Wolfram Schott
2018

Depth Gauge System

It was my Danish friend and mentor, the late Preben Torp Jacobsen, fly-tier, rod-maker and author of several books, who had the idea back in the 1980’s.

Setting a taper with a 60° tip on your depth gauge requires you to "zero" it, e.g. on a flat piece of steel. Inevitably, the tip will be round by several tens of millimeters (or thousands of inches), due to production. The resulting strips, as planed in your form, will be oversized, and your glued-up rod will be off specification. A number of devices have been introduced during the last decades, to overcome this. Garrison, on pages 40 and 70, describes the use of test-strips, to arrive at the correct setting (depth of groove).

So, here is what I came up with. Everything is made of steel, but can also be made of other materials, like brass.

The depth gauge base plate has the dimensions of a Stanley 9 ½ block plane (which is what I use), which is approx. 6.3 inches long by 2 inches wide, and it is ½ inch thick. With its weight (870 grams = 30.7 oz) and its low center of gravity it sits firmly on the forms. The position, where the 60° contact point is placed, corresponds with the position of the cutting edge of the iron in the plane, ca. 2 in. from one end (see drawing 1). The bottom has to be perfectly flat, of course, just as flat as the sole of the block plane (check with a straight edge).

My contact point is not a cone, as in most equipment, but rather a wedge with a 60° included angle. This has some advantages: the very contact with the groove in the planing form is not an infinite thin line on each flank, like in a cone, but a substantial area. Any small deviations along the groove, either accidental dust grains or chatter marks of the bevel-cutters or whatever are "evened out" by the large surface area of the wedge-sides. This is comparable to the conditions a strip of bamboo will be subjected to, when put into the groove. Also, it is not so much prone to abrasion, when sliding it up and down the forms. The wedge must not have a very sharp chisel edge, which would be vulnerable to "accidents" (though not as vulnerable as tips of cone-shaped contact points). The wedge, having a cylindrical upper portion and an also cylindrical "shoulder" above that, travels and rotates freely in a dual-diameter borehole (reamed, diameter dependent of dial-indicator shaft), which is drilled into the square "tower" on the base-plate. Its shoulder of a somewhat larger diameter prevents it from falling out, the lower part of the borehole being correspondingly smaller. The travelling tip of the dial indicator (without any contact point) sits loosely on top of it. The indicator shaft is held in place by a grub-screw (see drawings).

A wedge with threads screwing to the indicator shaft (the spindle), like a cone-shaped point, is no good solution. The spindle does not turn freely on its axis and the wedge fits only in one position into the groove.

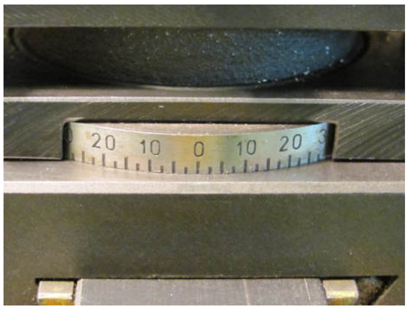
Producing a cone-shaped contact point (60°) is easy enough with a lathe. A round (cone-shaped) contact point for a four-sided rod ("quad") rather difficult and a dual-angle point for a five-sided rod ("penta") impossible.

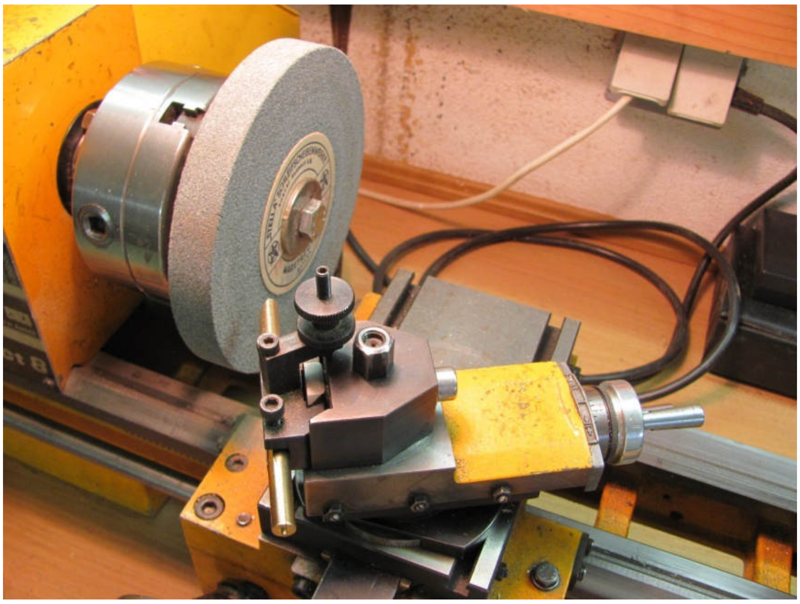
Wedges are easily made by grinding or milling the required faces onto a cylindrical bolt.

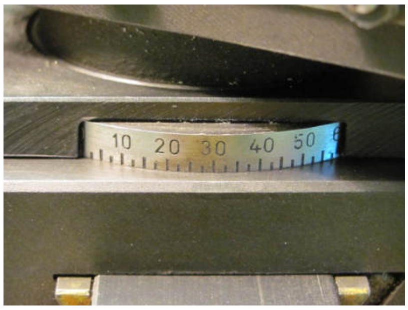
- Put a grinding-wheel into your lathe-chuck, on an arbour. Fasten a suitable rod, or bolt, (steel, brass, somewhat longer than required) into the tool-post and adjust the free end parallel to the grinding wheel. The top, or coumpound slide dial is set to zero degrees.
- Set the compound slide to 30 degrees and feed the end of the bolt into the grinding wheel, using the tool post slide hand wheel. Also, use the cross-feed hand wheel to move

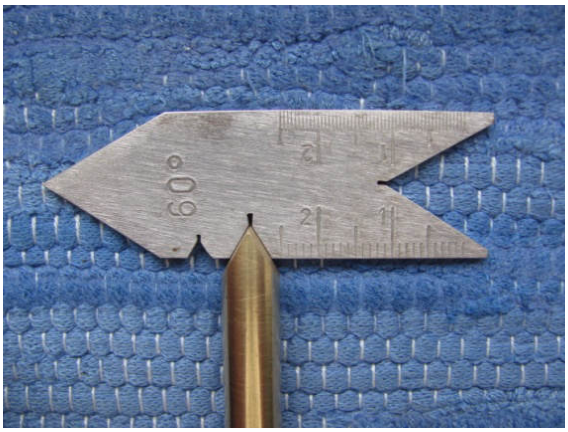
the bolt in and out, to prevent producing a groove in the grindstone. Go slow, 500 rpm is enough, and protect your eyes.

- Turn the bolt by 180 degrees (crucial !) and grind the other 30° bevel.
- Check with a 60° gauge
- Turn the ends to the required two diameters, part off, de-burr, polish.









You can also use a square piece of steel or brass, or a hexagonal one, and turn it round after having ground the 60°- wedge-tip.

Making a tip for Quad-forms (45° bevel), set the compound slide to 45 degrees. A wedge for a penta-form requires two angle-settings.

The dimensions given in the drawings are meant to be a guide and can be adjusted to suit available manufacturing facilities (tools) and dial indicator shaft diameters. Mine is a Mitutoyo 2046-08 with a 8 mm (0.314 in) shaft and 10 mm throw; it reads 1/100 th millimeters. In the drawings I just converted my metric measurements into decimal inches, so the resulting numbers might not always appear rational.

