



# Effect of Liquid Penetrant Sensitivity on Probability of Detection

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16th NNWG Workshop  
LaRC Hampton VA  
November, 2008

Bradford H. Parker  
Goddard Space Flight Center



# objective

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- The objective of the task is to investigate the effect of liquid penetrant sensitivity level on probability of crack detection (POD).
- NASA-STD-5009 currently requires the use of only sensitivity level 4 liquid penetrants. This requirement is based on the fact that the data generated in the NTIAC Nondestructive Evaluation (NDE) Capabilities Data Book was produced using only sensitivity level 4 penetrants.
- Many NDE contractors supporting NASA Centers routinely use sensitivity level 3 penetrants. Because of the new NASA-STD-5009 requirement, these contractors will have to either shift to sensitivity level 4 penetrants or perform formal POD demonstration tests to qualify their existing process.



# approach

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- Compare POD results for Sherwin and Magnaflux sensitivity level 3 and 4 penetrants. The comparison will be made for both Method A, Water washable, and Method D, hydrophilic post emulsifiable penetrant systems.

Magnaflux ZL-67 Method A, level 3, ZP-4B developer

Magnaflux ZL-56 Method A, level 4, ZP-4B developer

Magnaflux ZL-27A Method D, level 3, ZR10 B remover, ZP-4B developer

Magnaflux ZL-37 Method D, level 4, ZR10 B remover, ZP-4B developer

Sherwin HM607, Method A, level 3, D-90G developer

Sherwin HM704, Method A, level 4, D-90G developer

Sherwin RC65, Method D, level 3, ER83A emulsifier, D-90G developer

Sherwin RC77, Method D, level 3, ER83A emulsifier, D-90G developer



# approach (continued)

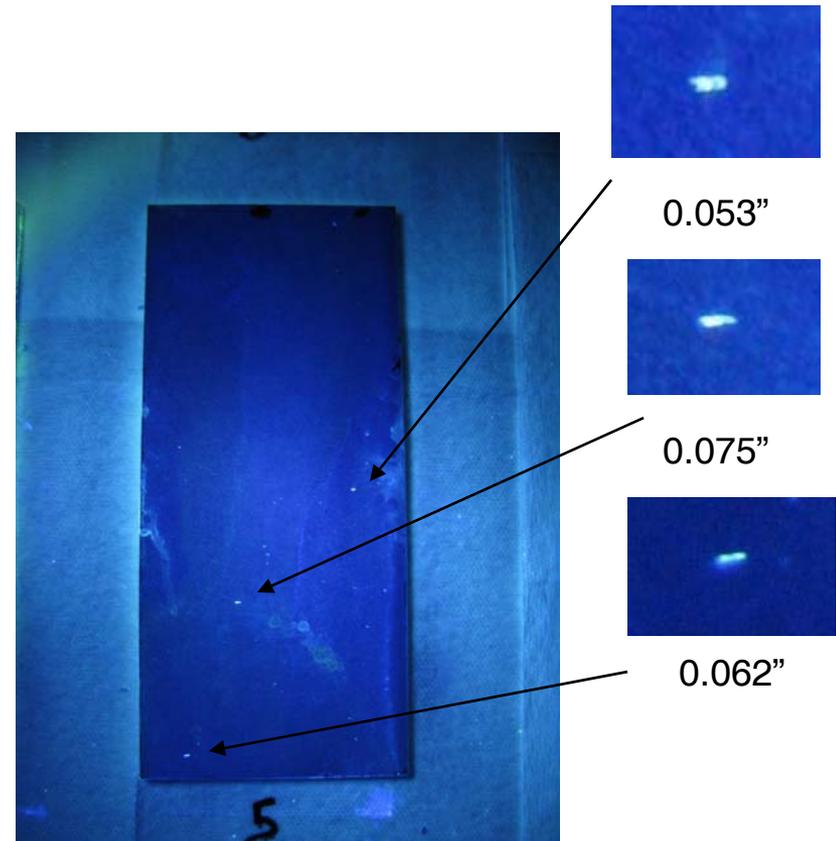
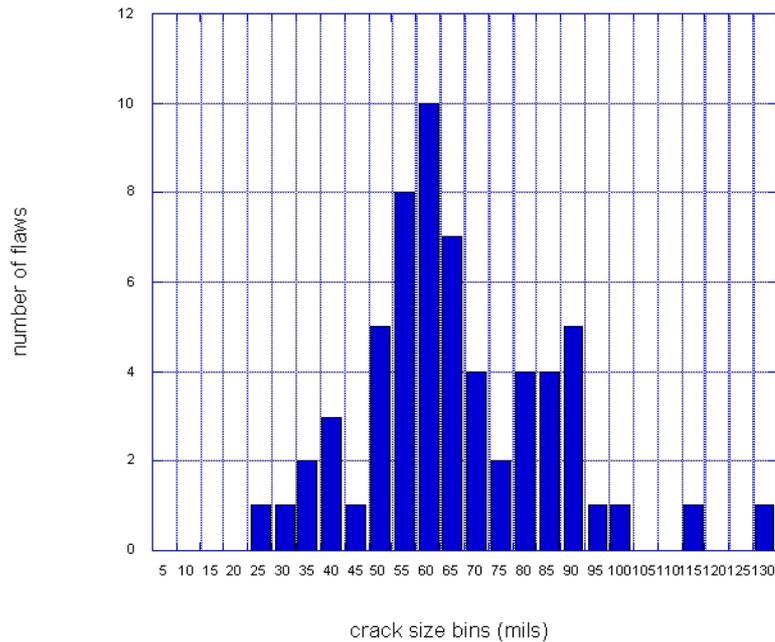
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- Three local NDE vendors will be used with a total of six inspectors. Each inspector will perform eight inspections of the panels set using the eight different penetrant system combinations.
  - Maryland QC Laboratory
  - The Bechdon Company
  - ATK
- One inspector will also perform 4 inspections of the panels set using the same penetrant system to look at repeatability.
- The Hit/Miss data sets will be evaluated using both the NASA DOEPOD software and the MIL-STD-1823 software.



