Filter Judge
USABlueBook Stock# 60855 & 60856
Gravity Filter Media Core Sampling Tool

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FILTER JUDGE ASSEMBLY INSTRUCTIONS

The Filter Judge has been designed to fit together without the need to force pieces together. It was assembled at the factory to make sure that it fits. If something does not appear to be fitting during assembly, then take it apart and try again—the use of force may break or damage parts that are made to easily fit together.

Please read these instructions all the way through before starting to assemble the unit. Failure to do so may result in injury to the person assembling the tool and/or may result in damage to the tool itself.

- Although assembly of the tool with only one operator is possible, it is easier if two people are involved.
- Allow the tool to reach room temperature before assembly (approximately 70 degrees F).

Step 1: Open the carrying case or cases (units in excess of 12 feet in length will have more than one carrying case). Remove all packing tape and cushioning material from each piece. Inspect for any damage. If there is any damage please notify USABlu eBook for replacement parts (a one-year warranty applies to all newly delivered units) at 800-548-1234.

Step 2: Begin assembly by connecting the very bottom (slotted) piece to the next unit. For 8 foot basic units, the bottom piece will be connected to the top piece (the one with the handles). For all other units (12 foot and longer), start by connecting the bottom piece to the first 4 foot extension piece. (The 12 foot unit has only one extension, the 16 foot has two extensions, etc.).

Step 3: Pull the lower inner piece out of the lower outside piece so that it can be screwed into the inner part of the next piece. (Extension pieces have female lower threads on the inside piece).

Step 4: The inner bottom and the inner next piece should screw together by hand. Once the threads have bottomed out, do not force the units together any tighter. Hand tight is all that is necessary—any tighter will be very difficult to disassemble and could damage the unit.

Step 5: Assemble the bottom section to the next section by connecting the cam lever couplings of the bottom section and the next section. Screw the handles into the threaded sockets on the branch of the tees (hand tight).

Step 6: Repeat this process until all of the inner and outer section are together. Each of the inner pieces must be fully bottomed out before the outer sections can be coupled together. Do not use the machined shoulders (or “flats”) on the male and female inner couplings for assembly—theese shoulders are for ease of disassembly only. Support the unit at four foot intervals on saw horses or pipe stands so that the entire unit is linear and concentric. This will help the operator assemble the tool quicker and easier.

Step 7: While the inner units are being threaded together, do not use your fingers to keep the bottom unit from turning while the next higher unit is being twisted onto the lower inside unit. This may result in injury to the operator’s fingers when the units bottom out. Instead, insert a ¾” wooded dowel or similar object into the slot to keep it from moving and to reduce the opportunity of hurting the operator’s fingers.

Step 8: Once all of the pieces are assembled, turn the top and bottom handles such that they are aligned with each other. Next, open the cam lever coupling between the bottom and the next higher piece.

Step 9: While holding the two handles in alignment with each other, turn the outer bottom piece until the slots of the outer piece line up with the slots of the inner piece. Fold the handles of the cam lever coupling back down to lock it in place. Step 9 causes the inner and outer slots of the bottom unit to be aligned when the handles of the top section are aligned.

Step 10: Take samples, evaluate media depth, look for mudballs, look for uneven layers of media, etc. per the operating instructions.

Step 11: When finished sampling, clean out all remaining media from inside the bottom tube. Wipe all moisture from the inside and outside, and place back into the carrying case. It is important to store the unit in the carrying case while not in use so that the PVC pipe components do not warp or become brittle. Warped and/or brittle units will result in a Filter Judge that is no longer easy to use and/or results in a unit that provides undependable samples.
FILTER JUDGE OPERATING INSTRUCTIONS

1) Once the tool is fully assembled, the operator can simply lower the tool (handles turned so slots in lower section are closed) to the top layer of filter media prior to the start of a mild backwash flow cycle.

2) A backwash cycle should be started. As the flowrate gradually is increased, the tool will settle under its own weight to the top of the filter underdrain (or to the top of the gravel layer in systems that do not have a gravel-less design). At this flowrate the filter media is slightly fluidized.

3) The operator then simply turns the top handle on the Filter Judge one half of a turn, which causes the slots on the inside tube to line up with the slots on the outside of the tool. The media then falls into the tool, and the operator simply turns the handle on the top of the tool another half of a turn to close the tool and capture the sample.

4) The tool is then pulled from the filter cell. The water in the sample drains from the annular space between the inside and outside tubes. The tool can be laid on a horizontal surface where the operator once again turns the top handle one half of a turn to expose the captured media for inspection. Measurements of the media can be made with the handy waterproof ruler attached to the side of the slotted bottom section. The presence or absence of mudballs can be noted, as well as the depth of the interface zone between layers of media.

5) The operator can pull out the media for testing, or can return the media to the filter cell.