Calibrating a depth gauge, whether the contact point is a cone or wedge, by putting it on a flat piece of whatever material and setting it to "zero", will inevitably produce false readings on the dial indicator (too small, depending on how round the tip is), and subsequently produces oversize strips of bamboo, as mentioned before. Using a calibration device with a 60° groove (for a six sided rod) of known depth milled into it will not help much, either, the cutter also having a however so small "rounded" tip or edge, producing a rounded bottom of the groove. Depending what is "rounder", the bottom of the groove or the tip of the contact point, you will get errors one way or the other.

The solution is, of course, to saw, grind or mill a small slot into the bottom of the groove, making room for the tip. This will allow the sides of the contact point (wedge) to rest against the groove walls, which is precisely the situation a piece of bamboo will encounter when put into the planing form. The depth of the groove is not critical. Something like 0.12 to 0.19 in. (3 to 5 mm, mine is 4.705 mm) will do. Calibrating the depth of the 60° groove is easily made with the help of e.g. a perfectly round (check it) dowel pin or drill-shaft of suitable diameter, digital callipers and/or micrometer (better) and bit of geometry homework (see drawing 3).

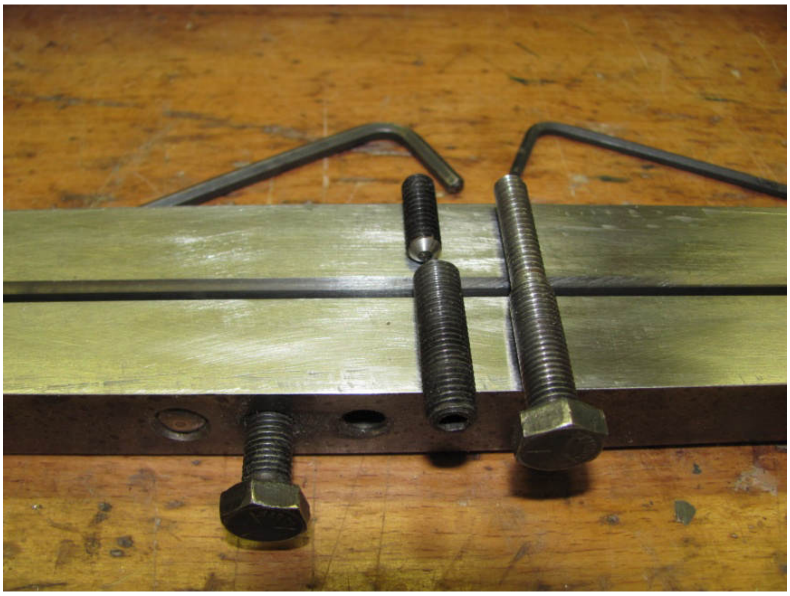
To calibrate the system for a six sided rod, you just put the assembled depth gauge (base plate, wedge and dial indicator) into the Calibration Tool and move the dial indicator up and down in its base until it reads the calculated depth of the groove, which is, also, the depth of the triangle (D). There you tighten the set-screw. Fine adjustments can be made by rotating the face of the dial indicator to the exact depth. My Calibration Tool, too, is approximately as long and wide as the sole of a Stanley 9 1/2 block plane.

Calibrating the dial indicator for a four sided rod (with a 45° wedge) gives you a reading of the length (S) of a side of the triangle, or half of the diameter corner-to-corner. To arrive at the depth of the triangle (D), which is half of the diameter (face to face) of the rod, you multiply S by 0.7071 (see drawing 3).

Calibrating the dial indicator for a five sided rod (with a 54° wedge) gives you a reading of T, which is neither the length of a side (S), nor the depth (D), of the triangle. To arrive at the depth of the triangle D, (which is also the radius of the inner circle of a pentagon), you multiply the reading of the dial indicator, T, by 0.8511. To arrive at S (the radius of the outer circle) you divide the reading T by 0.9510 (see drawing 3).

The whole Depth Gauge System, when calibrated with the Calibration Tool, will interpret the surface of the planing form just as the sole of a Stanley 9 ½ would. All bumps, scratches, planing-iron-digs, warps, misalignments of the two steel bars and whatever would be in the way of a perfect dead flat surface of the planing-form will be taken into account ("evened out"). You will always have a correct depth setting relative to the sole of your plane and the protruding cutting iron and the resulting strips will come out as intended.

My first (hex-) planing-form is over. 30 years old and made of mild steel, with Garrison-type differential-screws and additional set-screws for hex-keys at each 5"-station, right besides those, to lock the setting. These have the same diameters/pitch as the differential-screws and meet tip-to-tip between the two bars, thus locking the setting ("push-screws").



I have planed way over 100 rods on it, which means 600 butt-strips and 1200 tip-strips plus a number of mids for 3-piece rods. Planing two sides each strip this translates into several thousand times down to bare steel. I have shaved away quite some steel during this time and hacked into it a number of times, not holding the plane parallel enough to the surface. I had to true it up with a belt-sander and 240 grit paper a few times. Still, with my system, I always can set and plane a taper correctly, even on my much used planing-form. To facilitate easy operation of the differential-screws with hex heads, I welded a suitable socket-wrench to a T- bar (approx. 6 in. long shaft with a 3 in. handle).

I have also made a contact point and a corresponding calibration tool for my quad-forms, which works just as well. Planing-forms and calibration devices for a five sided rod I do not have, though. But I have included the necessary information to make one.

