
Model 406-6 and 406-6A Bore Targets



Assembly and Adjustment Manual



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Company**

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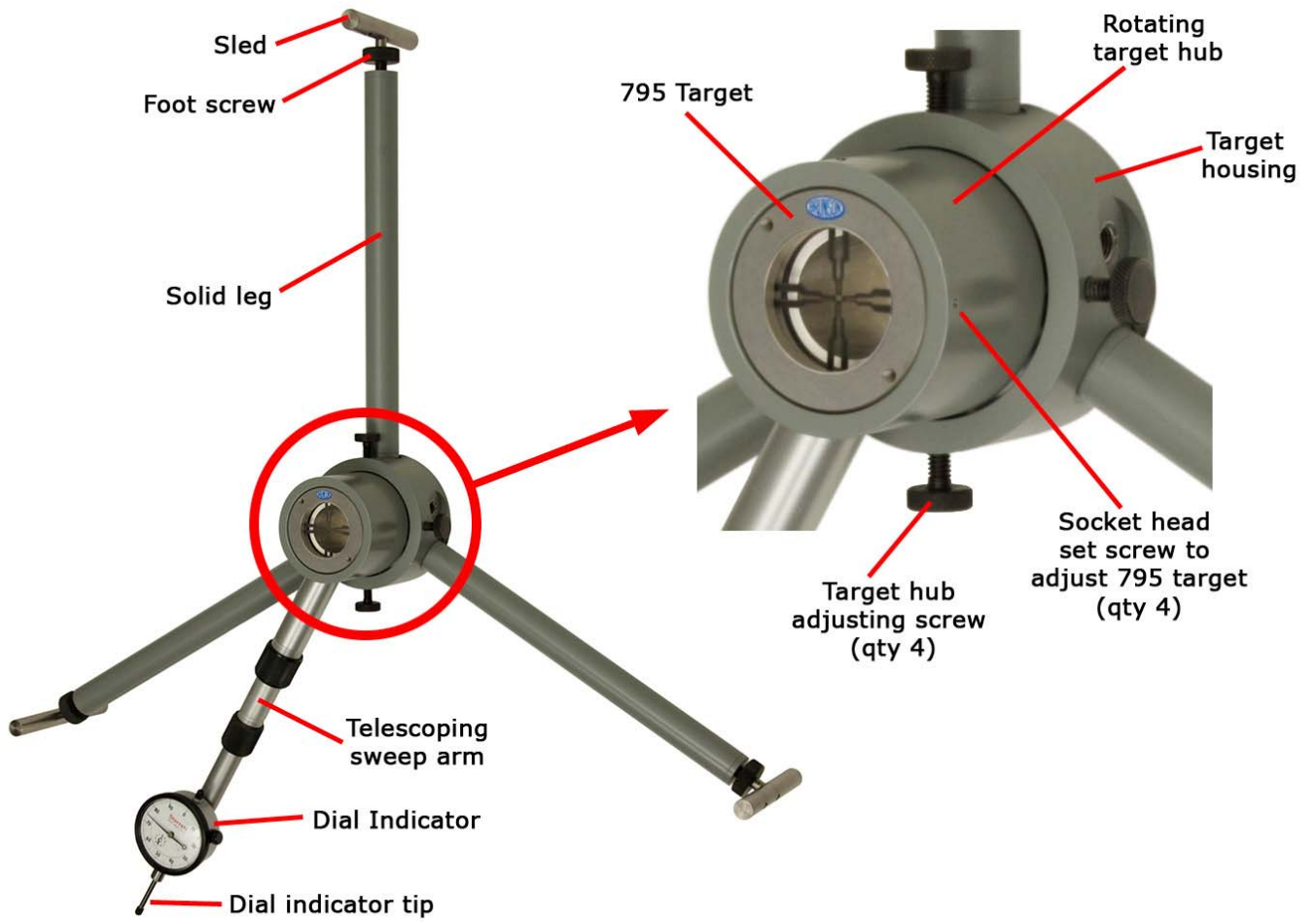
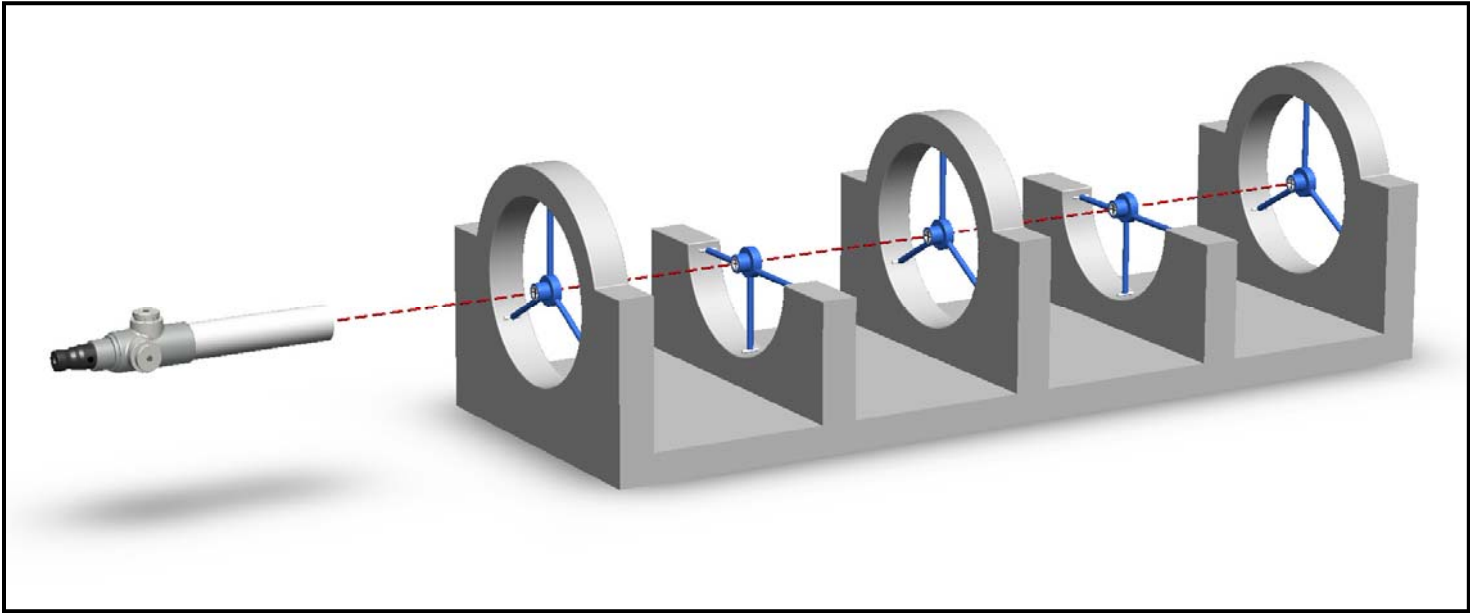
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Thank you for purchasing a Brunson Bore Target. Remember that our customer support does not stop after shipment of a product—we are here to help you with any measurement challenges that you may have.