6) This process is repeated throughout the filter cell until the operator is satisfied with the results.
Filter Judge Cautions:

1. The Filter Judge is designed to take a sample during a slight backwash flowrate (about 3 to 5 GPM per SF of filter surface area). The operator must be able to backwash his filter at this low flowrate for the tool to take a representative sample.

2. The Filter Judge is not designed to take samples of liquids or materials with high water content (such as sludges). It is specifically designed to take core samples of granular water treatment plant filter media.

3. The Filter Judge is not designed to take samples of the gravel support layers common on older styles of filters. The top layer of gravel is not much larger than the sand it supports, but the tool will not sample the gravel. The tool will become locked up if gravel is sampled—which means that the tool must be pulled out and cleaned before being used again.

4. The Filter Judge works well for filter media no larger than the following:

<table>
<thead>
<tr>
<th>Material</th>
<th>Effective Size</th>
<th>Uniformity Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthracite</td>
<td>Between 0.95 and 1.05 mm</td>
<td>Less than 1.30</td>
</tr>
<tr>
<td>Sand</td>
<td>Between 0.45 and 0.55 mm</td>
<td>Less than 1.40</td>
</tr>
</tbody>
</table>

Particles that exceed these sizes will likely cause the Filter Judge to lock up and are therefore not recommended.

5. Do not force the tool down into the media—let it settle under its own weight. If it does not settle under its own weight then increase the backwash flowrate until it does. If the maximum backwash flowrate won’t allow the tool to settle under its own weight then the underdrains may be plugged, the backwash flowrate is not adequate to expand the media, or both.

6. Since the tool requires media bed expansion to operate properly, it can only take a sample of the media in its expanded depth. The nominal 4-foot bottom has a sampling section that is 39” at the maximum. Therefore, for example a bed with 37” of total sand and anthracite cannot be sampled with the 4-foot bottom because the expanded depth may exceed the 39” of available sampling depth in the 4-foot bottom. In that case, it is recommended that the nominal 6-foot bottom section be used instead of the 4-foot bottom.

The 6-foot nominal bottom section has a top opening that is about 66” from the tip. This allows it to sample about 60” of media.

7. The Filter Judge is not actually built in 4-foot or 6-foot increments. The sizes referred to or shown in the catalog or web site are actually nominal lengths. The “4-foot” sections are actually a bit less than 4 feet so that they can be shipped in standard cases.
8. Some operators may be tempted to order only an 8-foot tool, thinking that they can simply stand on the backwash trough to take samples. This is very dangerous and is not recommended under any circumstances.

9. Make sure there is enough space vertically above the filters to lift the tool out of the filter. Generally speaking this is not a problem in warmer climates, but may become an issue in colder climates where filters are situated indoors due to the possibility of freezing.

10. The Filter Judge tool is too long, even in its shortest (8-foot) configuration, to be easily assembled with only one person. Therefore, it is best to have two people put it together. However, do not fall to the temptation to put your fingers into the bottom sampling slots to keep the inside piece from rotating while you are screwing the inside threaded components together. Whenever the threads “bottom-out”, the person with his fingers in the slots will be pinched rather hard by the person that is using the long handles to thread the pieces together.

Instead of using your fingers, insert a piece of ¾” PVC pipe into the openings. Once the threads are bottomed out, then the PVC pipe can be removed from the slots.

Next, line up the handles. If the slots on the bottom are not lined up when the threads of the inside piece have bottomed out, then simply release the levers of the cam-lever coupling on the bottom section and rotate the bottom outside piece until the slots line up. The close the levers and the tool will be in its proper position (when the handles are lined up then you know that the slots are, too).

11. Always rotate the top handle in a clockwise direction while keeping the handle of the bottom section in the same position. This should keep the inside sections from unscrewing. If you rotate in a counter-clockwise direction then the inside pieces may start to unthread and you will not be able to properly rotate the tool for taking a sample.

12. If your filter has a gravel support layer, do not let the tool drop down into the gravel layer. As previously mentioned, the tool is not designed to sample gravel and it will get locked up if the operator tries to sample the gravel.

Although the top gravel is not much larger than the sand, in most cases the gravel is too large. The two bottom pieces will become locked up with the gravel in the annular space between the outside of the inner section and the inside wall of the outer section.

Should this happen, simply unlock the cam-lever couplings on the bottom sampling section and pull the inner section out and wash away the gravel. The next time the tool is inserted into the cell, do not let it go down into the gravel layer. You will quickly develop a feel for the difference in the sand and the gravel as the tool is being inserted.

13. There is no need to worry that a hole will be left in the media after the Filter Judge has pulled a core sample. During the mild backwash required, the hole where the media was removed collapses upon itself as the tool is withdrawn. There is no danger of creating a short-circuit.