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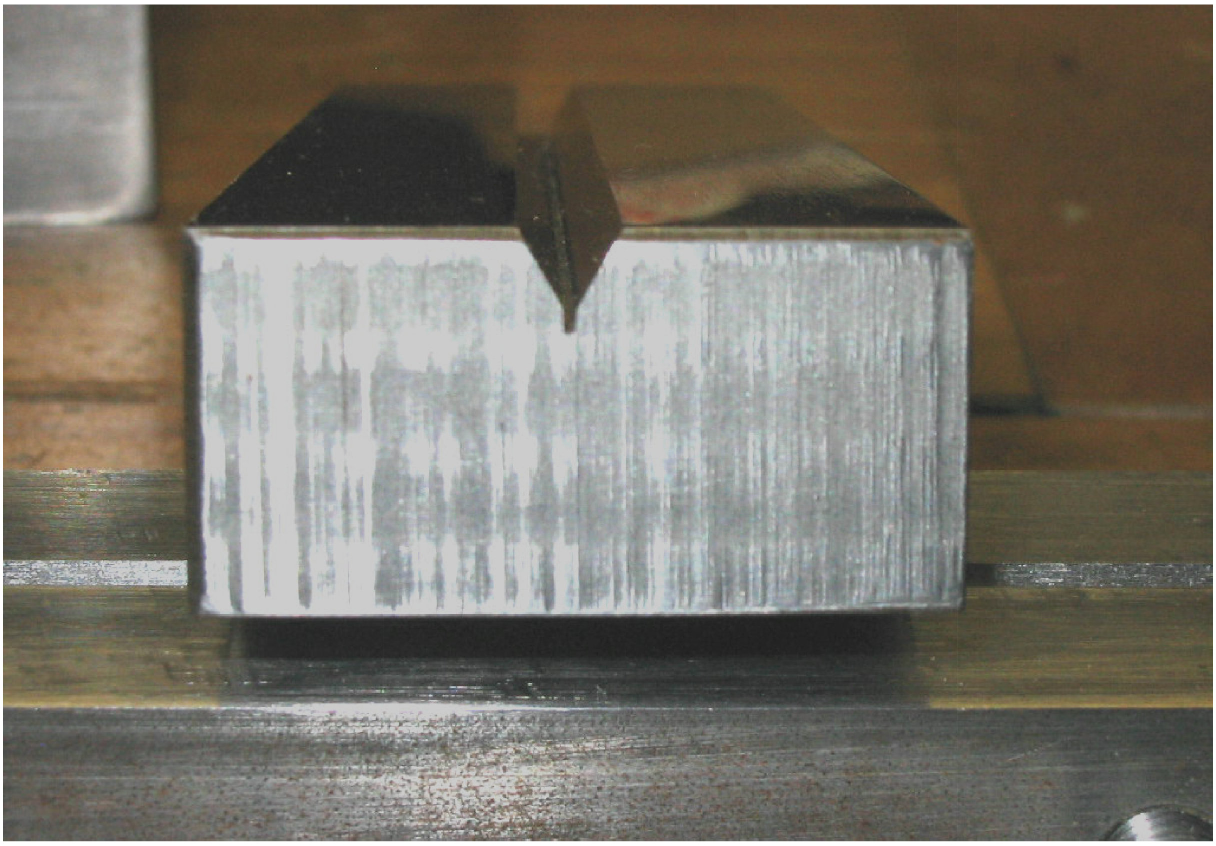
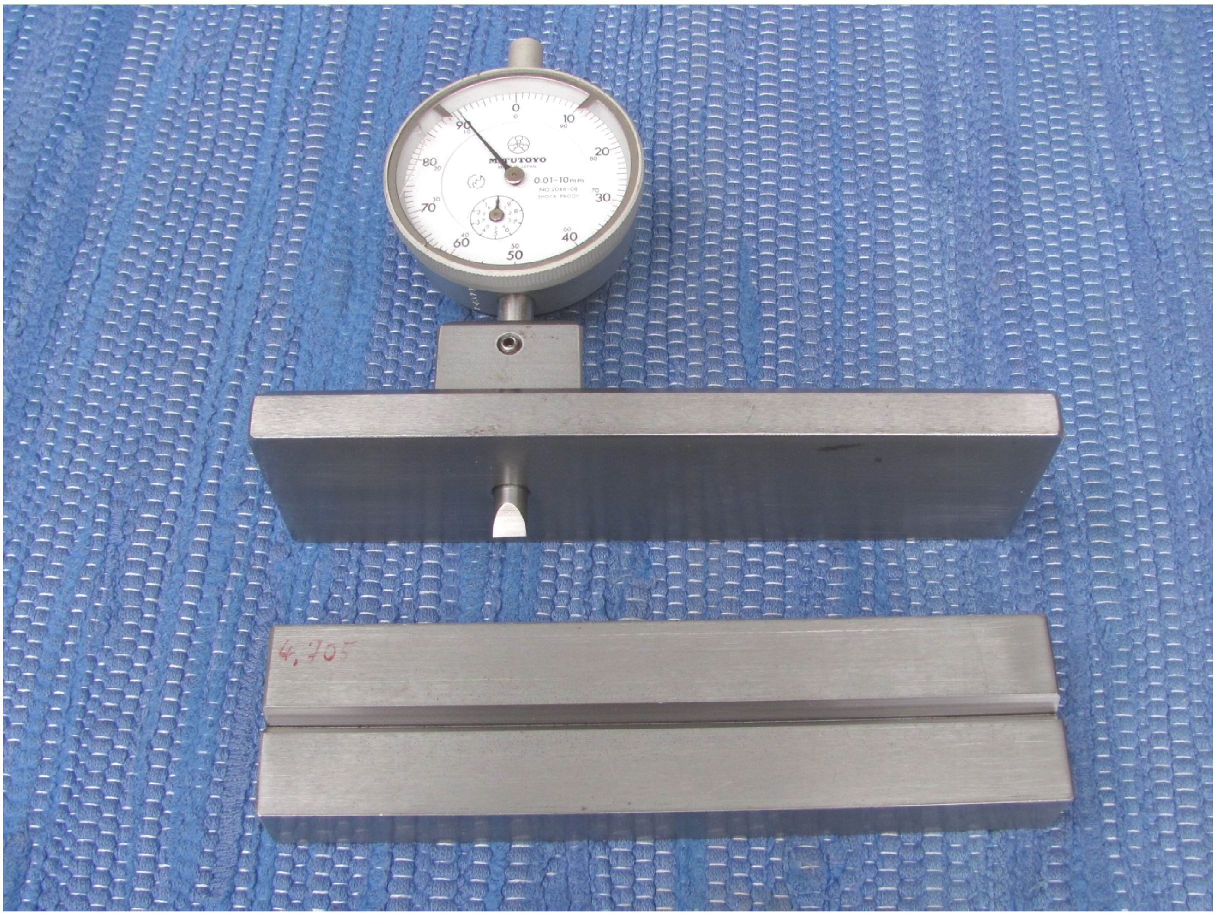
