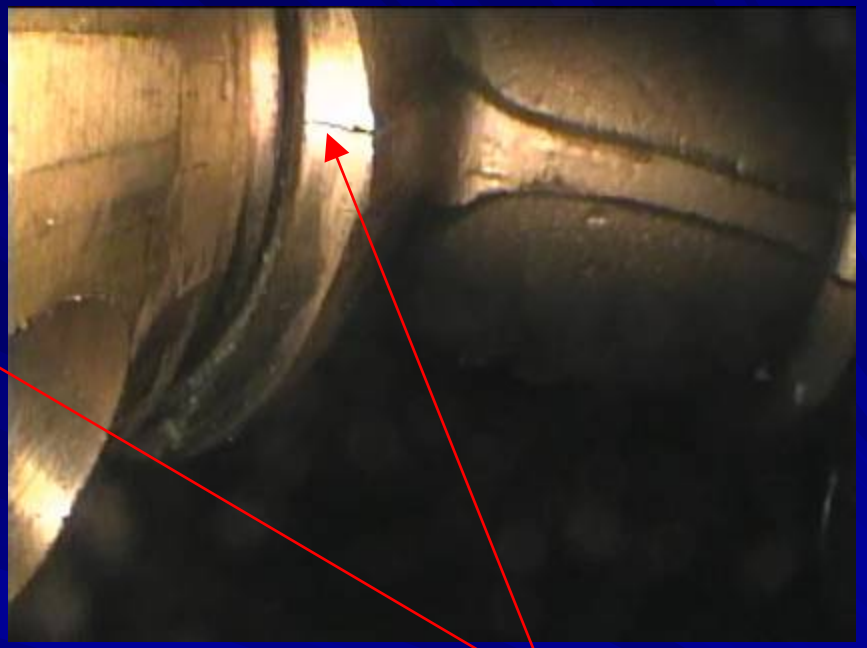

Two cracks were found on this cylinder valve

Crack around PRD boss (view looking down onto PRD)

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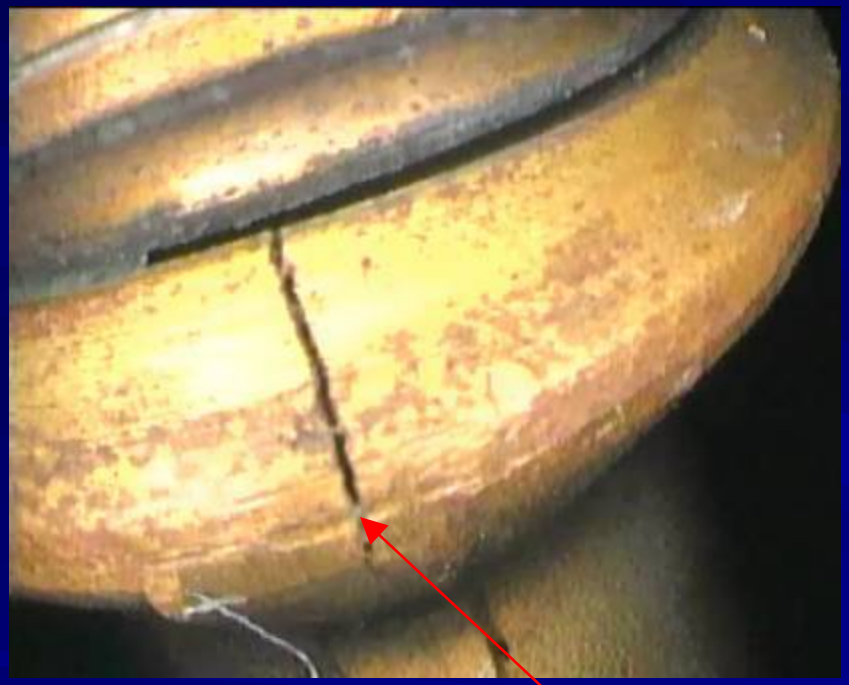

