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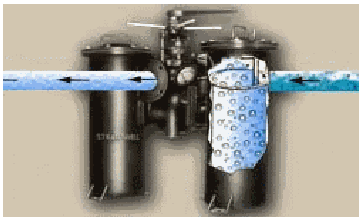
The Purpose, Use and Care of In-line Liquid Strainers.

Training For Operators, Maintainers, Technicians and Engineers.

Training Objective

This training teaches users and maintainers of in-line process liquid strainers why they are used, how they work, what causes them to go wrong and what is necessary to keep them operating properly all the time, every time.

Training Contents

- Purpose of the equipment.
- The principles of how the equipment works.
- Important parts and assemblies.
- In-service design and operation.
- How the equipment achieves its purpose and the necessary operating conditions.
- Most likely failure modes, their causes and what to do about them.
- On-Site, workshop or test bench observations of an equipment installation.
- Compare the installation to the minimum design required.
- Conduct site tests and trails on the equipment operation.
    - Predict effect of changes.
    - Observe actual changes.
    - Identify impact of changes to the equipment operation.
- Learning Assessment
    - Explain purpose and use of equipment.
    - Identify how the equipment achieves its purpose.
    - Specify the required operating conditions for proper performance.
    - List what failures are possible at the workplace and how to fix them.
    - Training Supervisor review.

Outcomes of the Training

This training will make the trainee clear and knowledgeable in the proper use, care and maintenance of in-line liquid strainers. It will give them in-depth knowledge of the equipment and the factors that affect its operation. They will use the new know-how to better operate, care-for and maintain such equipment in future.

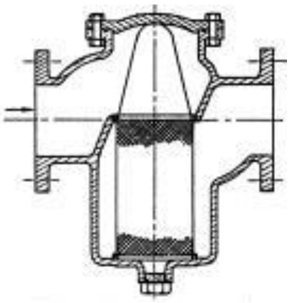
Time Required

The training takes one hour to complete for able people with some industry experience.

Training In the Purpose, Use and Care of In-line Liquid Strainers

Purpose of Equipment

In-line liquid strainers are used to trap and remove solid items from the liquid stream. Typically a screen or fine mesh catches the solid while letting the liquid through. A strainer is used to trap larger items than a filter, which is used to catch extremely small materials and fibres.



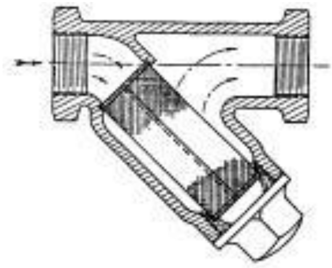
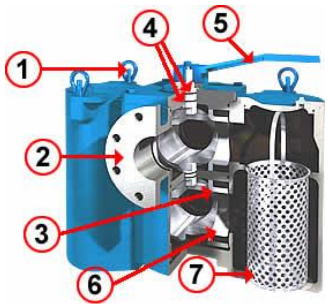



Figure 1 In-line Strainer In-line Strainer Y-Strainer Twin Basket Strainer

Pictured in Figure 1 are several types of in-line liquid strainers. The twin, or duplex, basket strainer allows one side to be cleaned out while the other is in service. The numbered items on the twin basket strainer are:

1. Quick release bolts to remove the screen.
2. Inlet nozzle for the liquid.
3. Internal valve sealing system between chambers.
4. Selection lever stem seal to stop leakage.
5. Filter chamber selection lever.
6. Interval chamber port sealing system.
7. Removable, robust strainer basket

Operation of the Equipment

Strainer screens have perforations or holes in them. The holes are sized to stop particles of larger size. The dirt or contaminant is retained on the upstream side of the screen or mesh and the cleaned liquid passes through. The trapped material builds up on the screen and thickens. As the contaminating material thickens it inter weaves and compacts to become a filtering screen itself, which acts to remove more and more finer material.

The unwanted material in the liquid flow is removed by the screen. As the build-up gets thicker it gradually blocks the flow of the liquid and less passes through. The material build-up must eventually be cleaned off so that the screen is again clean and can pass its original flow.

Figure 2 shows two basket strainers. Notice that the strainer's holes are large in proportion to the size of the basket. A strainer collects items bigger than the holes, but lets smaller material through.

