

DEVELOPER

The PENETRANT PROFESSOR occasionally reviews the growing number of back issues of this newsletter, just to see what subjects have been covered in the past. Surprisingly, or maybe not surprisingly, the use of developer has been a frequent subject. But to add to this, in reviewing one of the proposed chapters for the revision of the ASNT Penetrant Handbook, there was considerable discussion about developer. It is timely to pull together some of what has been discussed.

WHAT DOES IT DO, AND IS IT NECESSARY?

Developer increases the size of the penetrant indications, and makes them easier to see. It is just that simple. To answer whether its use is required or not, we will refer to the two primary specifications.

MIL-STD 6866 — “Unless otherwise specified, developers shall be utilized for penetrant inspection in accordance with the requirements of this standard. Type I penetrants that are qualified to MIL-I-25135 without the

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from Met-L-Chek

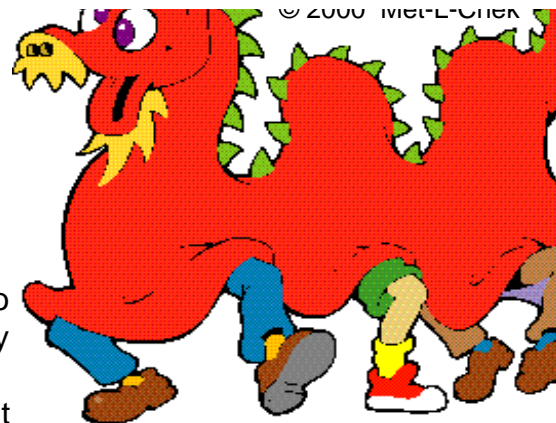
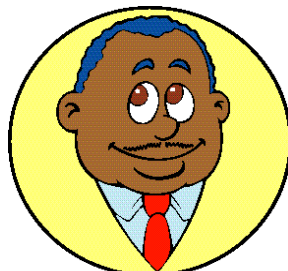
standard dry developer are so noted in QPL-25135 and may be used without developer.”

Qualification without developer was never achieved for MIL-I-25135. The penetrants could not pass the sensitivity test unless developer was used. Therefore, no penetrants listed on the QPL were allowed to be used without developer.

ASTM-E-1417 — “Unless otherwise specified, developers shall be used for penetrant examination.”

BUT THEN

A series of round robin tests were initiated by McDonnell Douglas personnel, using a set of artificially cracked specimens. From these tests, it was shown that the flaws could be adequately located without using developer. The Air Force Materials Laboratory participated in the tests and concurred with the results. The results of these tests were first announced at the Spring 1996 ASNT Penetrant Committee meeting by Dennis Smith, and then reported in the June 1996 issue of this newsletter.



STILL LATER

After our report, several testing laboratories decided that they could give up using developer, and suddenly we had some irate OEM QC folks on the phone. What they said was simple. “Sure, the round robin tests were OK, but they apply only to the kind of crack samples which were used. When our parts are tested without developer, there are many defects which are missed.” These OEM people asked us to publish this important qualification, and we did so. What was important about this was that those who decided that they could inspect without developer forgot a couple of things. The first thing that they forgot was the common sense notion that developer makes flaw indications easier to see. But that notwithstanding, they forgot two very important specification items. The first is that the penetrant is not listed as an approved penetrant on the QPL without developer, and therefore, they were using an unapproved penetrant. Second, not using developer violated MIL-STD 6866 or ASTM E-1417, since they had not obtained the concurrence of their customer. Remember the opening words of these specifications, “Unless otherwise specified...”. Apparently no one had thought about these extremely important things.

SCIENCE

About the same time, Ward Rummel published a highly relevant article in the January 1998 issue of *MATERIALS EVALUATION*. What this article demonstrated in text and in charts was just what all of us know to be true. It is simply better to use developer than not to use it. But Ward showed this scientifically, using the results of some carefully controlled experiments with flaws of various sizes. He showed that the probability of detection (POD) of flaws was far lower when no developer was used, particularly when the flaws were small. In fact, while the probability of detecting a 3/4 inch flaw using developer was 100%, when developer was not used, the probability fell to slightly less than 60%. The tests showed that a 0.05 inch flaw had an 80% POD with developer, and only 20% without it.

COMPENSATION

Ward Rummel's work also demonstrated the role of UV-A intensity. Once again, we all know that we can see something better if it is illuminated better. The scientific connection between the brightness of a flaw indication and the intensity of the UV-A illumination is very simple. The brightness is directly proportional to the intensity. In the work that Rummel did, the poor POD of not using developer could be partially compensated for by increasing the UV-A intensity. As an example, when the intensity was increased from 400 μ watts per square centimeter to 1200 μ watts per

square centimeter (3 times as bright), the POD of a 0.05 inch flaw increased from 20% to 60%, or three times as much.

CONCLUSIONS

Does this mean that all one must do to get by without developer is to increase the UV-A intensity to the appropriate level? Not at all. There are several reasons for this. The first is that the neat proportionality shown in this particular example (make the intensity three times as big, get a three times as big POD) is not valid in all cases or for all flaw sizes. As a general rule, the higher the intensity, the more probable the detection will be, but the rule does not apply to all flaws and all instances. Then, remember that the penetrant is not listed on the QPL for use without developer. Finally, the inspection process may be controlled by a specification, such as ASTM E-1417, which does not allow this kind of variation in the inspection process.

WHAT THEN ?

There is a way out, for those who want to give up the obvious advantage of using developer, and it is clearly spelled out in both MIL-STD 6866 and ASTM E-1417. The first sentence of the paragraph on the use of developer begins, "Unless otherwise specified...". So all that need be done is to get the customer to specify that no developer should be used. A sales job is required, and to be sure that it is effective, one needs to be convincing. The best way to do this is to do exactly

what both McDonnell-Douglas and Ward Rummel did. Collect a range of parts which have been found to be defective, and which contain the full spectrum of flaws which must be located. Then run sufficient tests using developer to generate a POD curve. When this has been done, repeat the tests using no developer, but using increased UV-A intensity. With some experimentation, an intensity level which is sufficient to generate the same POD curve might be found. If so, the customer might be convinced to allow an inspection process without developer. The design of this test must be carefully made, so that the results are convincing.

BEWARE

Don't fall into any traps. Remember your Mom saying to you when you were a kid, "Well, if Johnny jumped off a bridge, would you?" So if someone else decides that they can change their specification to eliminate developer, it may not mean that you can be a copy cat, as in "Monkey see, monkey do". Inspection is serious business, and changes which are contrary to both common sense and the specifications must be looked at very seriously, as in "Look before you leap!"

The Penetrant Professor