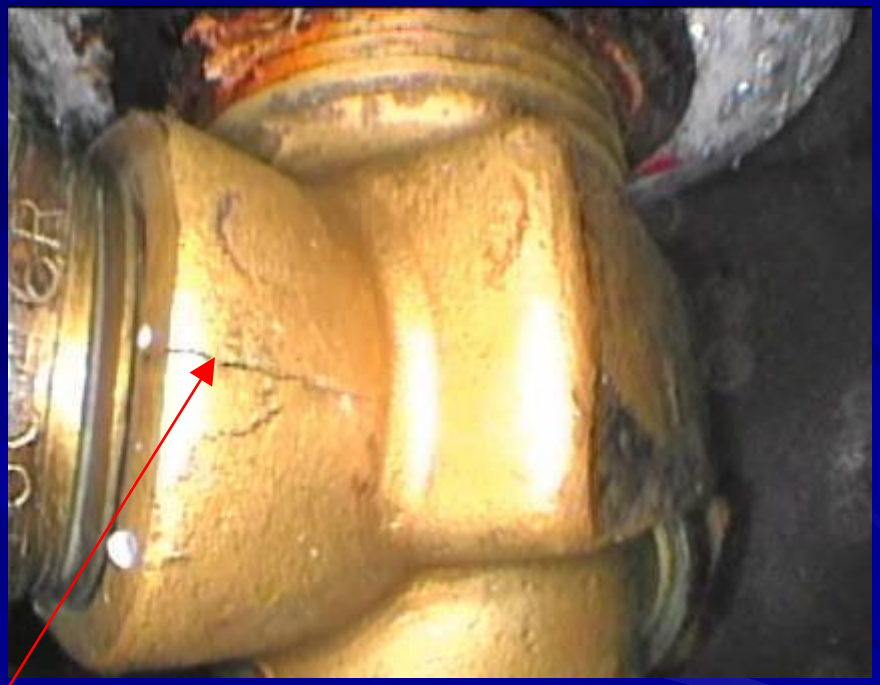

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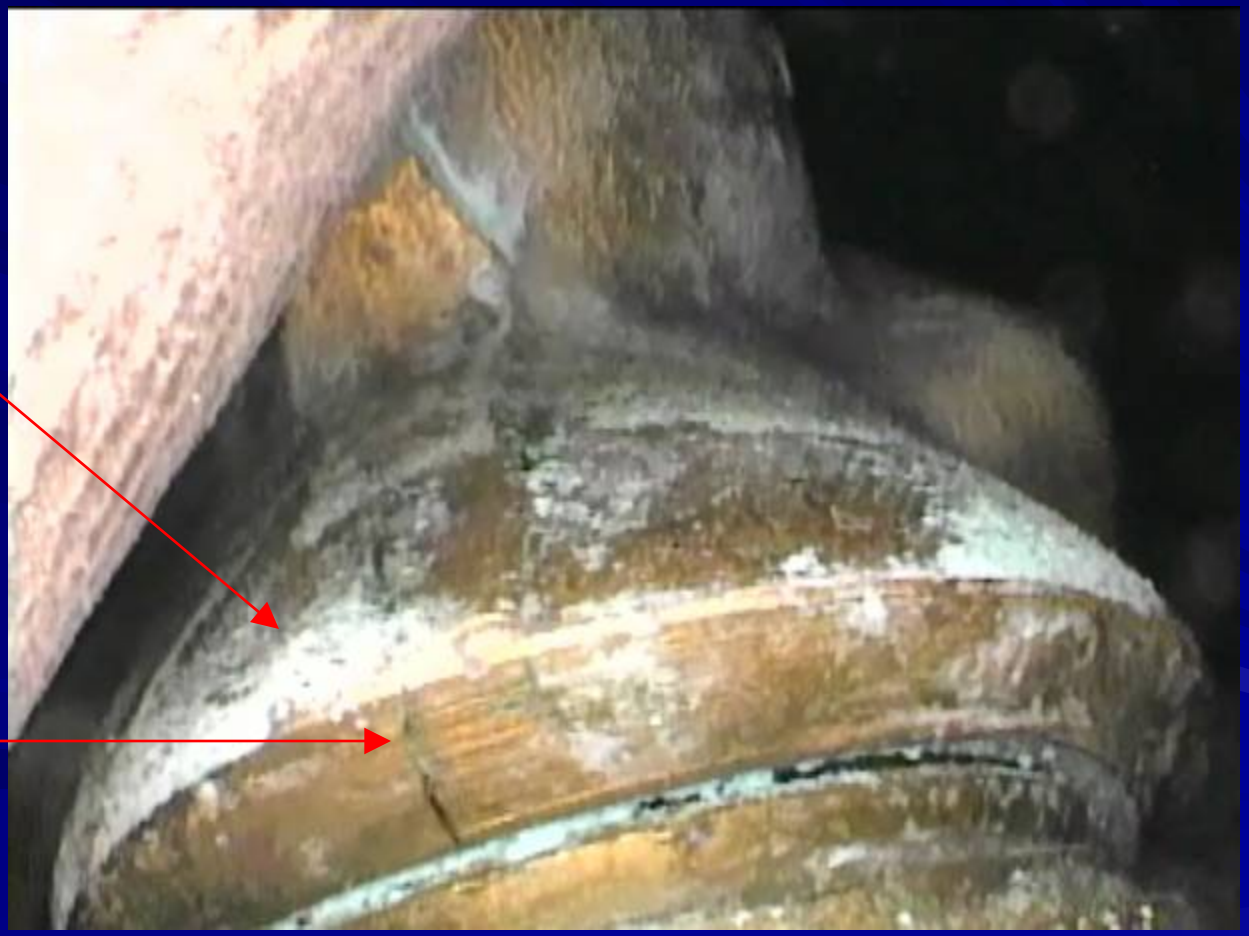
Example of crack and corrosion found during follow-up evaluations

Note white corrosion that was not indicated on examination report



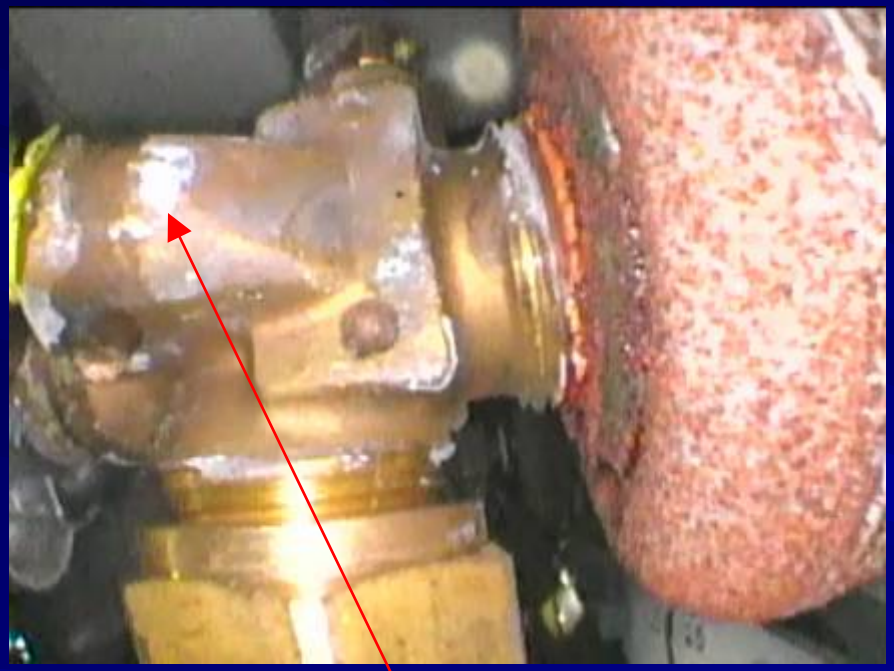
Crack around PRD boss (view looking down onto PRD)