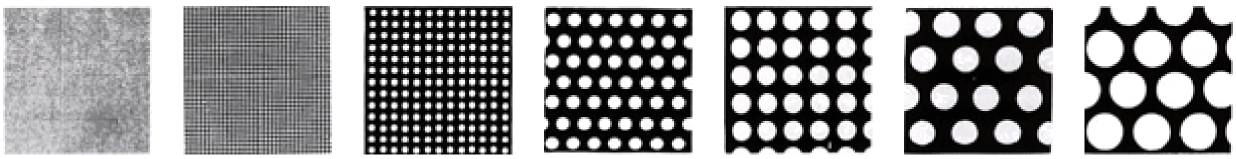

Figure 2 Basket Strainers with Large Holes

When placed into a pipeline or process stream it is necessary to know if the strainer is becoming blocked. When the material blocks the holes it causes a back-pressure in the liquid. By measuring the pressure change from a clean to a blocked surface it is possible to check the amount of material build-up. Once the back-pressure is too much the filter or strainer must be opened and cleaned.

This is not so with large holed strainers used to trap very course or large solids such as pieces of metal, plastic, wood, rock, etc. These large solids, when packed together, retain big passage ways around themselves and through the build-up on the screen. The large pathways do not produce large pressure losses and it may seem the strainer is clear from the pressures on the gauges. In fact the basket could be full. In such situations the stainer must be opened up regularly and cleaned out.

Important Parts and Assemblies

For a strainer the important parts are the housing and the screen. They both need to be made of materials that do not corrode and can take knocks from the material in the liquid. The gap where the screen seals against the housing must so close so that no material larger than the screen holes size can get past it. Figure 3 shows various screen and mesh hole size ranges used to make strainers.



Fine Mesh   Course Mesh   Perforated Metal Screens of Various Hole Sizes

Figure 3   Range of Various Basket Strainer Screens Hole Sizes

The basket needs to be strong and solidly built, with a means to remove it with force. At times a large force must be used to draw it from the housing, especially if screened material builds-up and jams it in place, or if the product crystallises in the housing.

In-Service Design and Operation

Figure 4 shows how a strainer is set-up in a process. Included is all the necessary equipment to insure the strainer operates correctly and to permit its operation to be monitored. This arrangement is best if a mesh is used for the screen, as it is likely that material build-up will block the holes in the mesh and cause a pressure drop across the filter. For stainer stations with large screen holes for lage particulate capture, it may not be necessary to have pressure gauges. Instead regular cleaning will be the only way to keep the screen basket clear.

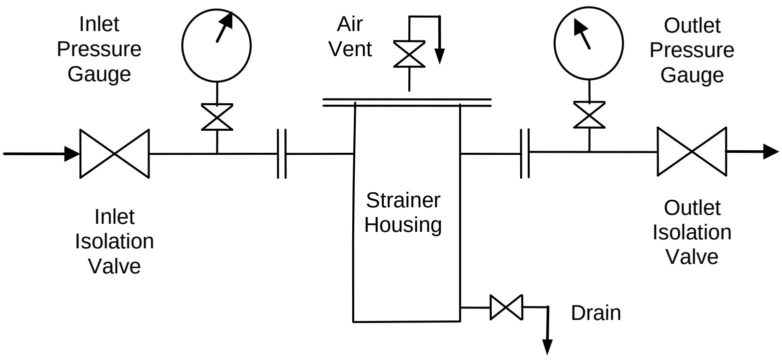


Figure 4 Minimum Filter Station and Strainer Design

The sketches below show the two flow directions that are possible through a strainer depending on the purpose and method of design.