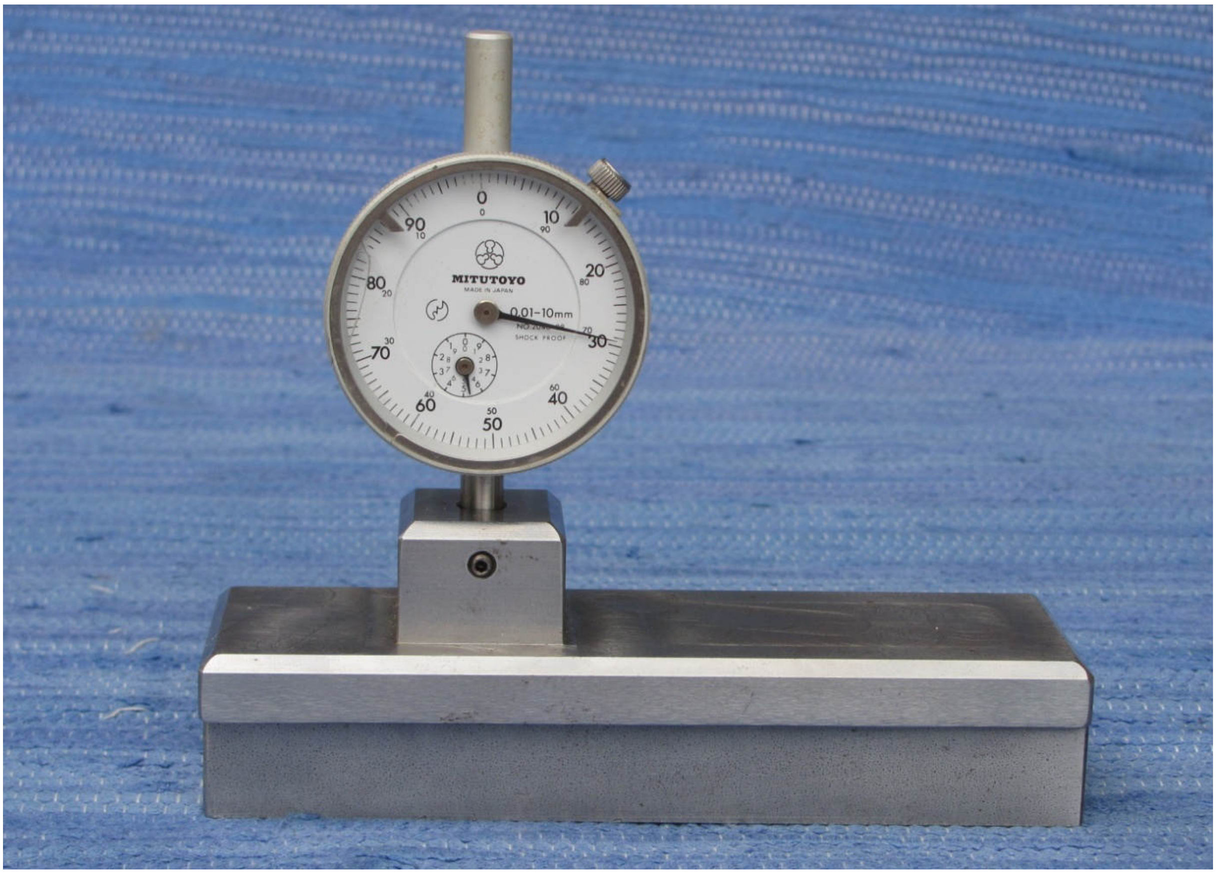
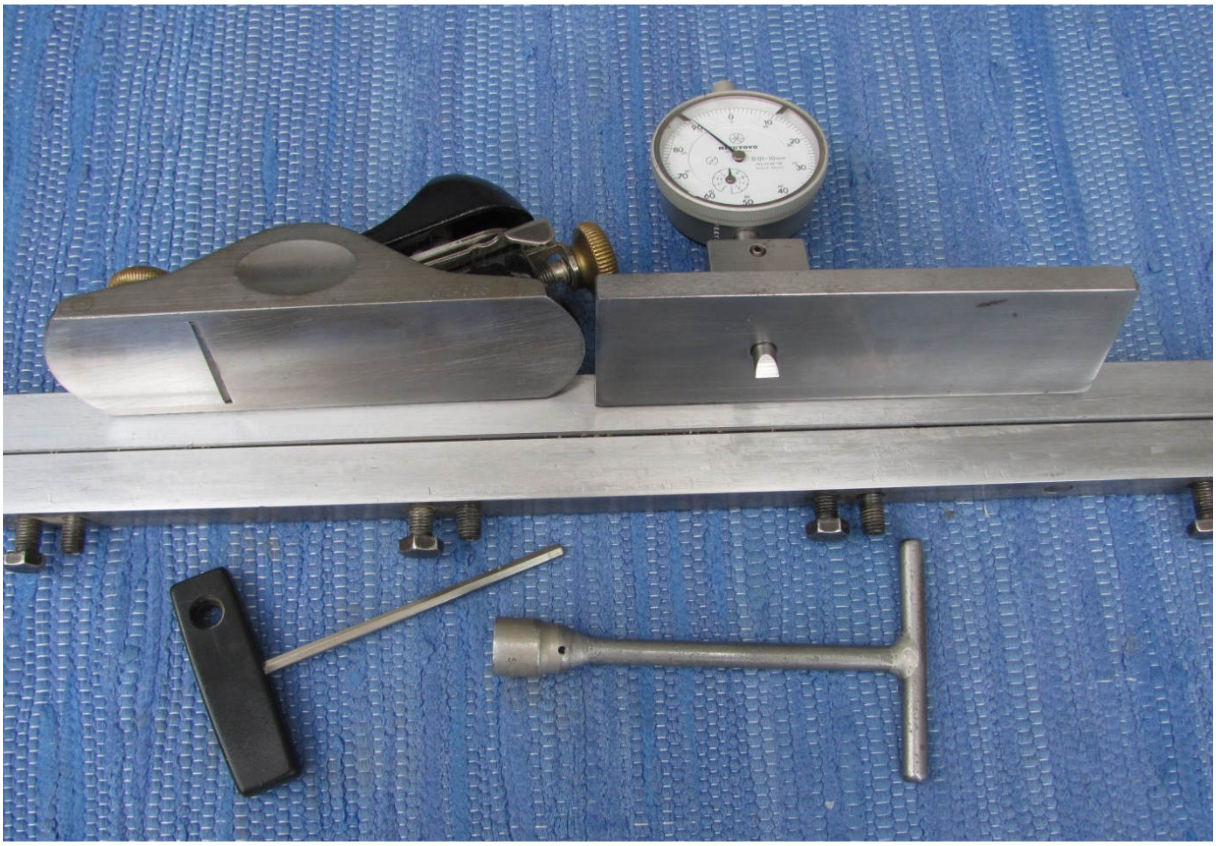
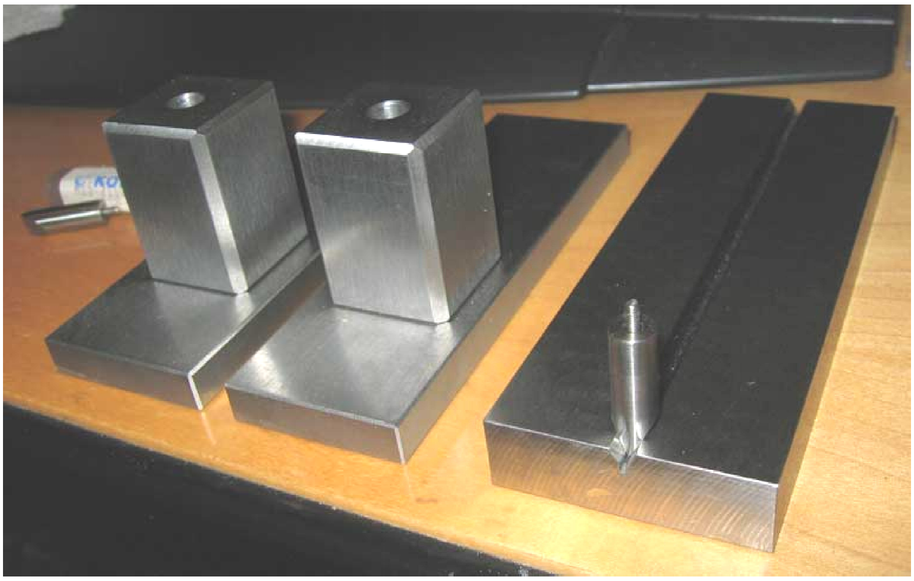
Thanks to Thomas Smithwick for proofreading.