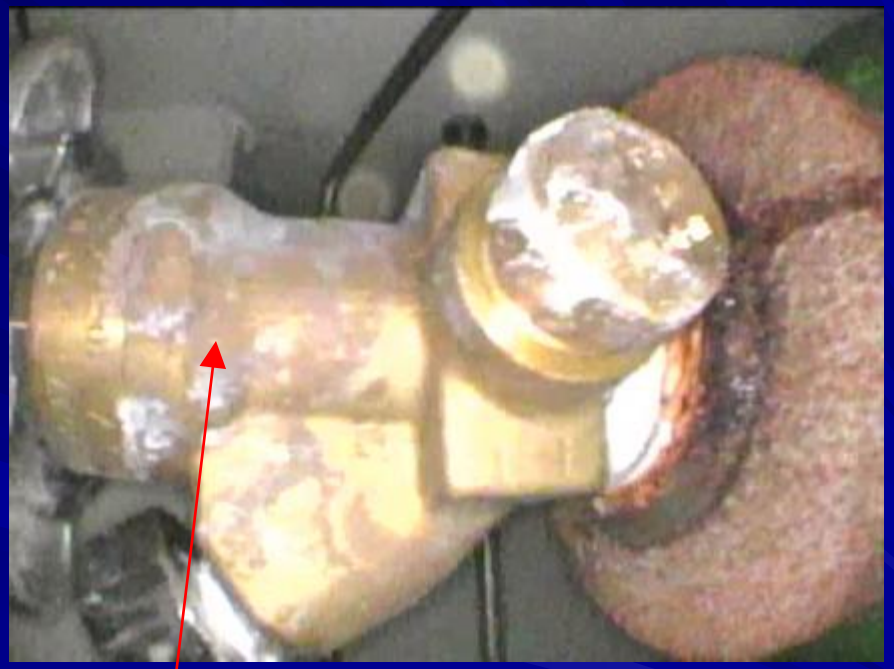
Example of corrosion found during follow-up evaluations

White corrosion is readily visible. This type of corrosion indicates the presence of zinc oxide, which means that the zinc is coming out of the brass matrix, a condition called dezincification.

This condition may lead to stress corrosion cracking.

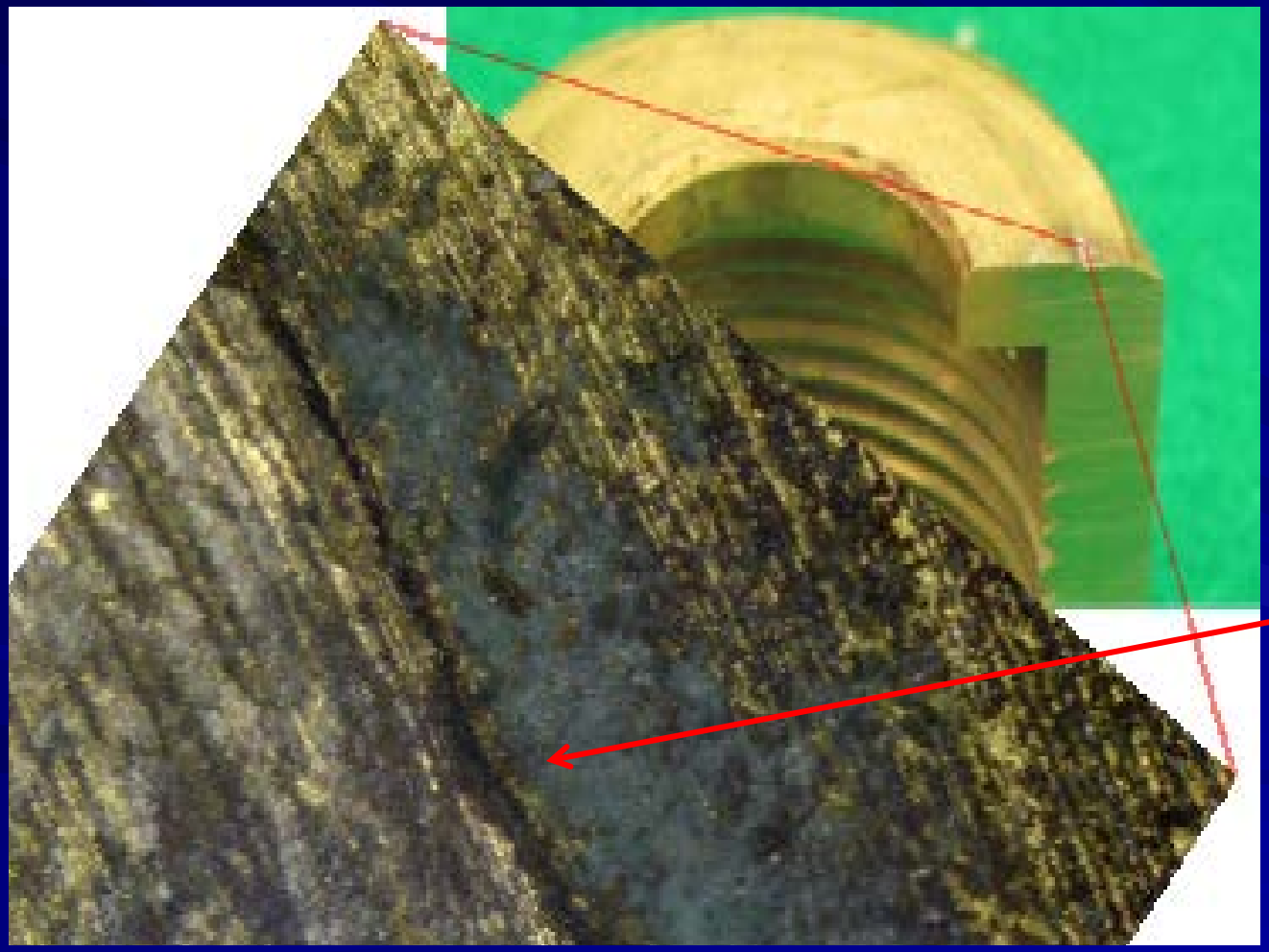
Example of corrosion found during follow-up evaluations





White corrosion is visible along with red discoloration indicating dezincification