# crack panels

6061 aluminum  
23 panels  
61 fatigue cracks  
0.023" to 0.129"





# progress

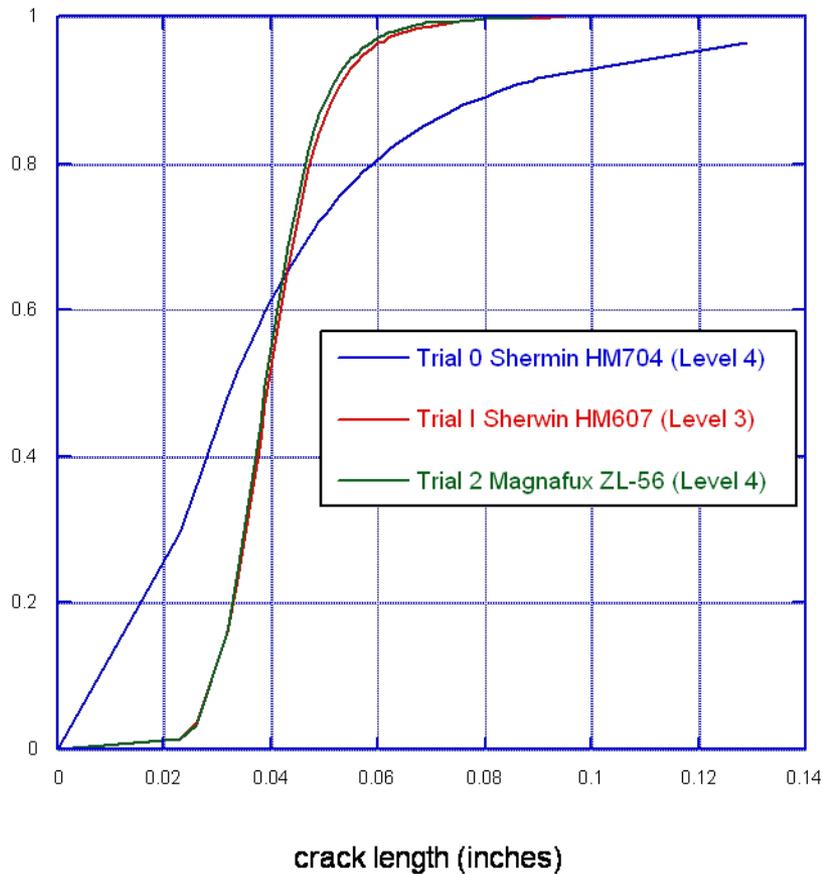
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- The test matrix is underway at Maryland QC Labs in Beltsville MD.
- The first inspector was asked to initially inspect the panels using their in-house procedure and penetrant materials of choice. The inspector selected Method A using Sherwin HM704, sensitivity level 4 penetrant and D-100 developer.
- Next, the inspector was asked to use the same procedure but with a Method A penetrant provided by GSFC. The inspector does not know the identity of the penetrant.
- The inspector iterates through the four Method A penetrants, two of which are sensitivity level 3 and two are sensitivity level 4.