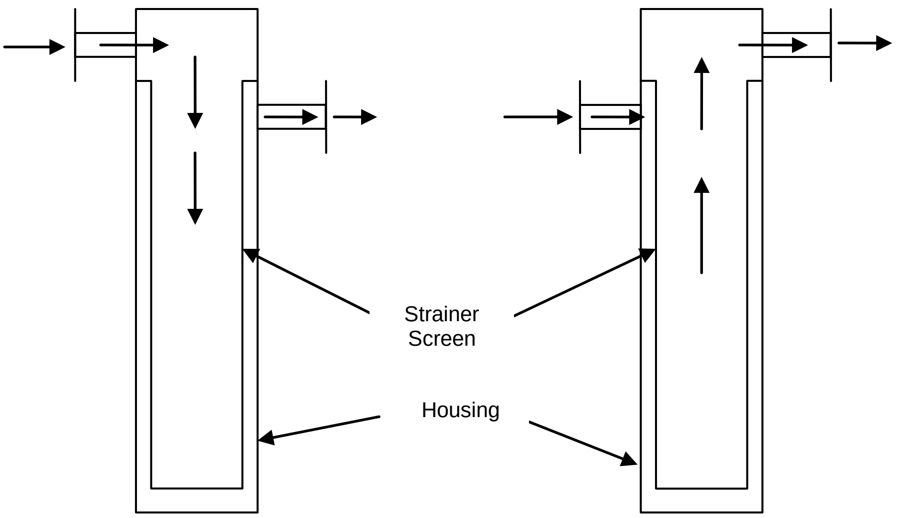


Figure 5 Liquid Flow Down Through Screen Liquid Flow Up Through Screen

How The Equipment Achieves Its Purpose And The Necessary Operating Conditions.

Take a look at first the basket strainer station design at Figure 4. Liquid and the contaminating particles flow under pressure from left to right through the strainer. The inlet pressure gauge shows the upstream, in-coming pressure. The outlet pressure gauge shows the liquid pressure after passing through the strainer. The outlet pressure is less than the inlet pressure because the screen is trapping the contaminating particles and creating a back-pressure. The back-pressure pushes the liquid through the built-up material and screen.

Now take a look at the station drawing below in Figure 6. You notice that the upstream pressure has risen and the downstream pressure has fallen. The screen build-up is becoming very thick and needs to be cleaned away. It is time to de-pressurise and drain the strainer, and remove and clean, or replace, the screen to return it back to a clean operating condition.

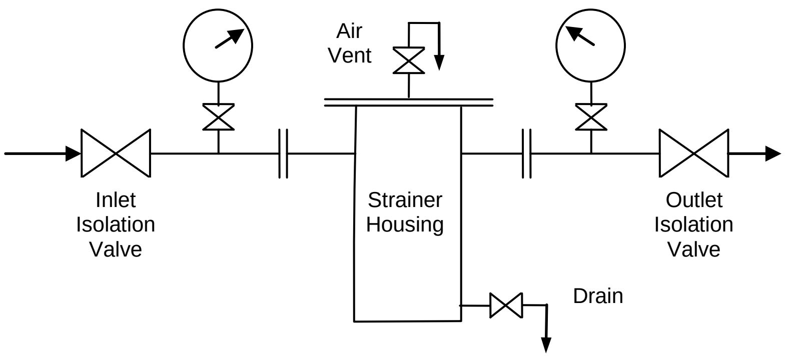


Figure 6 Backpressure in a Basket Strainer

Factors Affecting In-Line Filter Operation

There are several key factors that must be confirmed to insure successful in-line stainer operation.

- **Screen hole size** determines the size of particles that will pass through the screen and those which will not. The holes in the screen or mesh must not be so large that they prevent the sediment bed, or cake, developing.

- **Cake thickness** should develop evenly across the screen. Fortunately the nature of creating a cake means that any preferential flow in one area builds the bed up until the pressure is even with the rest of the bed. Provided the contaminant size is evenly distributed in the flow stream the cake thickness on the screen should be equally everywhere.

- **Low flow velocity through the filter** is needed so as to not disturb the cake and move it off the screen. This requires sufficient surface area of screen to create the right liquid velocities.

- **Process chemical attack of the screen material** is prevented by proper selection of fabric of sufficient thickness to also provide the necessary mechanical strength to take the forces that develop as the back-pressure increases during the filtration run.

- **Sufficient pressure is needed** to force the material against the screen and still push the liquid through the cake and membrane. That means as the cake thickens the upstream pressure must rise to push the liquid through the cake bed.

- **Small particulate size in the build-up** blocks liquid flow, as they act to seal the pathways for the liquid to flow around the larger particles.

- **The strainer basket fills from the bottom up** and only the screen above the rising level does the filtering. That means you need longer and/or larger diameter baskets if you want long production runs.

Most Likely Failure Modes and Causes and What To Do About Them

Problems with Screens

- **Screen blinding** occurs when the particles to be screened get caught in the screen itself and block the holes. This introduces a solid obstruction to the flow and if enough holes are blocked the flow falls and back-pressure builds quickly. If this occurs it may be necessary to change screen design, or the shape of the holes.

