Monitoring Capability of Penetrant System Performance Panels

ASNT Fall Conference
November 11, 2008

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What are your expectations when you process this panel?

Where did this panel come from?

- A East coast manufacturer has a penetrant line that reveals no defects
- A California manufacturer came up with a cracked panel
- Through the process of evolution and Nadcap, something very simple evolves into something incredibly complex. Holy Cow!

What do you get when you buy a panel?

Either a -1 (Polished) or a -2 (Grit blasted) panel

Tremendous variability between panels

Don’t like that? I suggest you manufacture a better panel and be able to deliver it whenever anyone wants one - You’ll make lots of money.

Monitoring Capability of Penetrant System Performance Panels

What Are the ASTM E1417 Requirements For System Performance?

- "The check shall be performed by processing a **known defect standard** through the system using in-use penetrant, emulsifier (if used) and developer and appropriate processing parameters."

- "The resulting indications will then be compared to the indications obtained using unused penetrant, emulsifier (if used) and developer. This comparison may be made with records of previously obtained indications or with a similar known defect standard processed with unused materials from a hold-out sample."

- "When required by the CEO or when the sensitivity or performance of the in-use materials falls below the performance of the unused materials, the in-use materials shall be checked in accordance with paragraphs 7.8.3.2 through 7.8.3.4 as appropriate, prior to conducting any further penetrant examinations."

- Unacceptable materials shall be discarded or otherwise corrected in accordance with the manufacturer's instruction.

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What Are the ASTM E1417 Requirements For System Performance?

- The check is performed on recycled penetrant, emulsifier, and developer as well as materials that are not recycled (new)
  (It is NOT a materials test)

- It is touted within the industry as an overall check of the **system** (including the inspector) despite the fact that we perform other process controls such as:

  - **Penetrant Contamination**
  - **Water Contamination (WW)**
  - **Water Temperature**
  - **Water Pressure**
  - **Emulsifier Concentration**
  - **Dryer Calibration**
  - **Developer Condition and Contamination**
  - **Black Light Intensity**

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ASTM E1417 Requirements For The Known Defect Standard

- "The known defect standard used shall be approved by the cognizant engineering organization."
- The Known Defect Standard does NOT have to be a starburst panel.
- The Known Defect Standard can be ANY PART that has a known defect in it.
- The Known Defect Standard does NOT have to contain defects of the smallest size specified in the acceptance criteria.

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Industry Requirements For The Known Defect Standard

- Most aerospace primes have penetrant specifications similar to ASTM E1417, but impose more requirements.
- One major aerospace manufacturer states in their penetrant specification: “The defects in the standard will be capable of demonstrating unsatisfactory system performance.”
- This manufacturer accepts starburst panels as a valid standard to demonstrate unsatisfactory system performance.

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Nadcap HB7114-1 Requirements For The Known Defect Standard

- "The supplier shall perform an initial check with all new materials to establish a baseline for each known defect standard and material in use."

- "This check shall be performed utilizing a color photograph to record the baseline performance. The requirement is that the performance of the in use materials can not fall below that of the unused materials. Therefore a baseline performance must be established to compare to the daily results."

- "The establishment of the baseline photo may be performed by an external source providing that the color photo is representative of the panel when run at the supplier's facility. The outside source shall process the panel utilizing the same penetrant materials and test parameters as the supplier and produce a color photo of approximately 1:1 scale."

- Comments:
  - The Known Defect Standard does NOT have to be a starburst panel.
  - Nadcap seems to consider this more of a materials test, not the operator. However, they will write you up for a compliance finding (Major) if the operator strays from the procedure.

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Nadcap HB7114-1 Requirements For The Known Defect Standard

- Results of the system performance test, utilizing the in-use materials, must indicate the same number and appearance (e.g. size, etc.) of the flaws detected originally when the baseline was established. Example: If 4 stars of a certain size and appearance are originally detected, then the same number and appearance of the stars is expected each subsequent test and the actual number must be recorded.