Model 406-6 and 406-6A Bore Targets

This manual applies to the Brunson Instrument Company **Model 406-6** and **Model 406-6A Bore Targets**.

Overview

These bore targets are designed to allow the measurement of a wide variety of cylindrical holes. The bore target assembly provides a way to place an optical target exactly in the center of a bore. Accomplishing this is fundamentally a two step process. First, a sweep arm outfitted with a dial indicator is used to center a rotating hub in the bore. Then, an optical target is adjusted to the rotational centerline of the rotating hub.

Please refer to the pictures on the opposite page, or the illustrated parts list at the end of this manual, for component terminology. Also, the instructions below refer to “full bore” and “half bore” configurations. This terminology refers to the character of the bore (or bearing land), and relates to whether it is a full circle or a half circle. In the illustration opposite (top half of page), half bores and full bores are both shown.

The general assembly and adjustment of the bore target is described below.

The 406-6 handles bore diameters of 6” - 60”. It contains solid legs in lengths of 1.5”, 3”, 4”, 5”, 10”, and 20” as well as foot screws of 1” and 2”. The larger model 406-6A handles bores from 6” - 150”. It includes an additional long dial indicator sweep arm and seven additional 20” solid legs (one of these is used for extending the sweep arm).

Select the combination of legs and foot screws that locate the bore target’s hub near the bore center. A helpful formula to determine leg length is:

$$\text{Radius of bore (inches)} - 2$$

Leg Assembly

If your application has different requirements than those discussed here, consult with our Customer Service staff using the contact information printed on the inside front cover of this manual.