14. The Filter Judge is not generally designed to take samples of pressure (“kettle”) filters. Since the top access hatch must be open in order to insert the tool, and since the media must be fluidized with a mild backwash for the tool to work, the only way for the tool to possibly work is if the backwash drain line or trough is below the top access hatch enough to keep it from overflowing during the sampling operation. Even then, a sample can only be taken below the access hatch. Using the Filter Judge to sample pressure filters is therefore not recommended.
USING THE FILTER JUDGE AS A TROUBLESHOOTING TOOL

The Filter Judge may be used to discover or diagnose some of the following problems associated with gravity filters:

1. *Loss of filter media*— Measuring the depth of media remaining in a filter cell is the primary use of the Filter Judge. If the depth of media is significantly different than the amount originally installed it may be a result of improper filter operation. A rule of thumb from some media manufacturers is that an inch or so of media will be lost every five years. However, the amount of media that is actually lost depends on several factors:

   - **Backwash flowrate**— A backwash flowrate in excess of the manufacturer’s recommendation may force the media in the top layer (usually anthracite) over the top of the backwash trough. Since the top layer has the lowest specific gravity of any of the media layers, it is the layer most likely to be washed out of the filter cell if the backwash flowrate is excessive. Look for grains of anthracite in the backwash trough immediately following a backwash cycle. If grains of anthracite are present, then consider lowering the backwash flowrate.

   Conversely, if the backwash rate is too low, then adequate flushing of the media may not occur. This may result in short filter run times, and / or turbidity breakthrough. Take a sample of media at the start of backwashing, and compare the amount of trapped material in it to the amount of material trapped in a sample taken at the end of the backwash cycle. If the difference is not significant, then the backwash flowrate may need to be increased.

   - **Backwash duration**— A certain amount of time is necessary to flush trapped particles out of the filter media, but any time in excess of that amount increases the likelihood of media being washed into the backwash trough. Installing a backwash turbidity meter may tell the operator when to stop backwashing when the turbidity target has been reached.

   - **Air scour intensity**—Air scour is used to agitate the particles so that when they rub against each other the agglomerated material on the grains of media is loosened, which then allows the backwash flow to remove the material easier than if the air scour action was not used. However, if the air scour flowrate is too high then the media may be damaged, leading to smaller media and a change in the operating characteristics of the filter. Take a sample of the media and have a laboratory compare the effective size and uniformity coefficient against the original material specification.

   - **Air scour duration**— Just as with the intensity of the air scour flowrate, leaving the air scour on too long may result in damage to the media, which in turns allows the backwash flowrate to remove media particles. Every filter is different, so you may need to experiment to find the optimal length of time to run the air scour blower. Start with the time recommended by the underdrain manufacturer. Vary the amount of time of air scour operation to see which one results in the lowest required backwash rate and time to achieve the desired turbidity target.

   - **Proximity of the top of the media to bottom of the backwash trough**—If the top of the filter media is too close to the bottom of the backwash trough, then when the media is expanded during backwashing the top portion of the media may be in the higher velocity portion of the backwash flow near the trough. This may result in some of the media being washed into the trough and out to waste.
• Damage to the filter underdrain system—Holes in the underdrain system, improperly connected air lines, and / or separation between the walls and the underdrain can cause short circuits. Short circuits may result in short filter runs. Take samples from different areas around the filter cell. If the depth is not consistent then the damage may be localized. Isolating and repairing a problem of this nature is very difficult and time consuming. Eliminate all other possibilities before dewatering and removing filter media.

2. Mudballs—Mudballs are accumulations of materials that have not been removed from the filter media. Mudballs can range in size from pea-sized to several inches in diameter. Some operators have even reported seeing mudballs that were several feet in diameter, although this condition is rare.

While taking samples for depth of media, look in the sample for signs of light brown balls. The Filter Judge can only capture mudballs that will fit into the sample column. Rake the media with your finger to see if there are any mudballs in the sample.

Mudballs are generally the result of improper backwashing operations (i.e.—backwash flowrate too low, backwash cycle being too short, air scour flowrate too low, air scour not long enough, and / or inadequate filter bed expansion).

Inefficient clarifier operation may be overloading the filter. If the clarifier is not achieving a 10:1 turndown in turbidity, then it may not be functioning as designed. For example, if the raw water turbidity coming into the clarifier is 30, then the settled turbidity leaving the clarifier going to the filter should be at least a 3, preferably less.

3. Water temperature— As water gets colder, it also increases in density. Backwash flowrates may not need to be as high in colder months due to the higher density of the water used in the backwash cycle. Similarly, if the water is cold, then the increased density may bring more solids out of the clarifier to increase the filter loading.

All water plant filters are different. Even if they are the same size, they will all have their own unique operating characteristics. It is therefore very important to regularly check your filter media so that you have an opportunity to catch any changes in operation before the problem gets out of control. Taking samples and measurements shortly after the filter has been installed will provide the operator with a benchmark that he can use to compare against in the future.