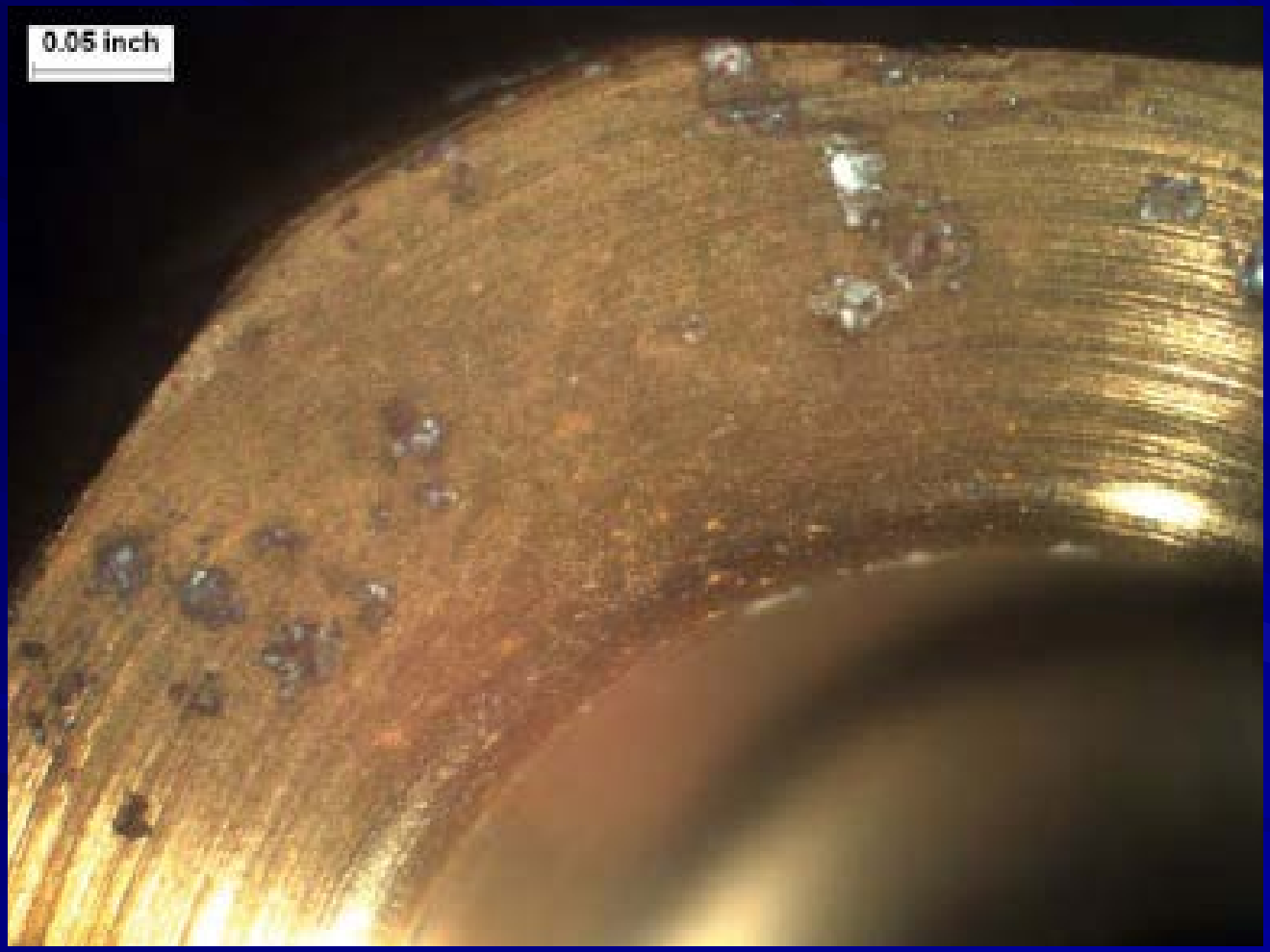
Example of SCC found during initial evaluation



Corrosion formed on surface

Note that on magnification cracks are forming

Example of SCC found during initial evaluation



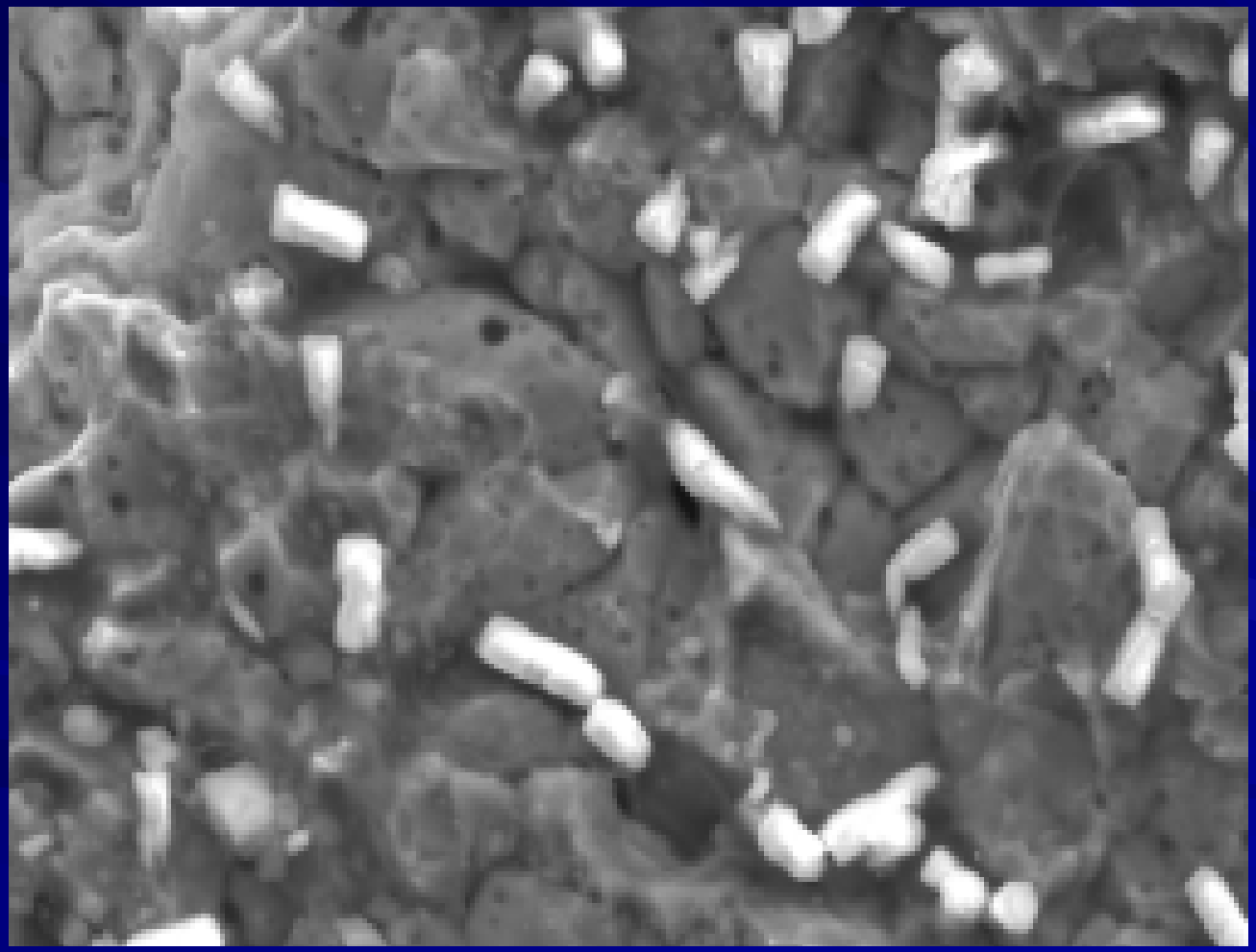
Corrosion forming on surface of otherwise shiny brass