- **Screen rupture** can be a result of fair-wear-and-tear over a long period of time. It could also be the result of high local velocities across the screen; large solids impacting the screen, water hammer, excessively high differential pressure or chemical attack.

- **Poor fabrication and assembly** of the screen onto the frame. Wire screens are very delicate and a crease or a scratch introduces a stress raiser, which becomes the weakest point under pressure. Do not damage screen mesh. Replace damaged screens. The screen must be sealed into the housing so that the material being screened-out cannot pass between the screen and the frame.

- **Improper cleaning of the screen** due to blinding or old sediment build-up. If necessary repeat the cleaning sequence to try and dislodge the cake. Chemical cleaning can be used if safe to do so or use hot liquid flushing in an attempt to soften the built-up. High pressure water cleaning may dislodge the blinding material, but the screen could b damaged.

- **Silted filtrate from the strainer** can be a sign of screen rupture. If sediment has got past the screen it will end up downstream and possibly ruin the product. Monitor the pressure gauges at the station and change or clean the basket when the backpressure gets high. If the down stream pressure is unexpectedly close to the up-stream pressure it a good sign that the screen has failed and needs to be replaced.

- **Solid material can build-up** and fills the basket. The large particles stopped by the strainer fall to the bottom and collect. If the basket is not cleaned it fills up to the top and then back down the inlet pipe.

- **Strainer holes block** from soft contaminants like plastic straps, rags, bags, foam cups, etc.

- **Crystallising liquids need to be emptied** out of the housing before they set or a jacketed housing with heating medium is needed.

On-Site Test, Workshop or Lab Test of an Installation and Learning Assessment

It is now time to do some 'hands-on' training in the field, or with a spare, or on the test-bench. To thoroughly understand this topic it is best to see what happens in a working situation and practice by making and controlling changes. You will better understand what the equipment does, and how to run it well, if you can operate it. Locate suitable equipment in your plant that you will be allowed to adjust and inspect.

1. Locate the manufacture's operating manual if available or find it on-line over the Internet. Take the time to read it. Tag anything you don't understand and come back to it at the end of the training to see if you come to know what they mean.

2. Hand-sketch below the equipment installation at your workplace and write the name of the individual equipment items on the sketch.

3. Internal Inspection

a. Once all is safe to do so, open the strainer and look inside. Name and describe below each equipment part you see. The manufacturer's manual and parts list can help you.

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b. Remove the screen and write a short description of its surface condition, its component parts and how it is built.

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c. Describe how to install the basket element into the housing and get a good seal. Also describe how to refit the lid to be sure it does not leak.

4. If at all possible, and once you have supervisor permission, operate the equipment to see what effects happen as the operating conditions change. If you cannot operate a real item of equipment then describe as best you can what will happen to the process due to the change.

a. Clean Screen, Start-Up Conditions.

Starting with a clean screen, record the pressures upstream and downstream of the strainer and calculate the difference.

b. Effect of Cake Build-up.

Describe what increasing 'cake' build-up on the screen will do to the upstream pressure? You can mimic the effect by gradually closing the outlet valve.

c. Pressure Difference with Cake Build-up.

If there was a cake build-up on a particular in-line strainer at your workplace, note below at what pressure difference you would have to act to clean to replace the basket. How much is the change in backpressure values between the clean condition and the blocked condition? If necessary ask an experienced operator or see the operating manual.

5. Describe Below How an In-Line Strainer Works to Provide Clean Filtrate.

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6. Possible Modes of Failure

a. List the ways that in-line strainers have failed to perform properly at your workplace. Talk to the experienced operators and maintainers if necessary.

b. Getting the Equipment Back to Proper Operation.

For each failure mode listed above, describe in detail what needs to be done to correct them.

This is the end of this training. Please record the following details and hand your answers back to the supervisor in charge of this training.

Trainee ________________________________ **Signature** ______________________________
(Print Name) (Trainee)

Supervisor ______________________________ **Signature** ______________________________
(Print Name) (Supervisor)

Assessment Result: ☐ Pass

☐ Repeat

Completion Date ______________________ ‘Pass’ recorded in the Trainee’s training records ☐