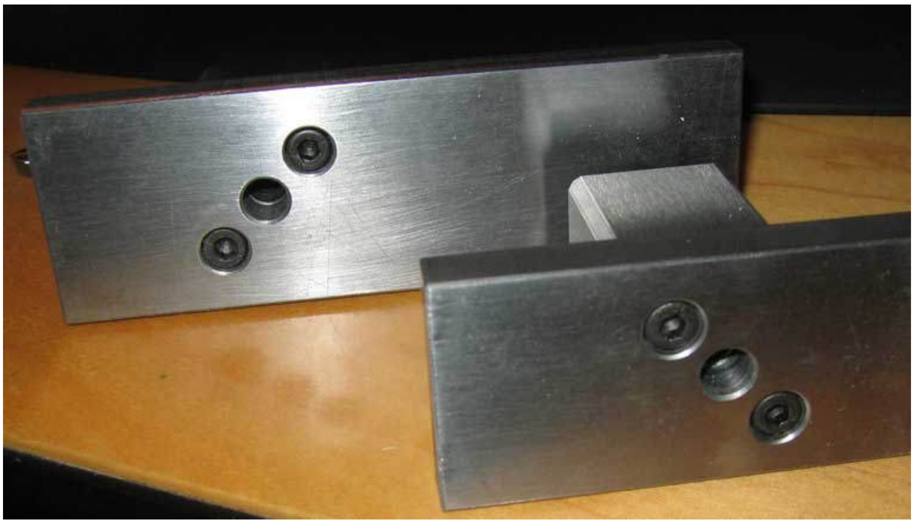

MITUTOYO
0.01-10mm
0
10
20
30
40
50
60
70
80
90
4,705


MITUTOYO
MADE IN JAPAN
0.01-10mm
SHOCK PROOF

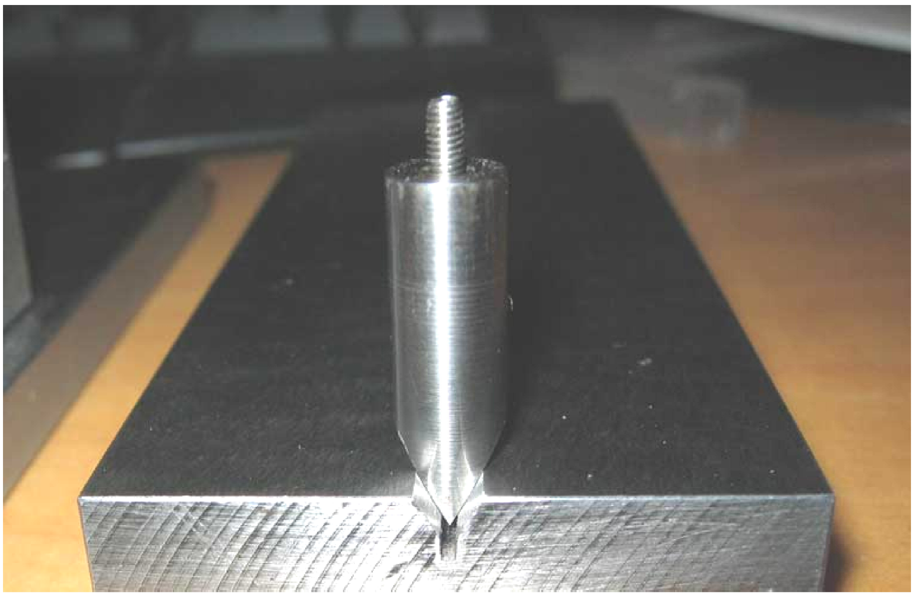




The dial indicator holder can be made separately, square or round…



… and screwed to the base plate.



A wedge-tip with threads to screw to the shaft of the dial indicator.

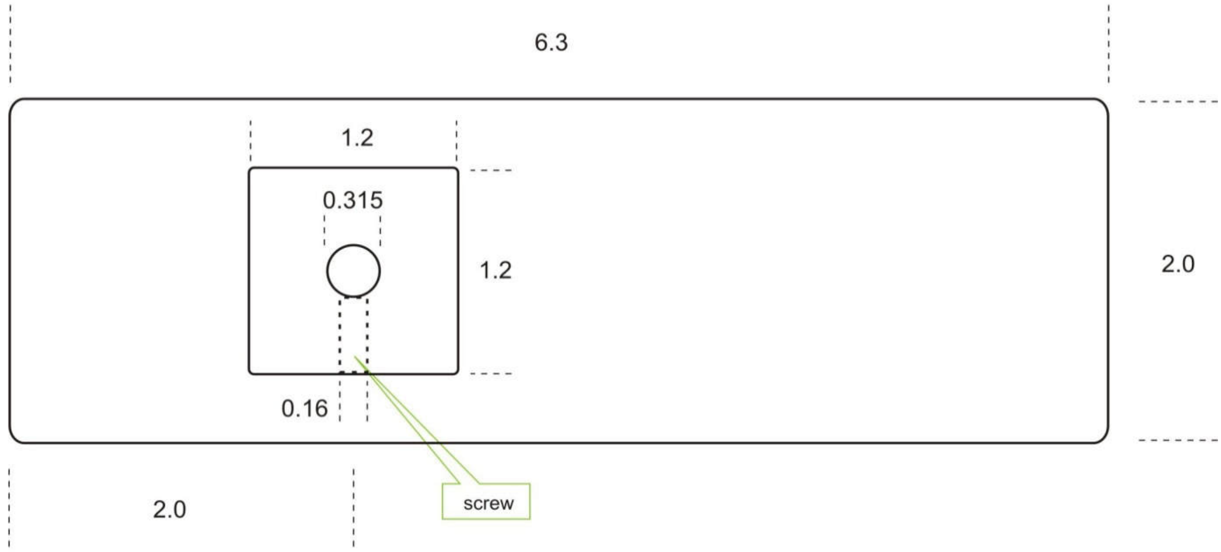
This is not a good solution, as it will not rotate.

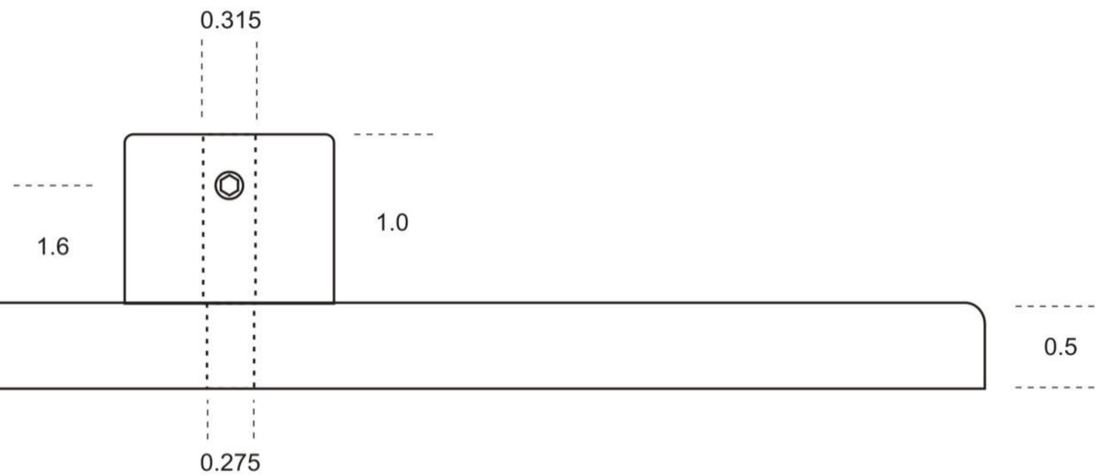
Imperial version (English)