# results

DOEPOD estimate of probability of hit (POH)

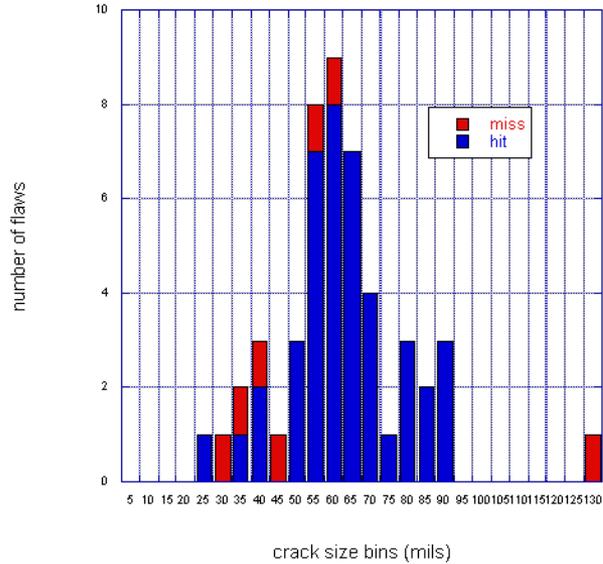


penetrant	DOEPOD A90 est. POH	DOEPOD A90/95
Sherwin HM704 (level 4)	0.082	Not reached
Sherwin HM607 (level 3)	0.052	Not reached
Magnaflex ZL-56 (level 4)	0.051	0.063

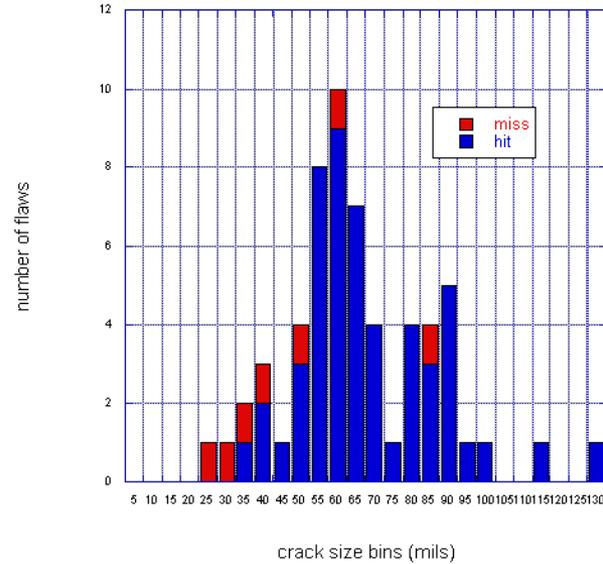


# results

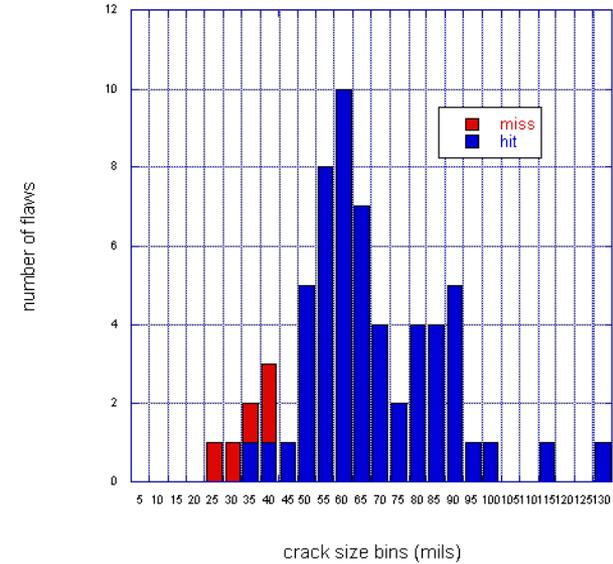
### Trial 0 Sherwin HM704



### Trial 1 Sherwin HM607



### Trial 2 Magnaflux ZL-56





# results

DOEPOD estimate of probability of hit (POH)