Attach the legs and foot screws to the target housing. Assemble the legs in the 120° positions for a full bore or in the 90° positions for a half bore. See Figures 1 (full bore configuration) and Figure 2 (half bore configuration) below.



Figure 1



Figure 2

In the photos above, ball feet are shown attached at the end of each leg. Use this type of foot only when point contacts on the bore are preferred over the sleds (which are seen in photo opposite page 1). The sled feet generally provide better stability.

Hub Assembly

Install the rotating target hub (Figure 3) into the target housing (Figure 4), first making sure that the four knurled target hub adjusting screws are backed all the way out as shown in Figure 4 below. Insert the target hub into the housing such that the four flats on the base of the hub are parallel with the wedges on the adjusting screws. Visually center the target hub in the housing and snug the adjusting screws.



Figure 3



Figure 4

If the bore is 11" or less in diameter, you must install the dial indicator directly into the target hub (See Figure 5). To do this, attach the dial indicator to the indicator mount using the 0.250" diameter socket head cap screw. The indicator mount looks like a hockey puck with a rectangle cut out of one side, and appears to form the letter "C". Place this mount (with dial indicator installed) into the target hub and tighten the four socket head set screws. Attach the correct dial indicator tip for the bore diameter being measured.

For all other bore sizes, the dial indicator is attached to the sweep arm, and the sweep arm is in turn attached to the rotating target hub.

For bores diameters of 11" - 18", use the rigid (non-telescoping) dial indicator sweep arm. One end of the sweep arm (with threaded stud) screws into the side of the rotating target hub, and the dial indicator mounts to the opposite end of the arm. Then choose the appropriate length dial indicator tip for the bore.

For bore diameters of 18" - 27", attach the short telescoping dial indicator sweep arm to the target hub and adjust to the appropriate length.

For bore diameters of 27" - 60", attach the medium telescoping dial indicator sweep arm.

For bore diameters of 60" - 150" (*Model 406-6A only*), use the long telescoping sweep arm. To reach the upper limits of this range, attach one of the additional 20" solid legs to the target hub, then attach the long sweep arm to that leg.

Insert the bore target into the bore. Adjust all three foot screws so that the assembly just fits in the bore.

Try to observe equal spacing between each of the three foot screws and its leg (see Figure 6). For full bores, be sure to insert the bore

Configure Sweep Arm and Dial Indicator



Figure 5

Note that the legs in Figure 5 are in the full bore configuration, and the sleds are attached directly to the foot screws.

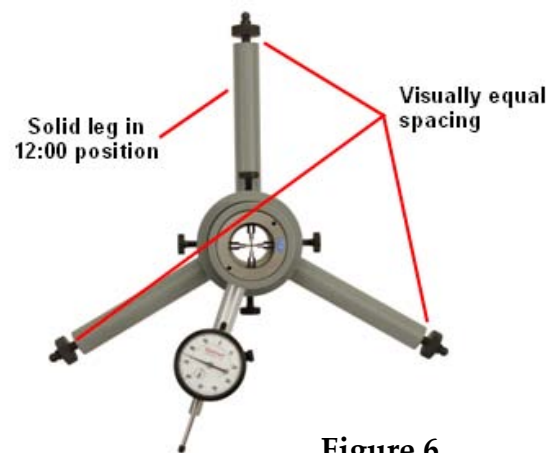


Figure 6

Install Bore Target in Bore

Position the target's sled feet (or ball feet) equidistant from the bore's edge. This assures the assembly is mounted square to the bore centerline.

target with one of the legs "clocked" to the 12 o'clock position (see Figure 7). Tighten the foot screws until the assembly is secure in the bore. Be sure to position each foot the same distance from the end of the bore using a spacer or tape measure. This will assure that the bore target is installed square to the bore centerline.

Rough Center in the Bore

Next, center the target hub in the bore. The steps below refer to rotating the "sweep arm" to various orientations. If your dial indicator is mounted directly in the target hub and you are not using a sweep arm, simply move the indicator tip to the same position as that indicated for the sweep arm in the instructions below.



Figure 7

1. Move the sweep arm to the 3 o'clock position, and "zero" the indicator. Do this by loosening the lock screw at the edge of the indicator face, and rotate the face so that it reads "0", then re-tighten the lock screw.