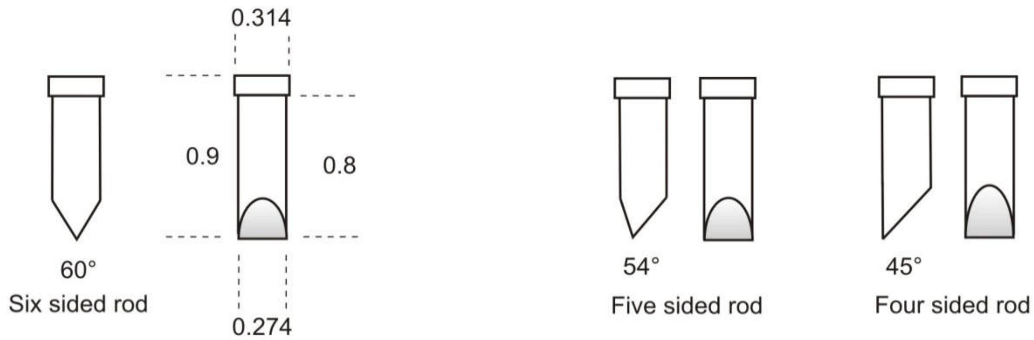
Depth Gauge 1

Drawings

All measurements in decimal inches

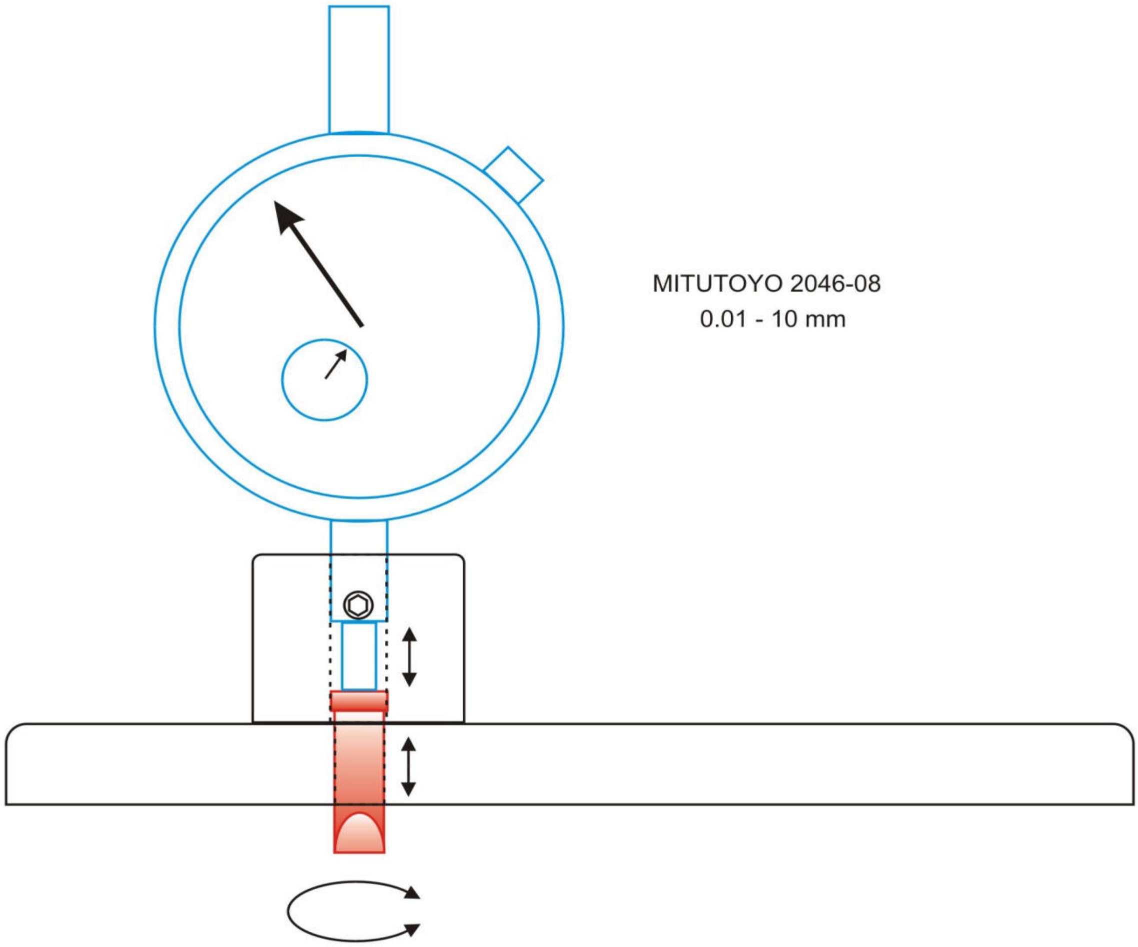


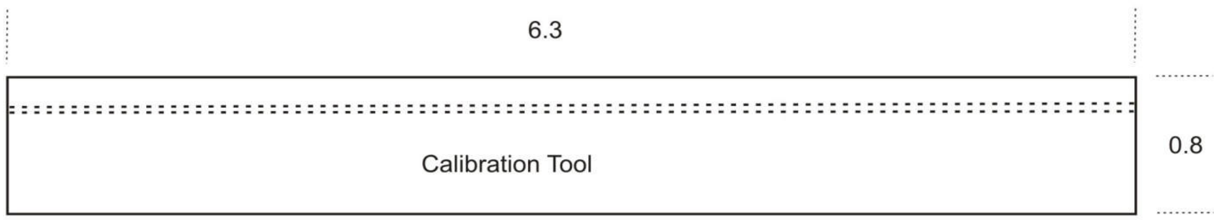


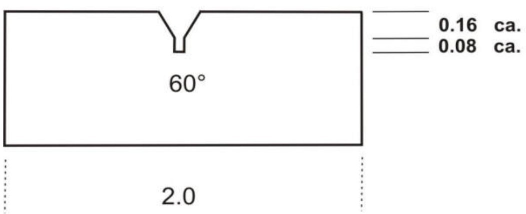


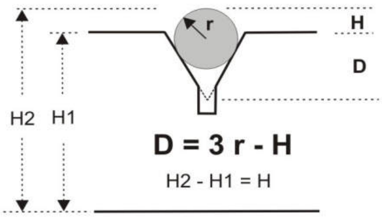
Depth Gauge 2

Assembly scetch with Dial Indicator
Calibration Tool
All measurements in decimal inches