Example of SCC found during initial evaluation

Corrosion formed on surface

note the pitting

Example of zinc oxide found during initial evaluation



Zinc oxide formed on brass leaving spongy copper metal

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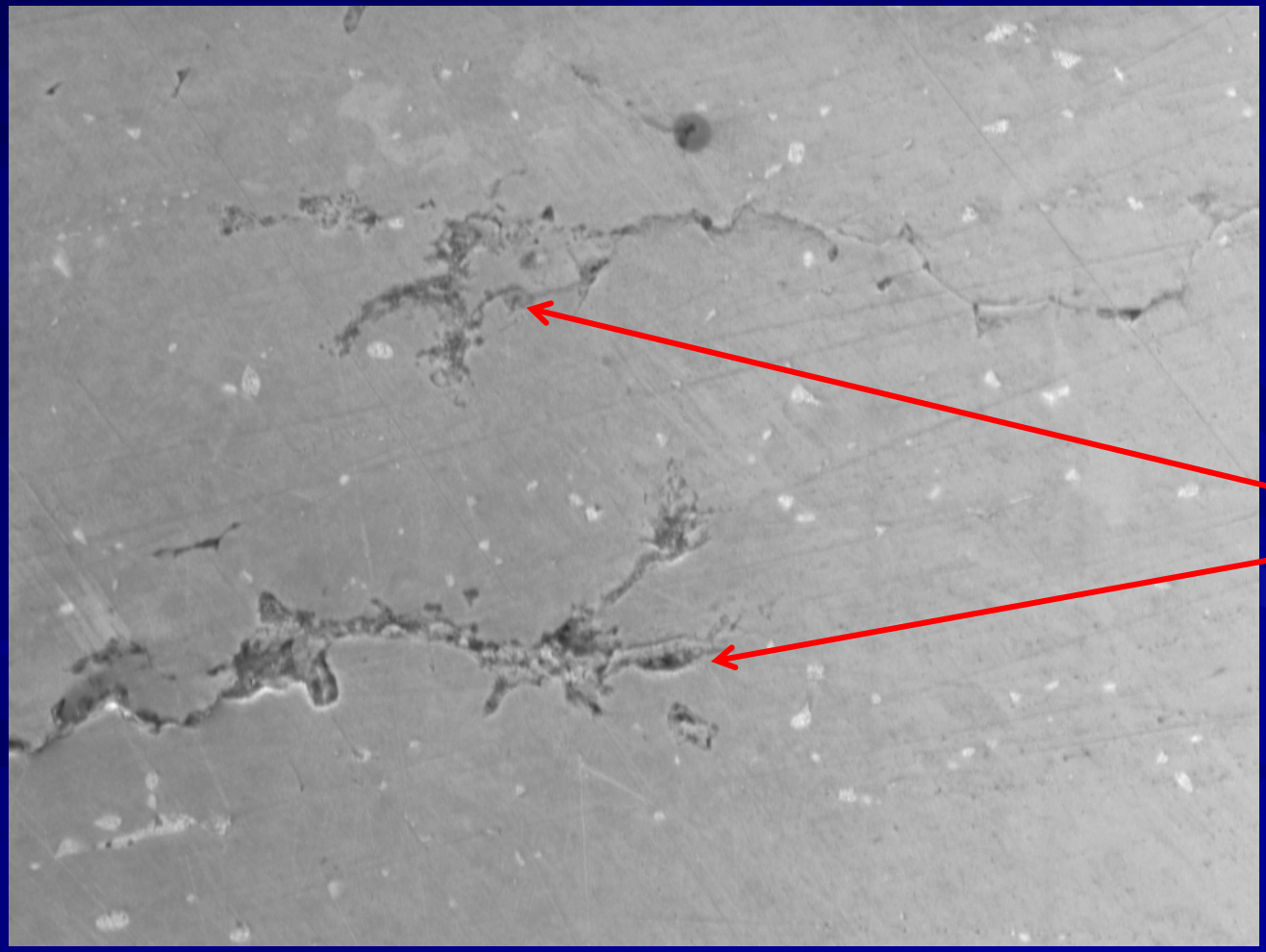

