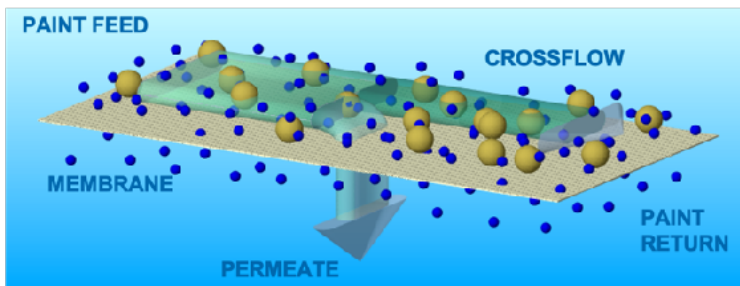


UltraFiltration from A to Z

This guide will assist you to better understand the UltraFilter (UF) system that is working in your E-coat paint System. The purpose of this guide is to allow you to make “Better Decisions Sooner” so there is less waste and better quality results for your customers.

In a UF Element there is a thin polymer film is used to remove some water from the E-coat bath to rinse the ware. This rinse water ultimately returns to the E-coat bath so very little paint is wasted. The UF membrane has small regular sized pores that allow waters, solvent, and neutralizers, to pass through while blocking much larger paint solids.



The spiral UF element configuration is the most common one used today. In the past other geometries and materials such as: tube, hollow fiber, plate & frame and ceramic UF types were used.



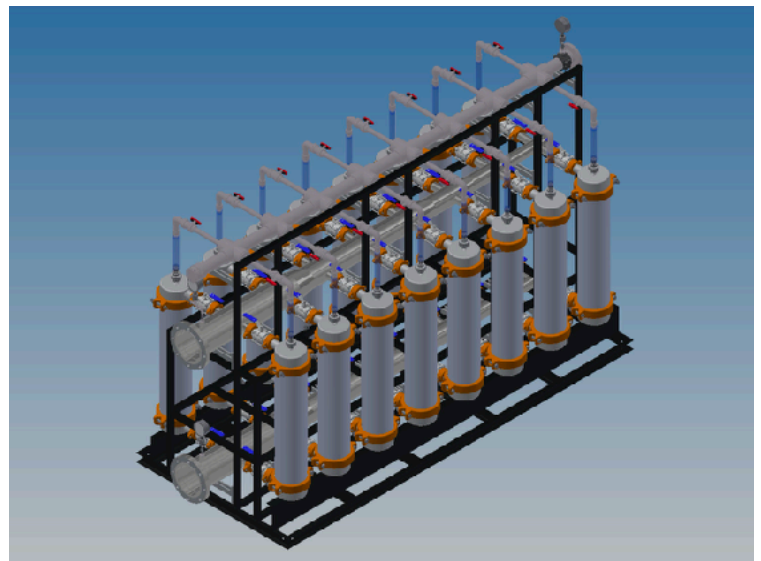
Generally there are 3 rinse stages (one of which is a dip and the others are a spray (as shown above). Some systems use a DI final rinse or an EDRO system to complete the rinsing. Grey colored E-coat paint is generally a little bit easier to produce permeate than black colored E-coat paints.

Use 2 liters of permeate to rinse each 1 m² (5 gal / 100 SF) of ware surface area. The most popular UF element is a 7640 type, which can produce 10 lpm (~2.5 gpm) of permeate (per design basis - its initial start-up can be twice as much). Thus your Permeate requirement = Painted Through-Put (PTP) multiplied by 2 liters/m².

Example: PTP is 30 m²/minute

Permeate Flow = 30 m²/min x 2 l/m² = 60 l/min
7640 type UF Elements = 60 l/min / 10 lpm/7640
= 6 x 7640 UF Elements

A UF system consists of: supply pump, duplex pre-filter system, UF Skid (with the UF elements, and some system to rinse and clean the UF membrane). The illustration below shows a double sided UF skid with 16 UF Elements.