2. Rotate the sweep arm 180° to the 9 o'clock position. If the indicator reads less than 0.300", move on to step 6. Otherwise, continue with the following steps.

3. Adjust the foot screws on the legs at the 4 o'clock and 8 o'clock positions (*full bore* configuration) or the legs at the 3 o'clock and 9 o'clock positions (*half bore* configuration) so that the indicator moves halfway

back to zero from its current position (i.e., remove half of the apparent error). Re-zero the dial indicator.

4. Move the sweep arm back to the 3 o'clock position, and remove half of the apparent error on the dial indicator using the same foot screws as before. Re-zero the dial indicator.

5. Repeat steps 2 through 4 until the assembly is rough-centered horizontally within 0.300". Then proceed to the next step.

6. Rotate the sweep arm to the 6 o'clock position. **Follow the appropriate instruction below depending upon whether you are using the *half bore* or *full bore* configuration:**

Half bore: Adjust the foot screw at the 6 o'clock position so that the indicator reads "0". This sets the target hub nominally at the same distance from the bottom of the bore as it is from the right and left sides of the bore. Now repeat steps 1 through 6 until the dial indicator reads within 0.300" in all three positions. When you have accomplished this, skip to the section titled "Precisely Center in the Bore" below.

Full bore: Adjust the three foot screws until the dial indicator reads half of the apparent error. Re-zero the dial indicator in this position and go on to step 7.

7. Rotate the sweep arm to the 12 o'clock position. Adjust the three foot screws until the dial indicator reads half of the apparent error. Re-zero the dial indicator in this position. Repeat these steps 6 and 7 until the assembly is rough-centered vertically (i.e., the apparent error between the top and bottom positions is less than 0.300").

8. Repeat steps 1 through 8 until the dial indicator reads within 0.300" for all positions of the sweep arm.

Now that the bore target's rotating hub is roughly centered in the bore, it's time to do a more precise adjustment and bring it exactly to the bore centerline. If the dial indicator is mounted directly in the target hub, simply move the indicator tip to the same position as that indicated for the sweep arm in the instructions below.

Precisely Center in the Bore

1. Move the sweep arm to the 3 o'clock position. Zero the dial indicator.

2. Rotate the sweep arm 180° to the 9 o'clock position. Read the apparent error on the dial indicator. Remove one-half of this error by adjusting the knurled target hub adjusting screws which are on the left and right sides of the target mount. Re-zero the dial indicator.

3. Rotate the sweep arm back to the 3 o'clock position. Remove one-half of the apparent error, again using the left and right knurled adjusting screws. Re-zero the dial indicator.
4. Repeat steps 2 and 3 until the assembly is centered horizontally within project requirements.
5. Now rotate the sweep arm to the 6 o'clock position. Adjust the knurled target hub adjustment screws on the top and bottom of the target mount until the dial indicator reads zero.

If you are dealing with a *half bore* configuration, repeat steps 1 through 5 above until the dial indicator reads "0" in all three positions. Then move ahead to the section titled "Install and Center 795 Target" below.

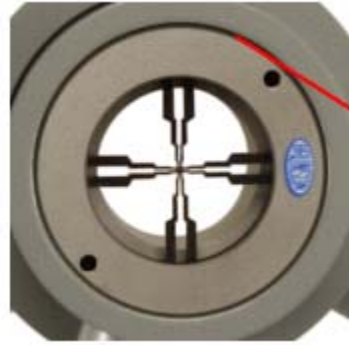
Your ability to center the bore target in the bore depends upon how well the bore is made and maintained. Bore roundness, surface texture, and cleanliness are the primary limiting factors.

However, if you are dealing with a *full bore* configuration, proceed with these steps:

6. Rotate the sweep arm 180° to the 12 o'clock position.
7. Remove one-half of the apparent error using the knurled target hub adjusting screws on the top and bottom (12 and 6 o'clock positions). Re-zero the dial indicator.
8. Rotate back to the 6 o'clock position. Remove one half of the apparent error using the same knurled target hub adjusting screws. Re-zero the dial indicator.
9. Repeat steps 6 through 8 until the assembly is centered vertically within project requirements.
10. Now check that the target hub is centered in all four positions (3, 6, 9, and 12 o'clock). Repeat steps 1-10 until the target hub is precisely centered in the bore.