- This comparison shall be made utilizing a color photograph (approximately 1:1, whose back ground does not interfere with the comparison) or by direct comparison of used versus unused materials.

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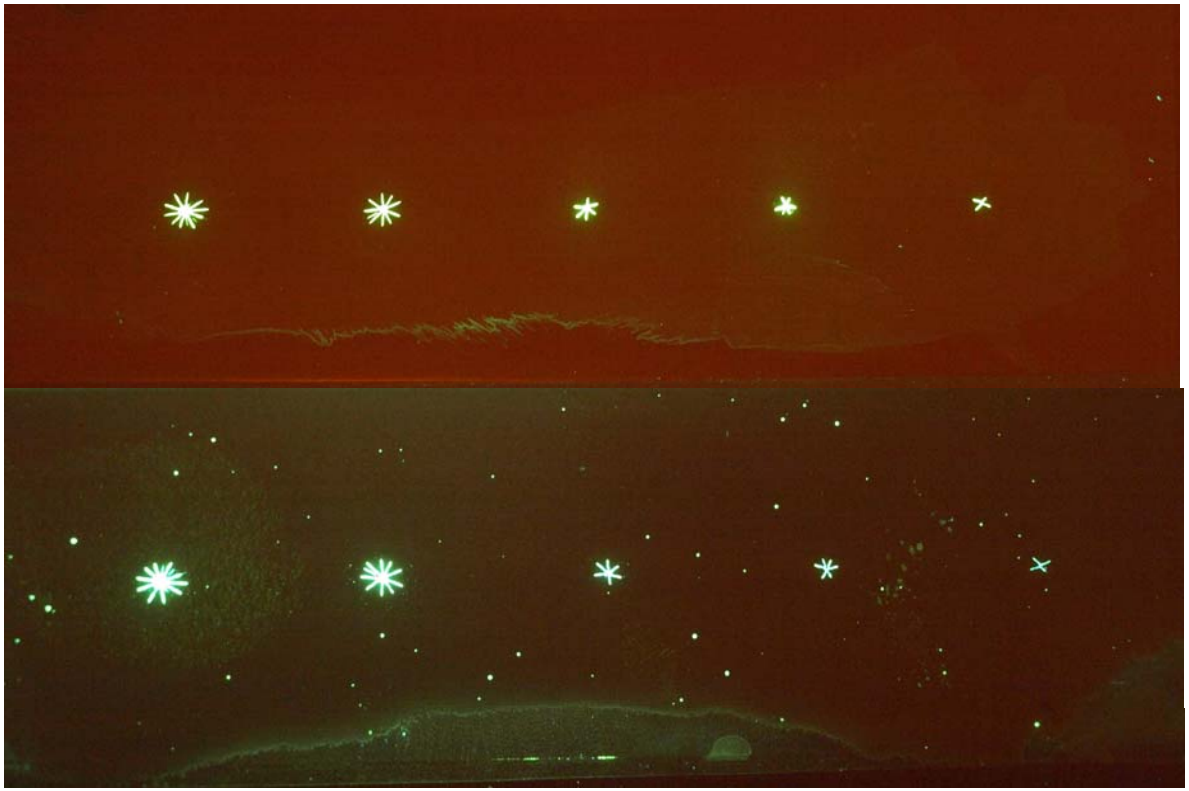
Nadcap HB7114-1 Requirements For The Known Defect Standard

- Nadcap does not allow replication.



Baseline

Replication

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Nadcap HB7114-1 Requirements For The Known Defect Standard

- Nadcap (Suppliers on the task group) do not like the new laser etched panels. On their net site, they still have this picture posted.

Old

New Laser

BASELINE

- 3 Baselines – WW, PE, and Nitric Acid Contamination

Water Wash Baseline

- All processing variables standardized, e.g., minimal dwell times, spray emulsification, oven at 140^0, virgin dry developer, UV light intensity at 2300 $\mu W/cm^2$ – Only the starburst side of the panel was used.