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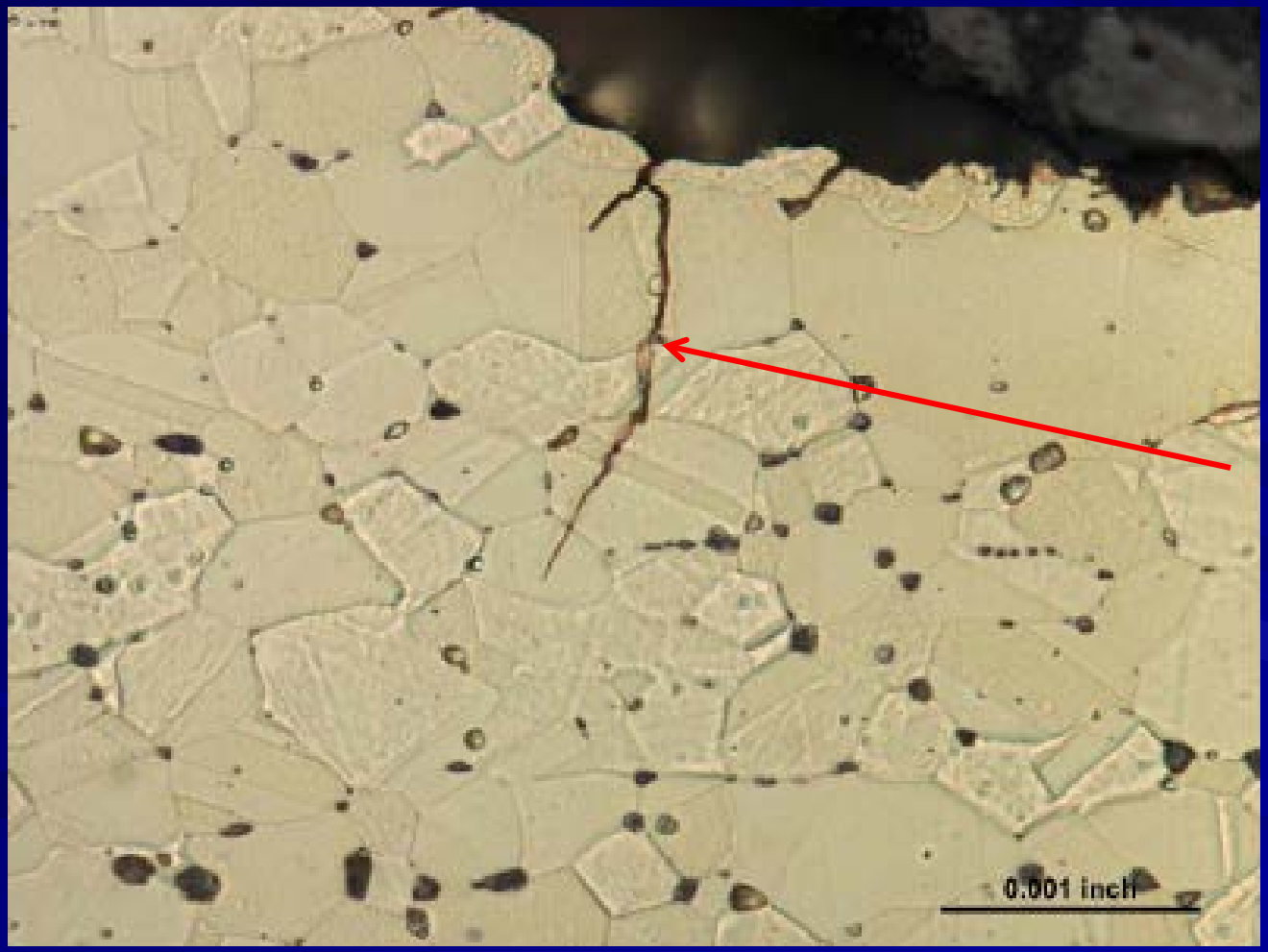


Corrosion pit with crack forming

Evaluation Video

Click on Video to View

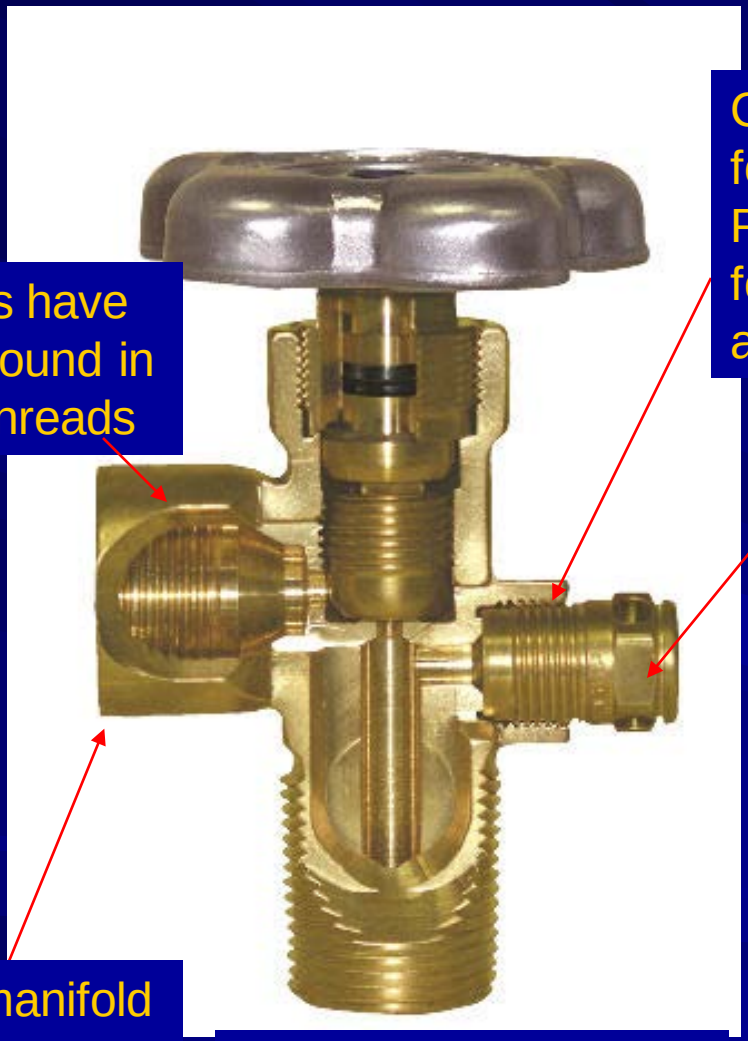
What to look for during an examination

- Gauge pressure and history to determine leakage over time.
- Moisture and water accumulation, which promotes corrosion and cracking.
- Any corrosion on the brass valves/fittings, including white, green or red areas indicating dezincification.
- Cracks on the pressure relief device bosses, valves and CGA fittings.
- Correct dimensions (measured) on CGA fittings.
- Only ammonia free/oxygen safe leak detection fluid can be used. If used, leak detection fluid should be wiped off so that residue does not impede future examination.