Install and Center 795 Target

Next, install the 795 target into the target hub. (Carefully remove the dial indicator from the target hub if working with bores under 11" in diameter.) Be sure to align the target's "cross" pattern with the socket head set screws that hold the 795 target in place (seen in Figure 3). This will make the centering adjustments easier. Note that a small gap exists between the target and the hub (Figure 8). Visually center the target in the hub as you snug the set screws. Do not apply too much pressure to the target, just enough to hold it securely.



Gap between hub and target

Figure 8

The next steps describe the procedure to adjust the 795 target so that it is precisely on the rotational centerline of the target hub.

1. Set up the measuring instrument (alignment telescope, precision sight level, etc.) nominally on the bore centerline approximately five feet from the target, if possible. Point and focus the instrument on the 795 target.
2. Align the instrument's reticle precisely on the target pattern. You may need to rotate the sweep arm slightly to orient the target with respect to the instrument's reticle.
3. Now rotate the target hub 180° by moving the sweep arm. Using the socket head set screws which secure the target (Figure 3), remove one half of the apparent target error in this new position. Be sure to slightly loosen the set screw on one side as you gently tighten the set screw on the other side, in order to make the adjustment. *Both horizontal and vertical adjustments may be made at the same time.*
4. Set the instrument's reticle precisely back in register with the target using the instrument's tangent screws.
5. Repeat steps 3 and 4 until the 795 target is centered both horizontally and vertically within the project specifications. When you can rotate the target hub without any apparent eccentricity of the 795 target, it is centered on the target hub's rotational centerline.

When calibrating the 795 target, any sighting distance will do. Five feet just happens to be a good viewing distance to see the smallest target spacing, which in turn provides the best repeatability.

When attempting this procedure in the half-bore configuration, it is sometimes easier to remove the sweep arm than try to hold it at the 12 o'clock position. Then, just rotate the target hub by hand to the various orientations required by the procedure.

Note: Once you center the 795 target on the rotational axis of the target hub, it is not necessary to perform that procedure again, even if you move the bore target to a different position in the bore. It is only necessary to do this procedure once during the course of a job, as long as you don't remove the 795 from the target hub.

Also, the procedure used to center the 795 in the rotating hub may be done at any time during the setup process. You can even mount and center the 795 in the hub before arriving at the job site if desired. To do this, it is necessary to fix the target mount securely so that it doesn't move. This allows you to rotate the hub and observe the 795 target with an instrument to make the necessary centering adjustments.

There is an exception to all of this, of course. If you are dealing with a bore diameter of 11" or less, you have seen that it is necessary to place the dial indicator in the target hub (in lieu of the 795 target), in order to establish the initial concentricity of the target hub in the bore. In this case there is no advantage to mounting and adjusting the 795 beforehand. Also, for these small bores, note that you must re-center the 795 target in the rotating hub every time that you move the bore target from one position to the next (i.e., every time that you remove the 795 from its mount).

Perform Final Check

This final check is less necessary for the smaller bores (under 11") because the size of the bore target is much larger with respect to the bore, making it comparatively more stable.

This is especially true when using the sled feet.

It is advisable to perform a final check prior to actual measurement operations. *This final check is only possible when dealing with bores larger than 11", because the 795 target and the dial indicator must both be installed at the same time.* This check is very simple. Rotate the bore target to the various quadrants (3, 6, 9, and 12 o'clock for *full bores*; or 3, 6, and 9 o'clock for *half bores*) while making sure that the 795 is still centered when looking through the instrument. At the same time, make sure that the dial indicator reads "0" at each of the positions. If both of these checks are good, you may proceed with the measurement task.

Applications Overview

The 406-6 and 406-6A Bore Targets are capable of establishing bore centerlines on many industrial components such as extruder tubes, crankshaft bores, turbine/generator bores, vertical pumps, gearboxes and many more. The solid leg construction coupled with sled-type feet make this unit ideal for difficult half-bore and vertical applications.

Figure 9 shows how three bore targets may be employed to perform an alignment. One near and one far bore target define the reference centerline. Then, a third bore target is used as an intermediate target which can be moved to measure the desired bores against the centerline established by the other two. The 795 see-through target has multiple bifilar (paired line) patterns to provide the correct target spacing at virtually any target distance.