- Panels were cleaned with acetone between each use. If fluorescence persisted, non-aqueous developer was sprayed on – then dwelled in the oven to draw the penetrant out of the cracks. If fluorescence persisted, Replica Transfer Coating© was applied to further pull out any penetrant.

BASELINE

- Photographed with a 10 Megapixel digital camera with a yellow filter- fixtured on a stand. Auto focus in visible light, turn off visible light, delayed/long exposure.

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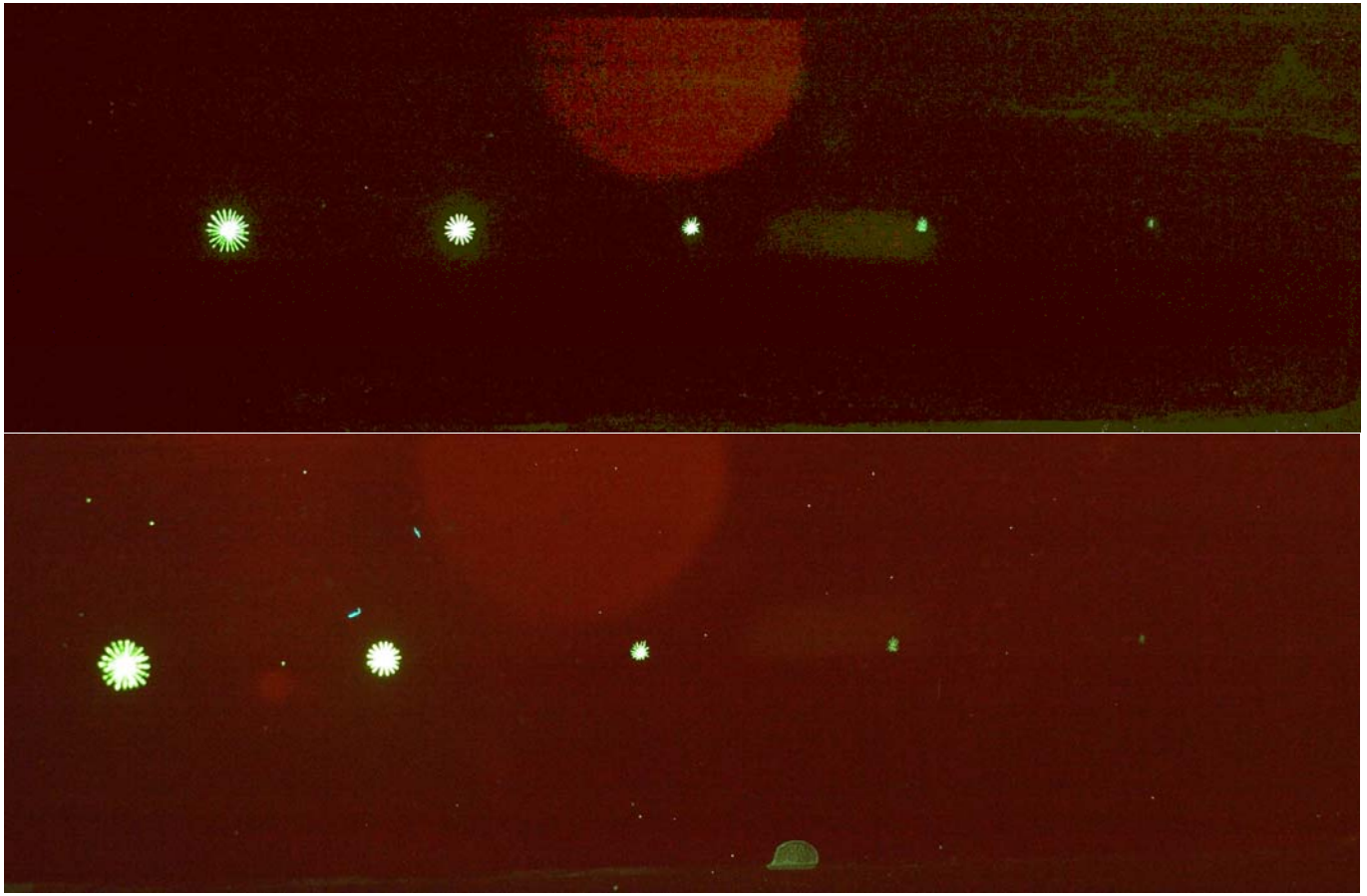
METHOD A - NITRIC ACID CONTAMINATION