Views of Various Valve and Cylinder Arrangements Showing Differing Examination Access

Different methods and tools may need to be employed

Common Valve Section Indicating Crack Locations



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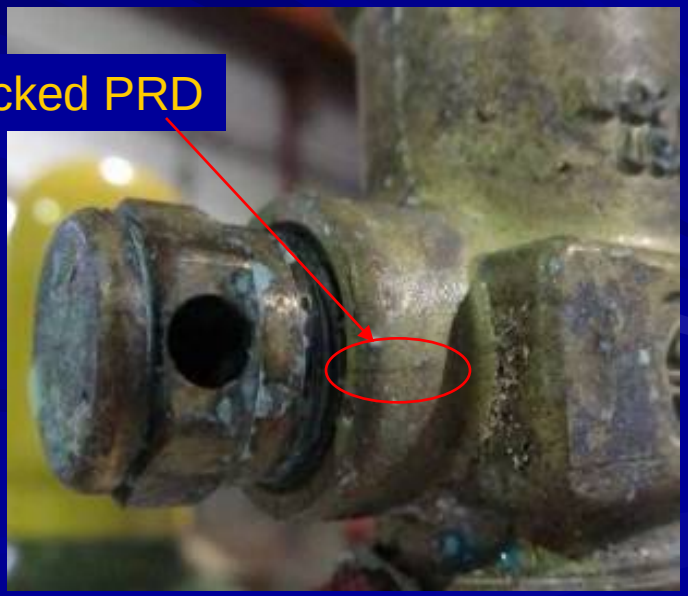

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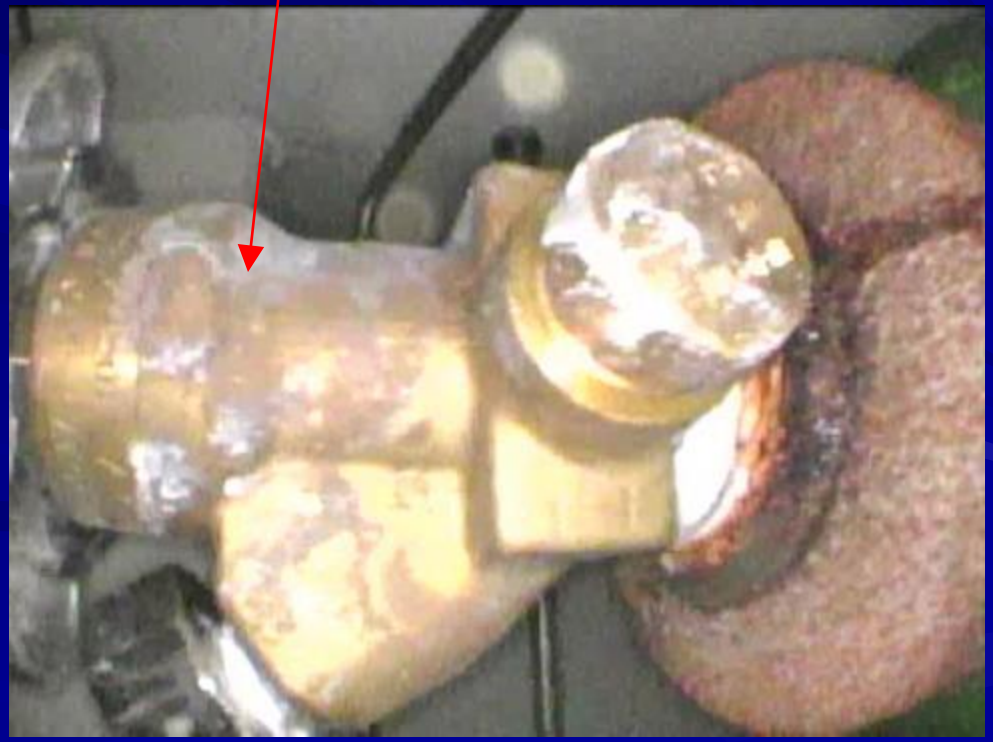
Examples of Conditions to Report