Bore targets may also be used to define a reference line of sight to check the geometric integrity of associated mechanical components. Machine squareness, parallelism and concentricity are a few of the parameters that can be checked or aligned when combined with other Brunson instruments.

Backlighting the train of targets is possible with a Brunson model 508-SMB target illuminator. This provides a soft, diffuse light source over the entire range of targets.

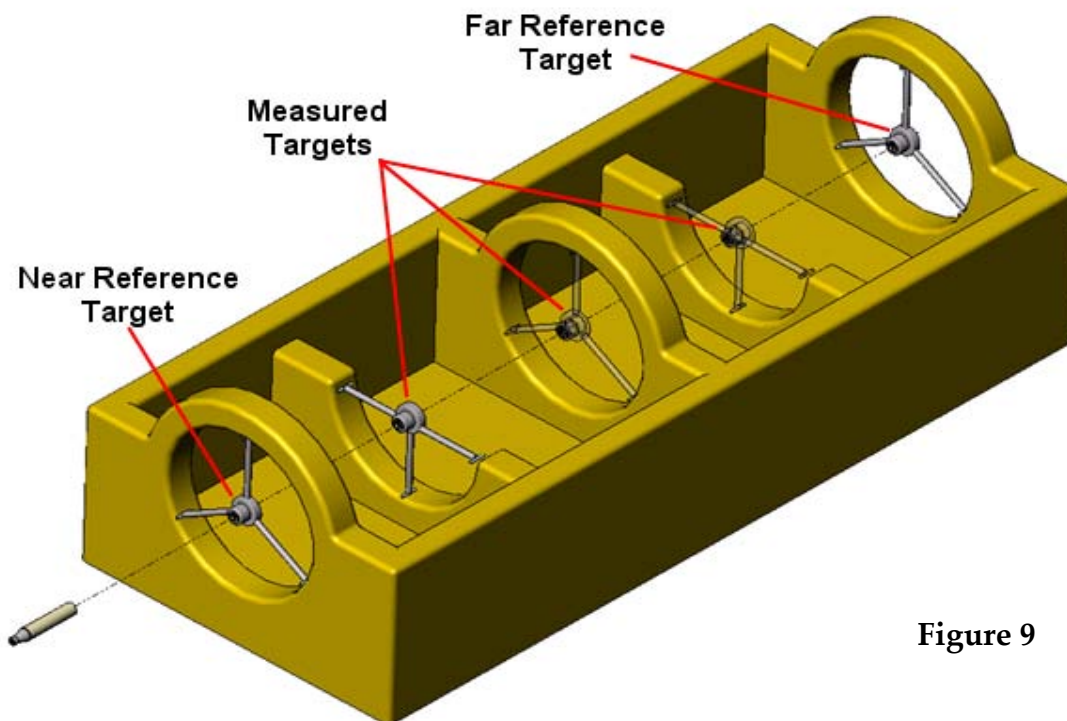
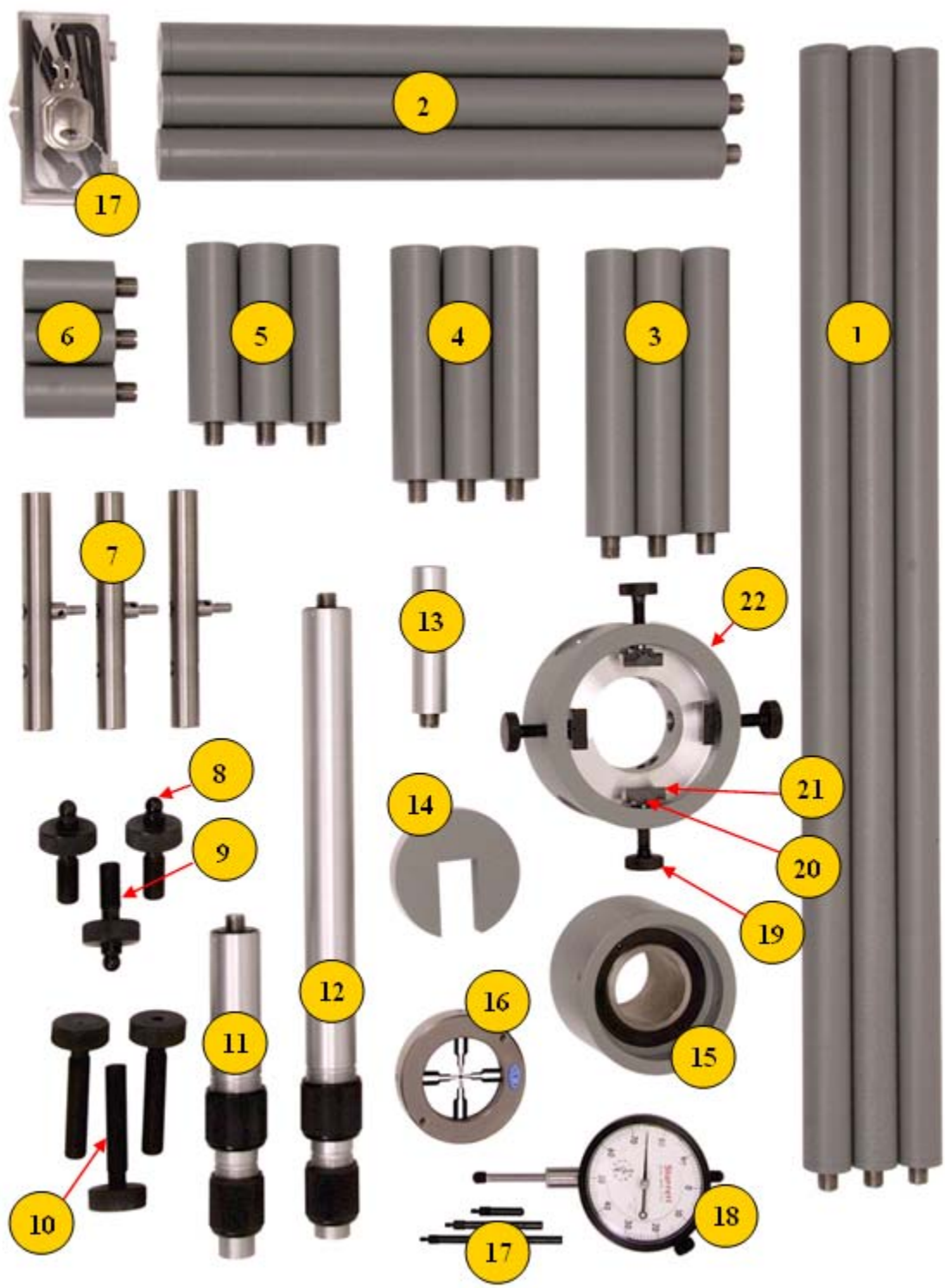