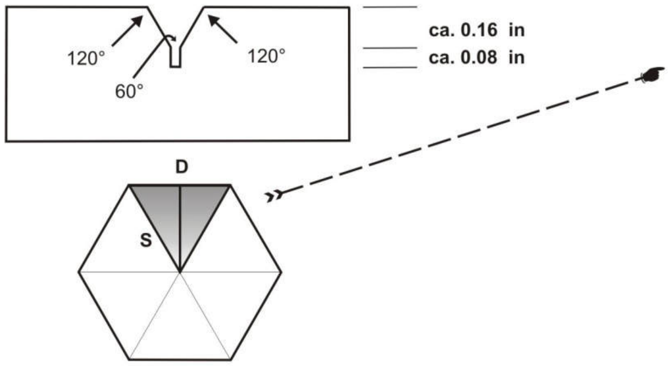


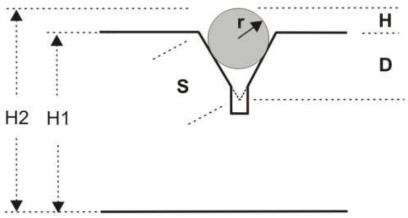
D = depth of 60° groove

Depth Gauge 3

Calibration Tool Mathematics

Not to scale

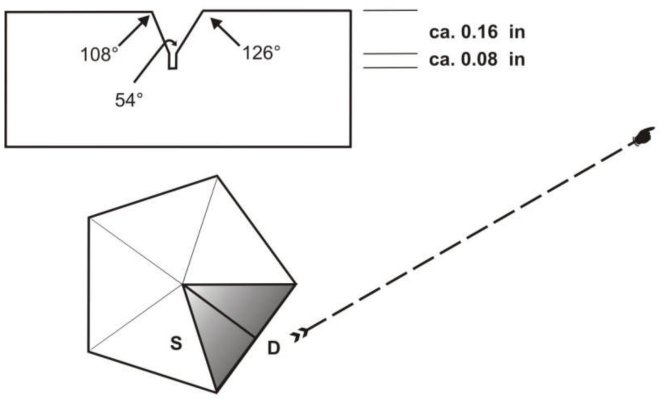


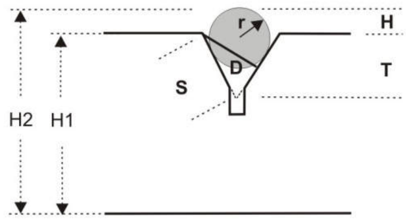


H2 - H1 = H

$$D = 3r - H$$

$$S = 2 \times D / 1.7320$$



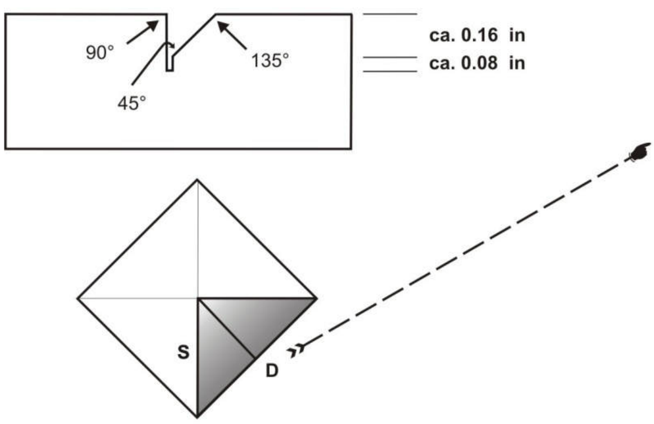


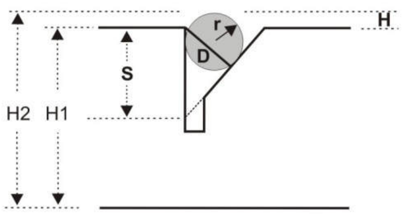
H2 - H1 = H

$$D = 2r \times 1.3507 - 0.8507 \times H$$

$$S = D / 0.8090$$

$$T = S \times 0.9510$$





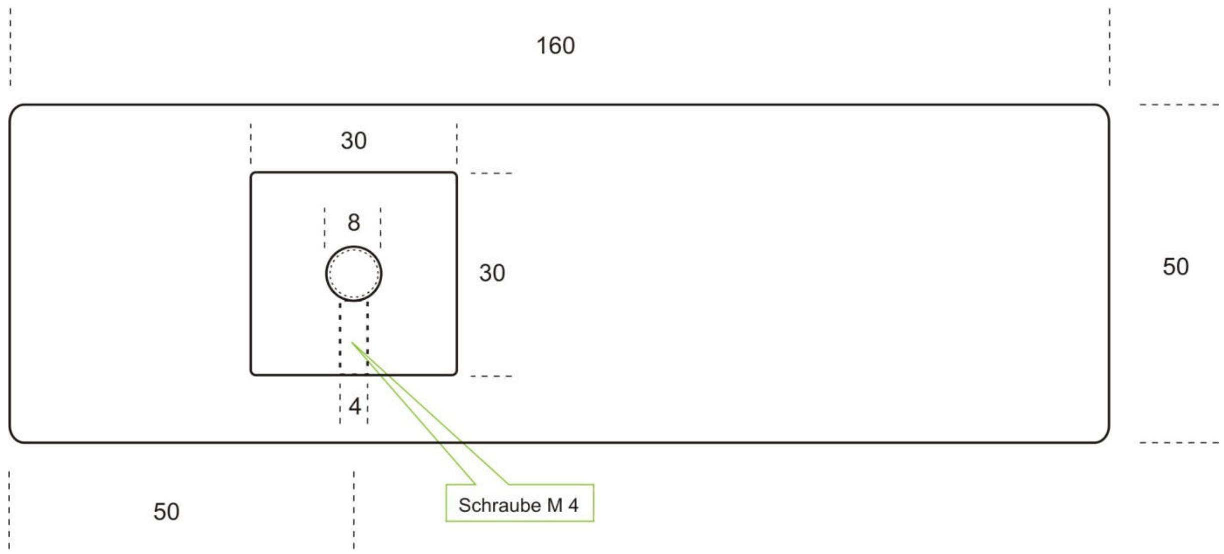
H2 - H1 = H

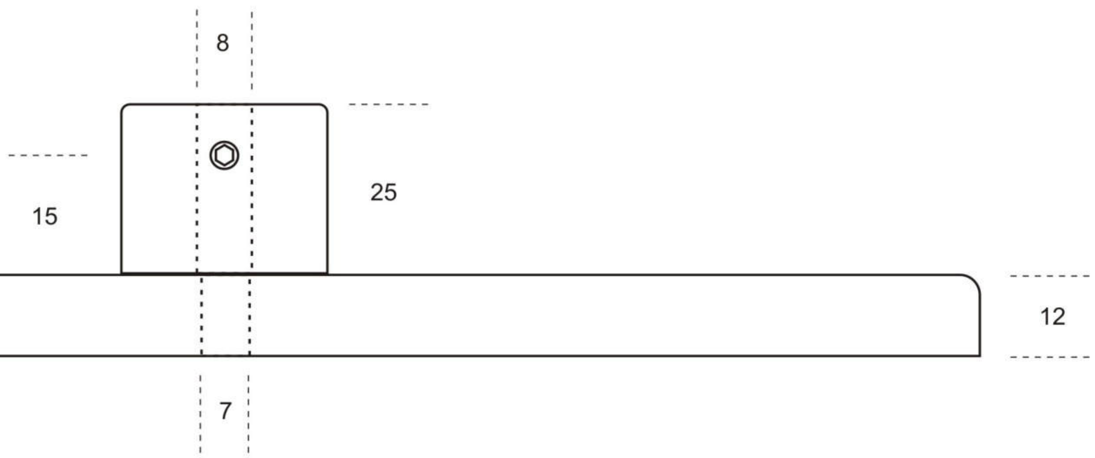
$$S = 2r \times 1.7071 - H$$

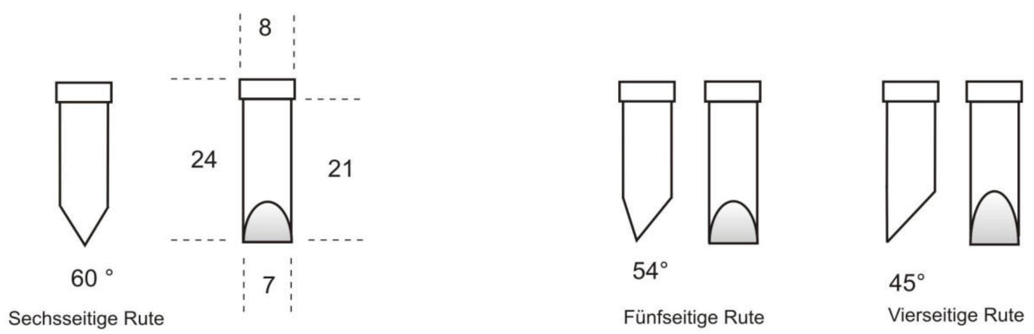
$$D = S \times 0.7071$$

Metric version (German)