- Approximately 1% Nitric Acid Contamination –
- Baseline
- Acid



METHOD A - WATER CONTAMINATION

– 20% Water Contamination –

– Baseline

– Water

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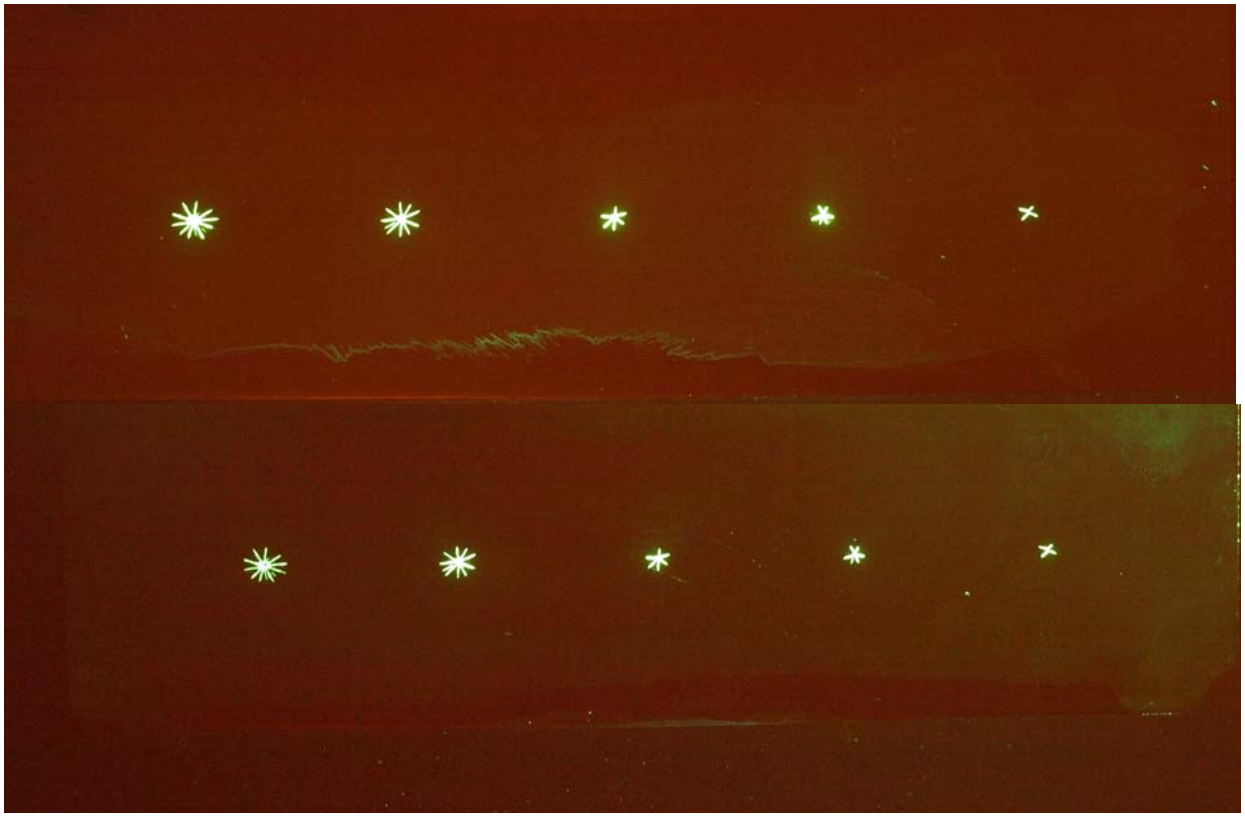
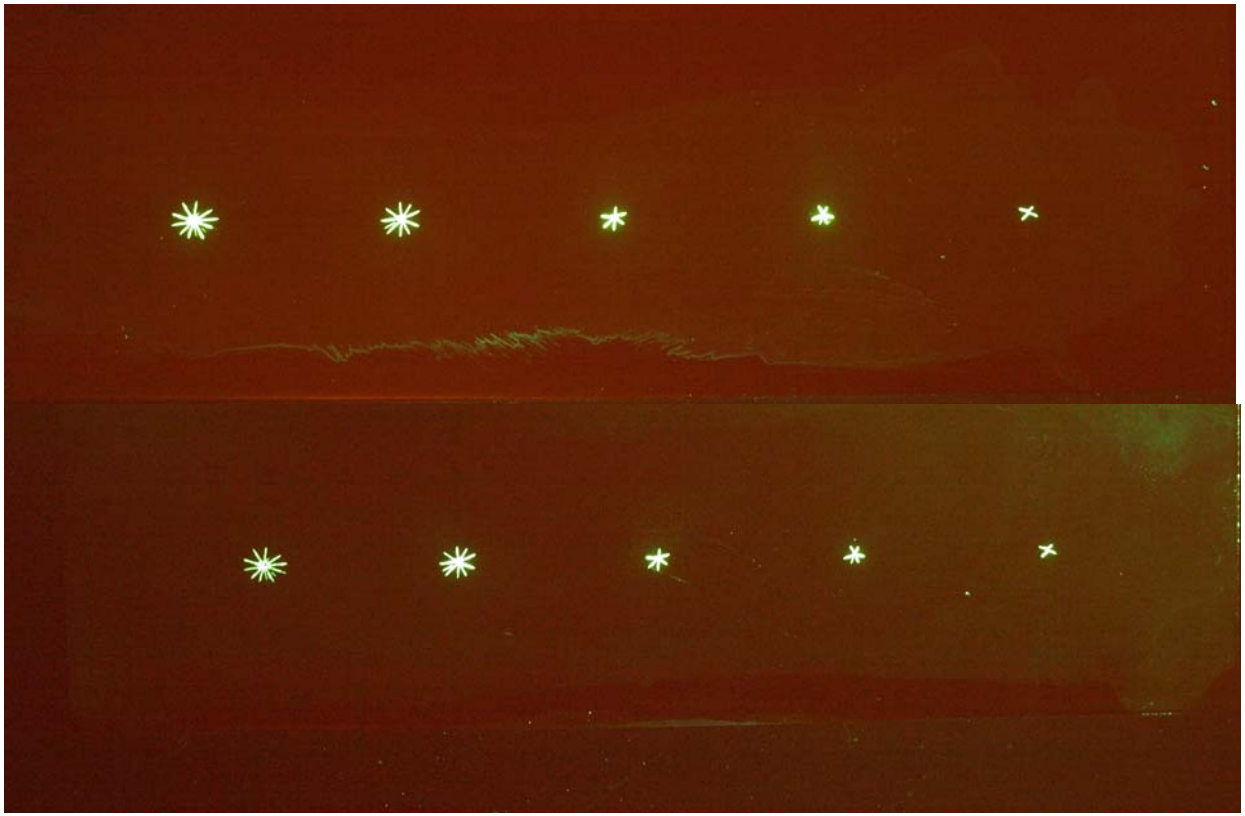
METHOD A - SHORTENED PENETRANT DWELL