EDRO is being used as an alternative to DI water because it can save on DI water and waste water disposal costs plus it can increase the E-coat paint transfer efficiency by as much as 2 percentage points in many situations.

UF Problem Root Causes

- Low paint flow
- Incorrect cup seal placement
- Poor pre-filter process
- No soft start or VFD used on UF feed pump restarts
- No Operator Checklist used
- Entrained air bubbles in the paint

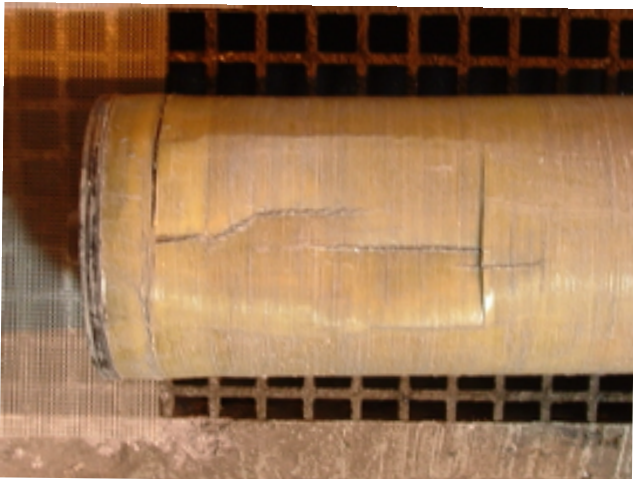
UF Inlet Face Blocked

Large dirt bits can be seen below. A poor pre-filter method allowed the dirt to enter the UF element and cause damage. Such dirt impedes the flow of paint, which results in a loss of permeate flow and a much shorter UF life.



Imploded UF Housing

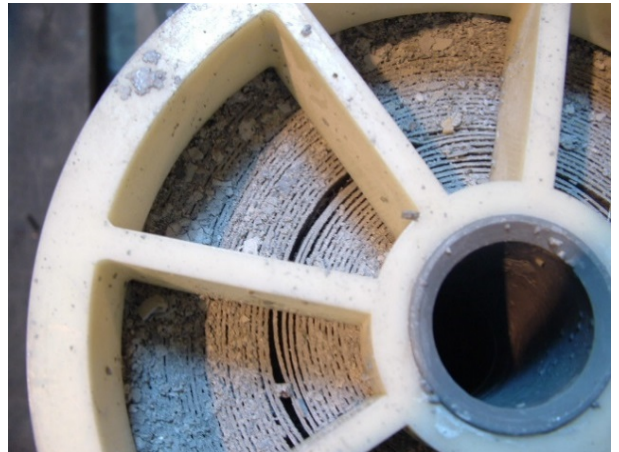
It is common to see an imploded UF housing at the lip seal end if: inlet face is blocked; no 60 second soft start; no VFD; or too fast paint valve opening.



- Hydraulic short circuit (by-pass pipe connection) between the paint Supply & Return manifolds
- UF feed pump shear from too large impeller diameter
- No UF System valve tags
- Foam on surface of the paint bath
- Elevated permeate pressure
- Poorly maintained pressure gauges

UF Membrane was damaged

In the photo below a poor pre-filter process allowed the inlet face to become blocked with large dirt bits. Once this happens the paint flow has to find an alternate route and so it opened up a wide flow channel, which usually results in a tear in the fragile UF membrane.



Air Bubbles Seen in the Permeate Flow Meter

If you can see air bubbles in the UF permeate flow meter - then there is a problem that will lead to premature aging of the UF membrane. Maybe there is an air leak in the UF feed pump suction piping. It is important to find the source of this air and stop its entry into the UF feed.