These cylinder valves have developed significant corrosion



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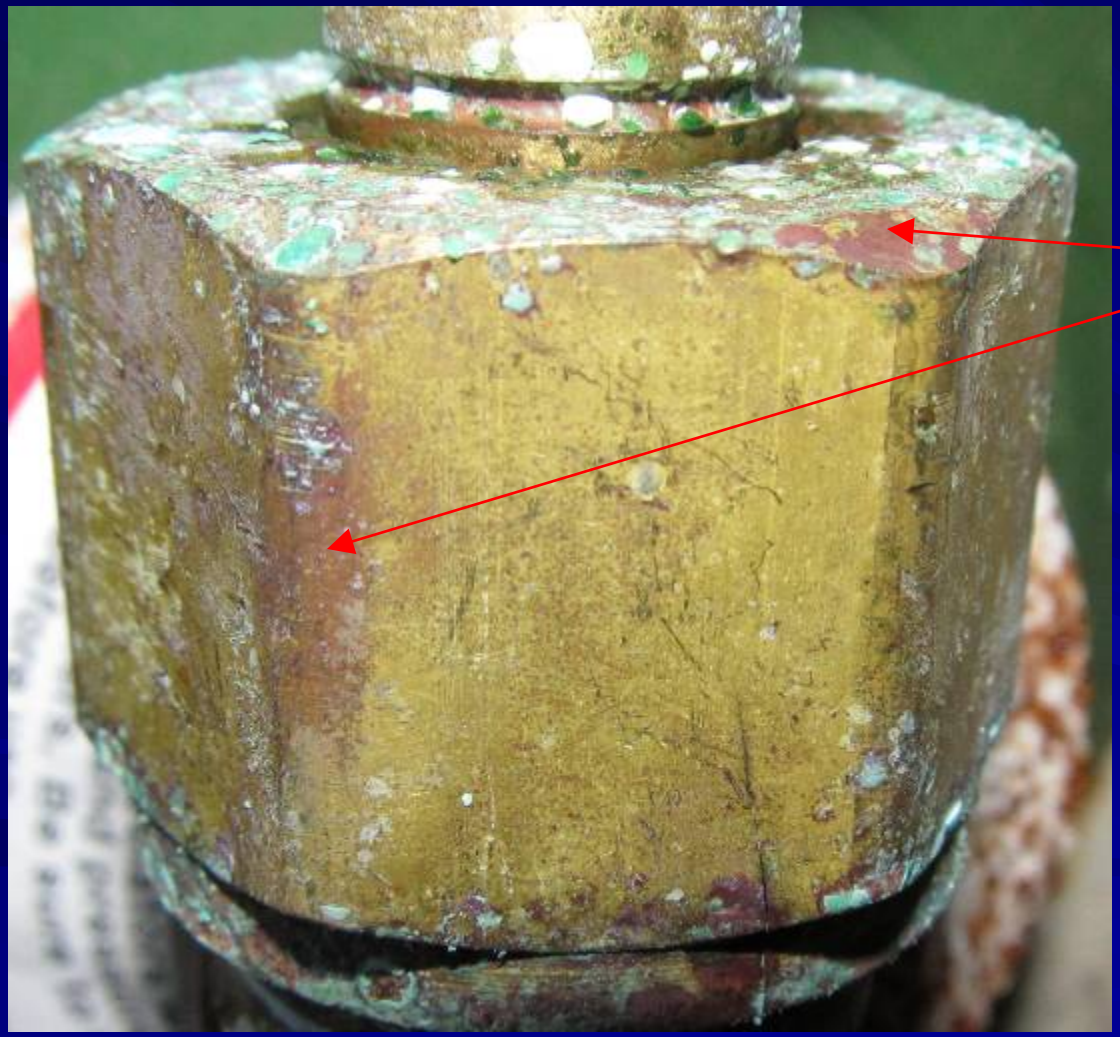
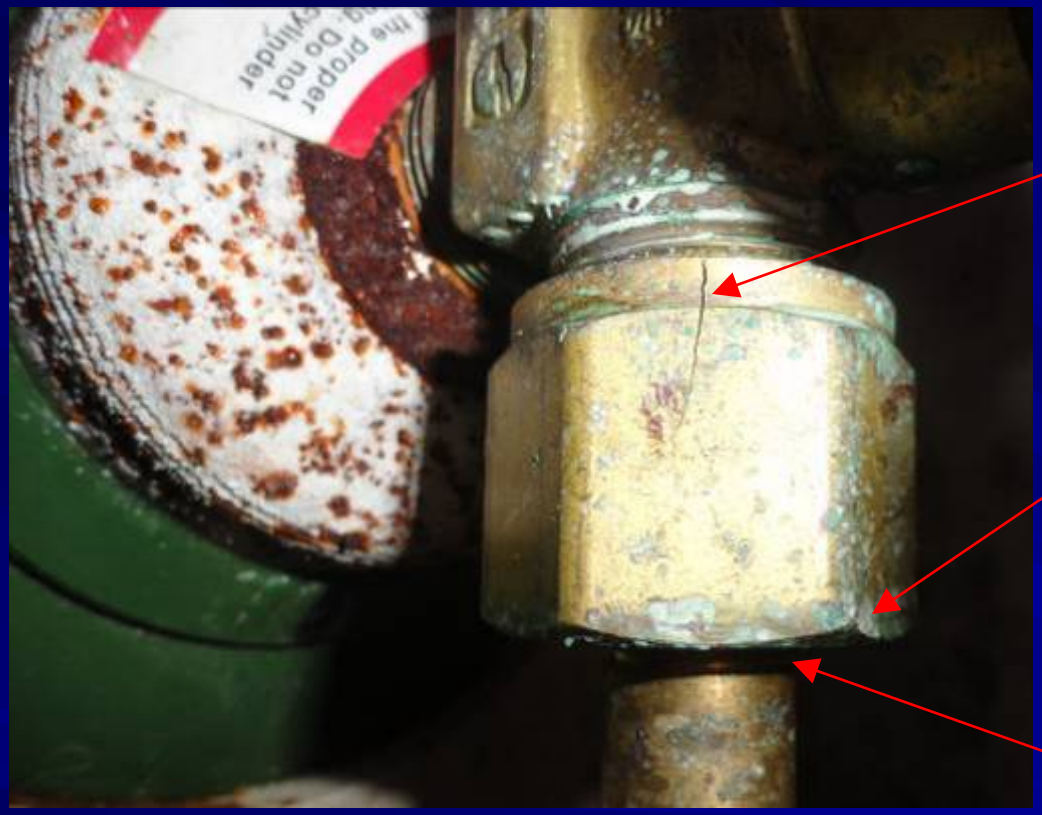


Copper colored and reddish areas indicate dezincification where the zinc has come out of the matrix and only copper is left behind.

Examples of Conditions to Report



A crack has developed in a high pressure fitting.

Green and white corrosion along with indications of dezincification are also present.

Also check for cracks on the rear face

Examples of Conditions to Report

Summary of June 14th meeting

- Based on the findings, WV and MSHA recommended new examinations to validate initial reports and to provide reports to WV and MSHA immediately following examination.
- Manufacturers should develop and provide new examination protocol to WV and MSHA
- Service personnel should be re-trained in conditions to look for and how to correctly document what is found.
- Proper examination tools should be provided
- MSHA and WV will continue to perform follow-up evaluations

Approval Applications

- Several manufacturers have not submitted part 7 approval applications.
- MSHA part 7 approvals are required prior to units being refit and placed underground.
- Refit units with MSHA part 7 approved components are required to be in use by December 31, 2013.
- Components used in 15-psi type refuge alternatives must also have MSHA part 7 approval by December 31, 2013.

Refit Schedules

- Based on the status of their part 7 approval applications and their reported refit capability, some manufacturers are not currently projected to have all existing refuge units refitted by the 12/31/13 deadline.
- Per 75.1506 (a)(3), operators can not use currently grandfathered units after 12/31/2013.