- 30 Second Dwell –
  - Baseline
  - Short Dwell



METHOD A - LENGTHENED PENETRANT DWELL

- 14 Hour Dwell –
- Baseline
- Long Dwell



METHOD A - HOT WATER WIPE

– 185° Water –

– Baseline

– 185° Water

METHOD A - COLD WATER WIPE

– 33° Water –

– Baseline

– 33° Water

METHOD A - OVERWASHING

- 4” Wash Distance for Two Minutes

- Baseline

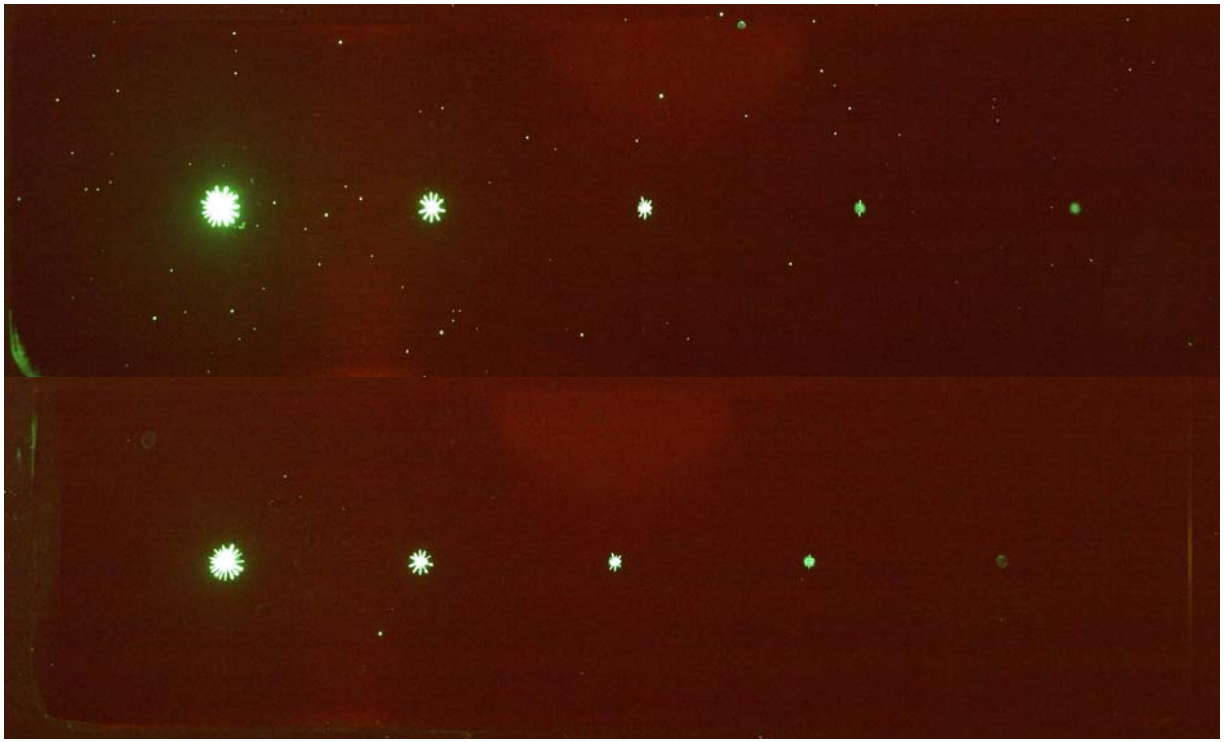
- Overwash

METHOD D – OVER EMULSIFY

- 4” Wash Distance for Three Minutes

- Baseline

- Overwash



METHOD A - OVERDRYING

- 30 Minutes at 140^0

- Baseline

- Overdry

What Do These Experiments Demonstrate?

Sherwin Inc.:

“The PSM 5 or any TAM panel is incapable of demonstrating system degradation.”

Conclusions

- **The starburst panel is NOT capable of detecting system degradation.**
- **The industry should probably de-emphasize this process control.**
- **Suggest that the industry concentrate on the primary reasons why escapes happen.**
  - **The parts were not clean enough before the inspection**
  - **The inspector did not understand the acceptance criteria**
  - **The inspector did not look at the part thoroughly**