

## SURFACE QUALITY SCRATCH-DIG DEFINITIONS

Scratch-Dig is a qualitative technique for classifying level of polish for small optics. Its origins lie with the Military standard MIL-PRF-13830B based on the original document created back in 1954.

The Scratch-Dig specification is a highly subjective standard based solely on visible inspection of an optic side-by-side with a qualified standard. All qualified standards trace their roots back to a still existing set of standards kept at Picatinny Arsenal in New Jersey.

Cosmetically speaking, the lower the numbers of a scratch-dig designation the less flawed the surface of the optic. Care must be taken in using scratch-dig solely when defining very high end, precision optics and other characteristics such as surface roughness may need to be defined. The terms "scratch" and "dig" are not related so each needs to be defined separately.

SCRATCH-DIG	QUALITY	APPLICATIONS
80-50	Very Low	Acceptable quality, can be easily fabricated
60-40	Low	Commercial quality, used for non-critical low power laser and imaging applications, where scattered light is not as important as cost.
40-20	Moderate	Standard scientific research applications for low to moderate power laser or imaging, which tolerate little scattered light.
20-10	High	Precision quality, minimum standard for laser mirrors and extra-cavity optics used in moderate to high power laser. Minimizing scattered light.
10-5	Very High	High precision quality, used for the most demanding applications such as intra-cavity laser optics or high power applications.

### SCRATCH

A scratch is exactly that, an elongated mark on an optical surface. The actual number approximates the width of the scratch but per MIL-PRF-13830B it is actually measured as brightness using specified illumination. The brightness of the scratch is compared to a qualified standard placed adjacent to the optic under the same lighting. Choosing the brightness on the standard that most closely matches the brightness of the scratches on the optics being tested determines the number.

There are other details to MIL-PRF-13830B, such as "sum of all scratch length with the specified scratch number will not exceed  $\frac{1}{4}$  the diameter of the optic".

### DIG

A dig is a round pit or mark, including a bubble. Dig is a bit more quantitative because it is approximated by the diameter of a "dig". If the dig is not perfectly round, then the dig value is the average of the length and width.

As with the scratch designation, there are more details in MIL-PRF-13830B such as "the total number of maximum size digs (allowable) will not exceed the diameter of the optics divided by 20".

It is important to understand how qualitative, as opposed to quantitative, the scratch-dig specification is. Establishing a clear understanding, visual agreement and written call-out between the customer and the supplier on surface quality is critical to fulfilling customer expectations. It's highly likely that sending samples to 20 different polishing facilities, asking for a 60-40 scratch-dig, will result in many different results. For most application this won't matter, but for highly precise optics, and high-power laser applications, a misunderstanding could result in a very unhappy customer.