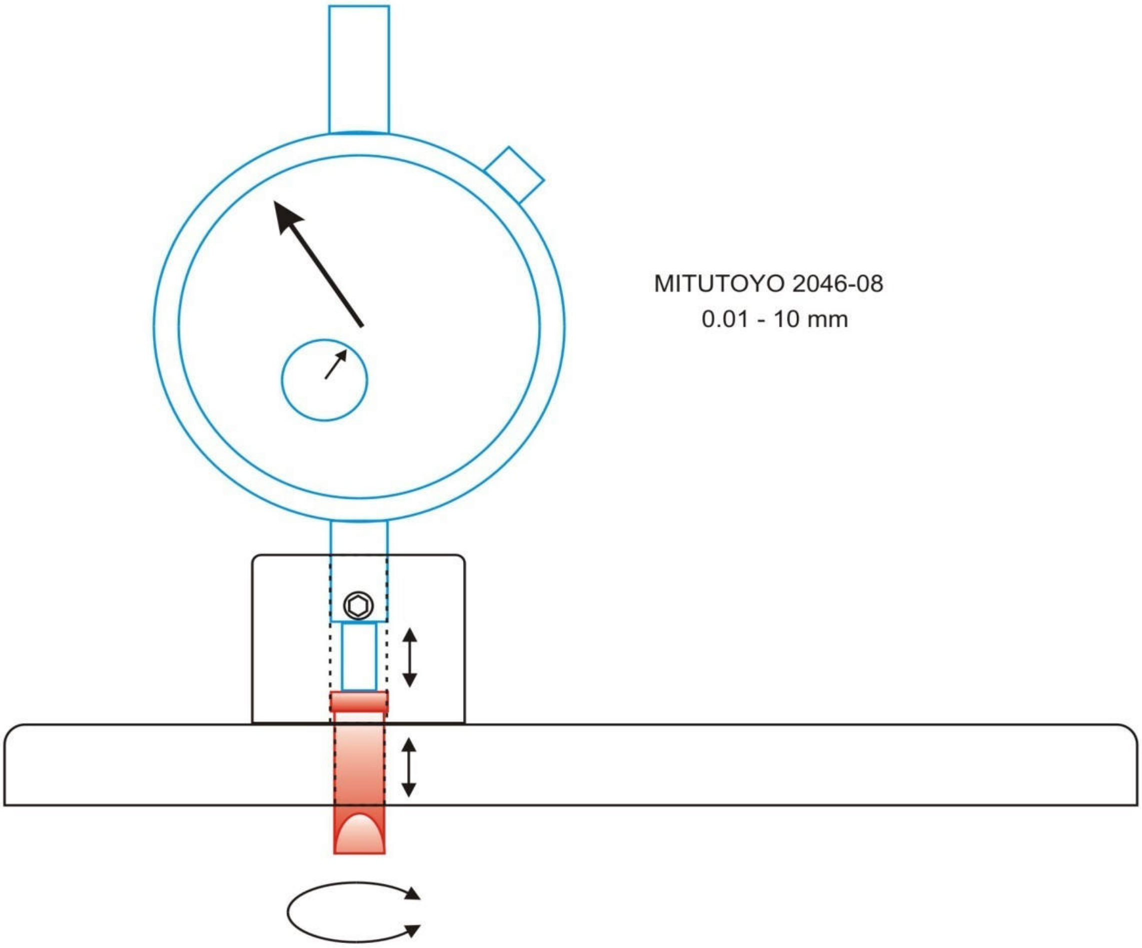
Tiefenlehre 1
Zeichnungen
Meßwerte in Millimeter

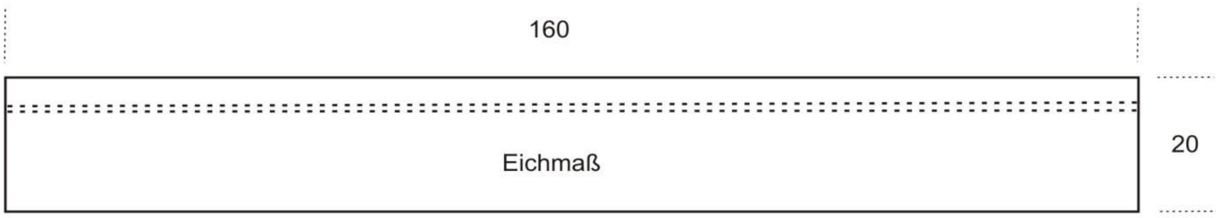


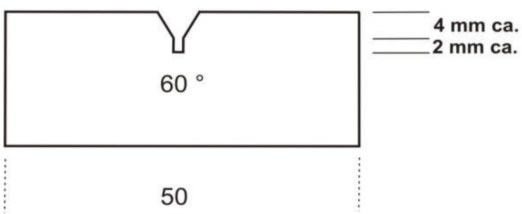


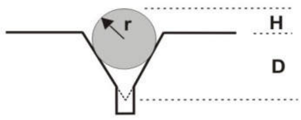


Tiefenlehre 2
Funktionsprinzip
Masse in Millimeter







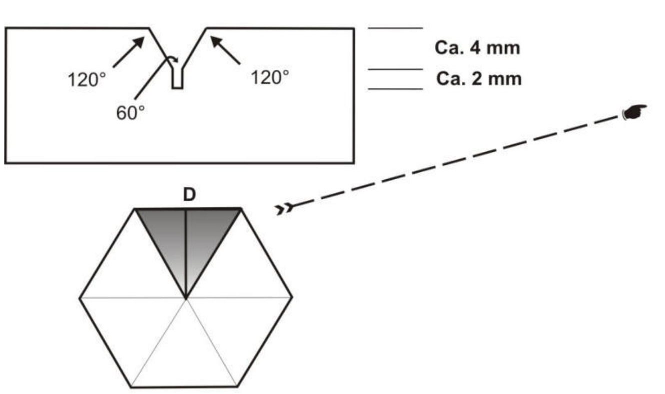


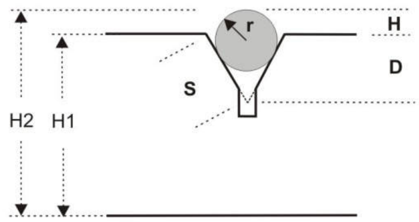
$$D = 3r - H$$

Tiefenlehre 3

Geometrie der Eichlehren

Ohne Maßstab

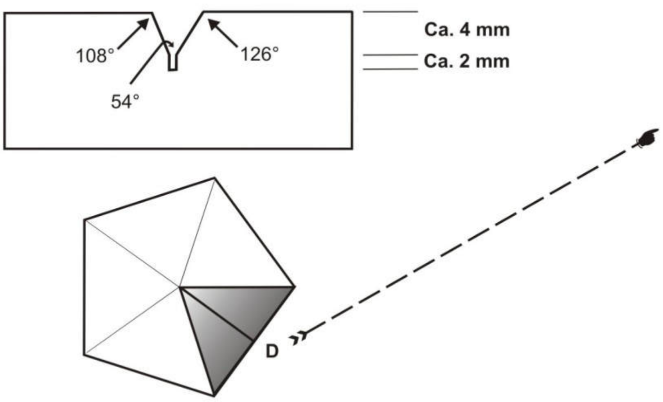


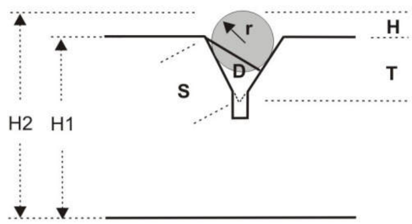


H2 - H1 = H

D = 3r - H

S = 2 * D / 1.7320



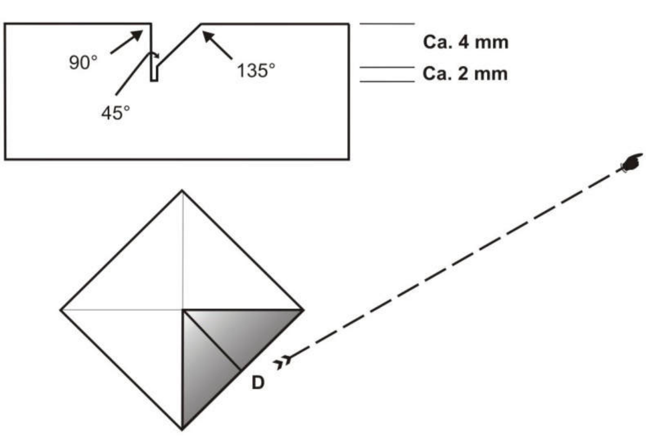


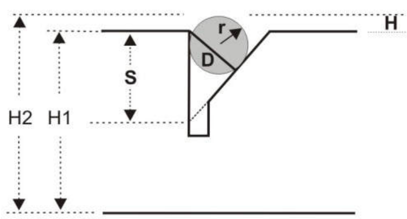
H2 - H1 = H

D = 2r * 1.3507 - 0.8507 * H

S = D / 0.8090

T = S * 0.9510





H2 - H1 = H

S = 2r * 1.7071 - H

D = S * 0.7071