The truth about scratch and dig

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For more than fifty years, the de facto standard method of describing surface quality in optics has been with a pair of numbers referred to as the scratch and dig specification. And for almost as long, people have been trying to use this cosmetic standard to control surface imperfections on precision optics, where scratches and digs affect the performance of the system. The result has been disastrous, as you would predict. The truth is that the scratch and dig specification of MIL-PRF-13830B is a highly subjective, visibility standard, which is excellent for cosmetics, but insufficiently quantitative for performance-based specifications.

This is not a secret. Matt Young made this blazingly clear in his 1985 article "The scratch standard is only a cosmetic standard[1]. But in 1985, there wasn't much we could do about it. There was no way to specify scratches and digs that was quantitative, objective, and did not require extensive capitalization. But in 1996, with the publication of ISO 10110 Part 7, there was an alternative. But ISO 10110-7 was cryptic and arcane, and aside from a few stalwarts, it never really became common practice.
But in 2009, the new version of OP1.002 offered an alternative that is familiar, easy to use, and effective for people who really require a functional specification. By offering both visibility and dimensional methods, OP1.002-2009 is the only standard I recommend these days.

And it's not a width standard, either!

Because of an unfortunate revision to C7641866 in 1974, which was used by the Army to purchase some experimental scratch artifacts, there is a significant number of people who refer to the scratch number as "the width in microns." This is simply not true, and never has been. But because such an "interpretation" is easier to meet, many optics shops will claim this in their specification documentation, on the assumption that their customer doesn't understand the requirement. Shame on them. This is just plain wrong. Scratch visibility and scratch width are not well correlated[2]. Not only is it a mis-interpretation of the MIL standard, it is the source of much of the confusion and conflict over the scratch and dig standard.

It's time to tell the truth.

Perhaps because of this confusion, the commercially available comparison standards have diverged. While the Army has maintained its own calibrated supply for military purchases, the commercially available standards cannot be certified against the masters. As a result, the comparison standards made by one supplier don't necessarily have the same apparent brightness as a set made by another supplier. Each is different, and the customer should indicate which he intends to use to interpret his specification. Such a clarification is reasonable for the manufacturer to make; claiming to interpret the scratch number as a width specification is not.

This is a call to action, to all you optics manufacturers, and to all you informed users of the scratch and dig standard. Stop this madness, and start telling the truth about scratch and dig. You know the real meaning of the scratch number; it is arbitrary, and corresponds to the visibility of the scratch, referenced to a pair of limit standards retained by the US Army ARDEC at Picatinny Arsenal. Take those

disclaimers and incorrect scratch width documents off your website. Start taking exception honorably by saying "we will interpret your scratch and dig spec per ANSI/OEOSC OP1.002-2009, using the xx calibration standard." And the next time you get a call from a customer's QA department, start the discussion by telling him the truth about scratch and dig.

If you want to learn the story of scratch and dig in all its glory, take my OEOSC accredited course "Understanding Scratch and Dig." I teach it periodically at conferences, as well as offering on-site training.

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[1] Annual Optics Review, Laser Focus/Electro-Optics Magazine, November issue, pp 138-140 (1985).

[2] See for example G. White and J. Marchiando, "Scattering from a V-shaped groove in the resonance domain", Appl. Opt. Vol 22, No 15, pp 2308-2312 (1983).