Figure 9

If you have any questions about the operation of your bore target or making alignment measurements, please contact our Customer Service staff. Remember that we also provide alignment classes. Please refer to our website, www.brunson.us, for details and class schedules.

Detailed Parts View



Parts List

Ref	Description	Part No.	Ref	Description	Part No.
1	Solid Leg (20")*	9498-G2	16	795 Target	13138-G1
2	Solid Leg (10")	9498-G1	17	Hardware Kit	9456-G1
3	Solid Leg (5")	9457-G4	18	Dial Indicator	9476
4	Solid Leg (4")	9457-G3	19	Adjusting Screw	9447
5	Solid Leg (3")	9457-G2	20	Screw-SHSS 0-80 x 1/8"	F24S00080008
6	Solid Leg (1.5")	9457-G1	21	Hub Adjusting Foot	9444
7	Sled Foot	9455-G1	22	Bore Target Base	9439
8	End-Ball	7580	NS	Carrying Case	9459
9	Screw-Adjusting (1")	9441	NS	Cushion-Upper	9492
10	Screw-Adjusting (2")	9441-1	NS	Cushion-Bottom	9491
11	Sweep Arm (short)	9495-G1	NS	Cushion-Lower Bottom <i>M406-6A only</i>	9505
12	Sweep Arm (medium)	9495-G2	NS	Stiffener-Foam Back <i>M406-6A only</i>	9506
13	Rigid (non-telescoping) Sweep Arm	9478-G1	NS	Sweep Arm (long) <i>M406-6A only</i>	9495-G3
14	Mount-Dial Indicator	9442	NS	Manual—M06-6 and M406-6A	PUB 406-6
15	Rotating Target Hub	9458-G1			

* The 406-6 contains three 20" legs, the 406-6A contains ten 20" legs

NS = Not Shown