UF Best Practices

Feed Pump

- Less than 30cm (12") impeller
- 320 lpm (85 gpm) per 7640 UF element @ 4 bar (58 psi)
- Suction opposite replenishment paint inlet
- Double mechanical seals for horizontal pumps with permeate seal flush
- 60 second motor soft start or VFD
- Use magnetic paint flow meter or pump volute mounted pressure guard/gauge along with the pump curve

Filter Bag

- Felt/polypropylene material
- Glazed or heat treated on exterior
- 25 micron rating
- Plain cover
- #2 size
- Plastic collar rings ONLY
- Welded seam ONLY
- Ex Model #: B-PO-G-25-P-2-P-WE

Maintenance

- Take picture of each UF element inlet face and post the pictures on your Quality/Training bulletin board. It will become obvious which used inlet face condition is more desirable
- Service Feed pumps each year
- Use your pump curve to confirm performance
- Replace all elements at one time, purchase UF elements ahead of time on a schedule
- Autopsy all unusual performing elements

Operation Checklist

- Describe situation and goal
- How many people needed and required tools/materials
- Note valve position before, during, and afterwards and post a UF Valve tag drawing
- Write step by step instructions
- Expected operating parameters
- Do this for each different task to be performed

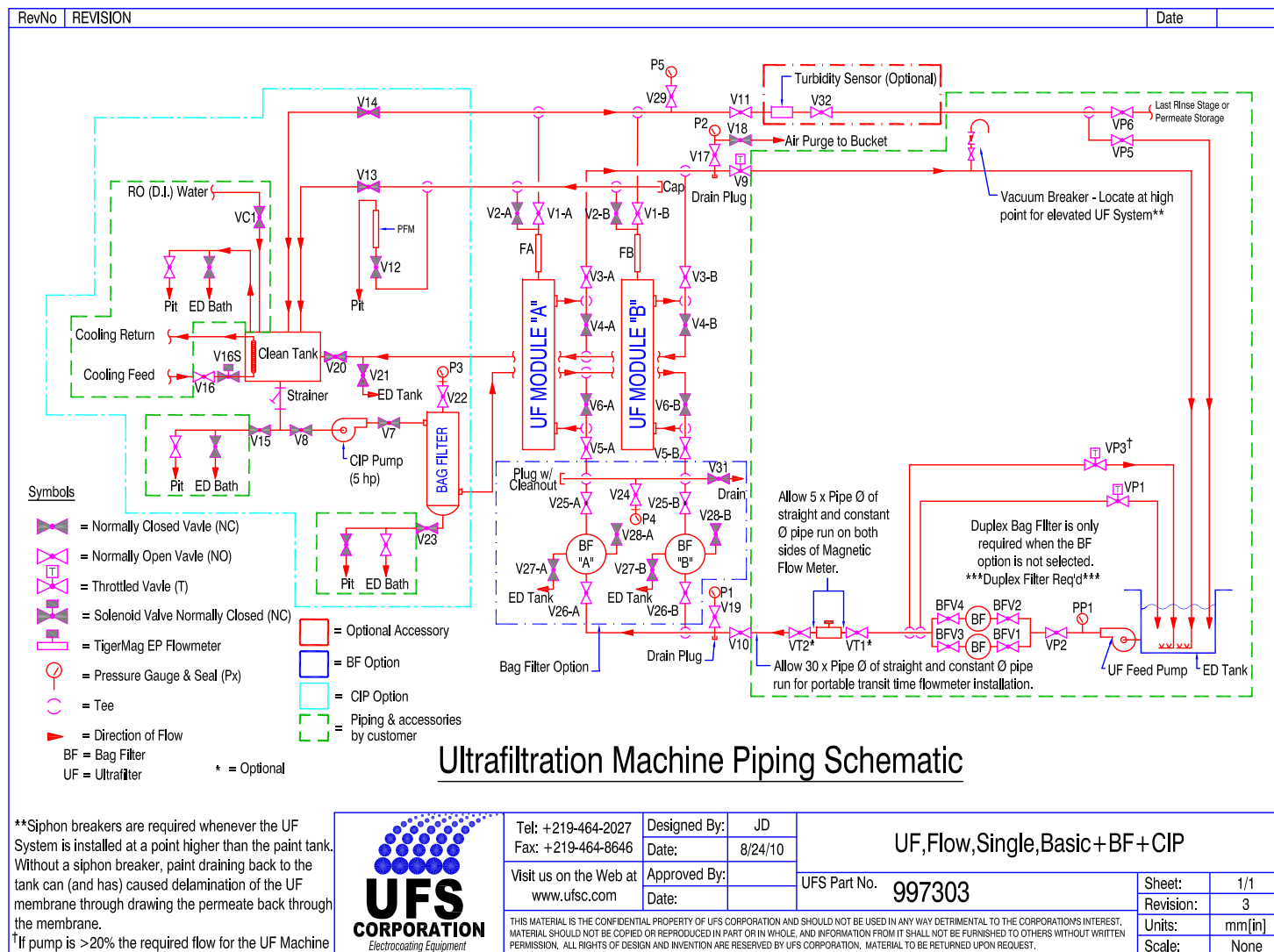
Pre-filter Essentials

- Use a Duplex scheme so that the full paint flow can be delivered to the UF system while a filter bag is being changed
- Change filter bag every 3 weeks or with a 1/3 bar (~5 psi) differential pressure increase
- Limit paint flow to 400 liters/minute (105 gpm) per #2 filter bag
- If changing to a 10 micron filter bag - consult your paint company first

UF Skid Wishlist

- Manifolds: tapered; no dead ends; and bottom drain plugs
- Piping: center feed with more than 12 UF elements; 2.5 - 3.5 m/sec (8 - 12 ft/sec) paint velocity; UF by-pass piping to e-coat bath
- Use drip pan
- Calibrated 10 cm (4") pressure gauges with glycerin-filled gauge guards
- Color coded valve tags
- DI or RO water to flush new UF element

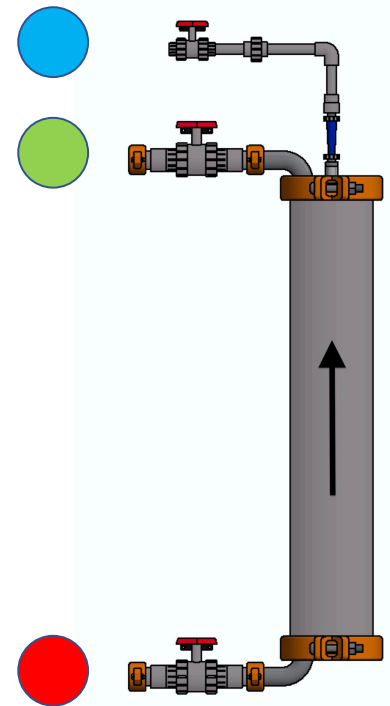
UF Daily Operation



Stopping Individual UF Element Operation

Procedure to isolate a UF element while keeping the others working:

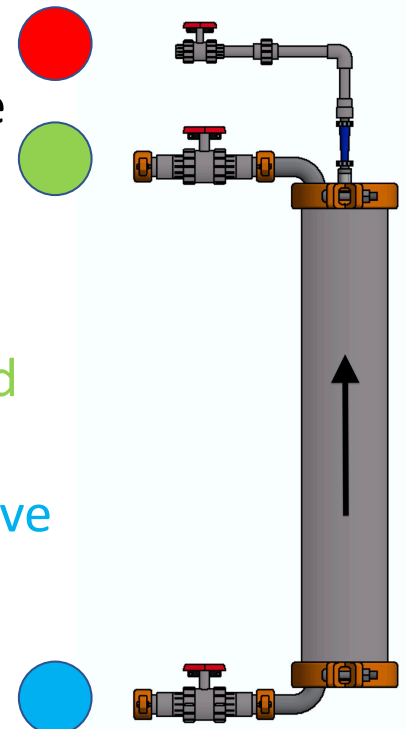
- Close the supply valve
- Close the return valve
- Close the permeate valve
- Drain the paint back to the E-coat bath



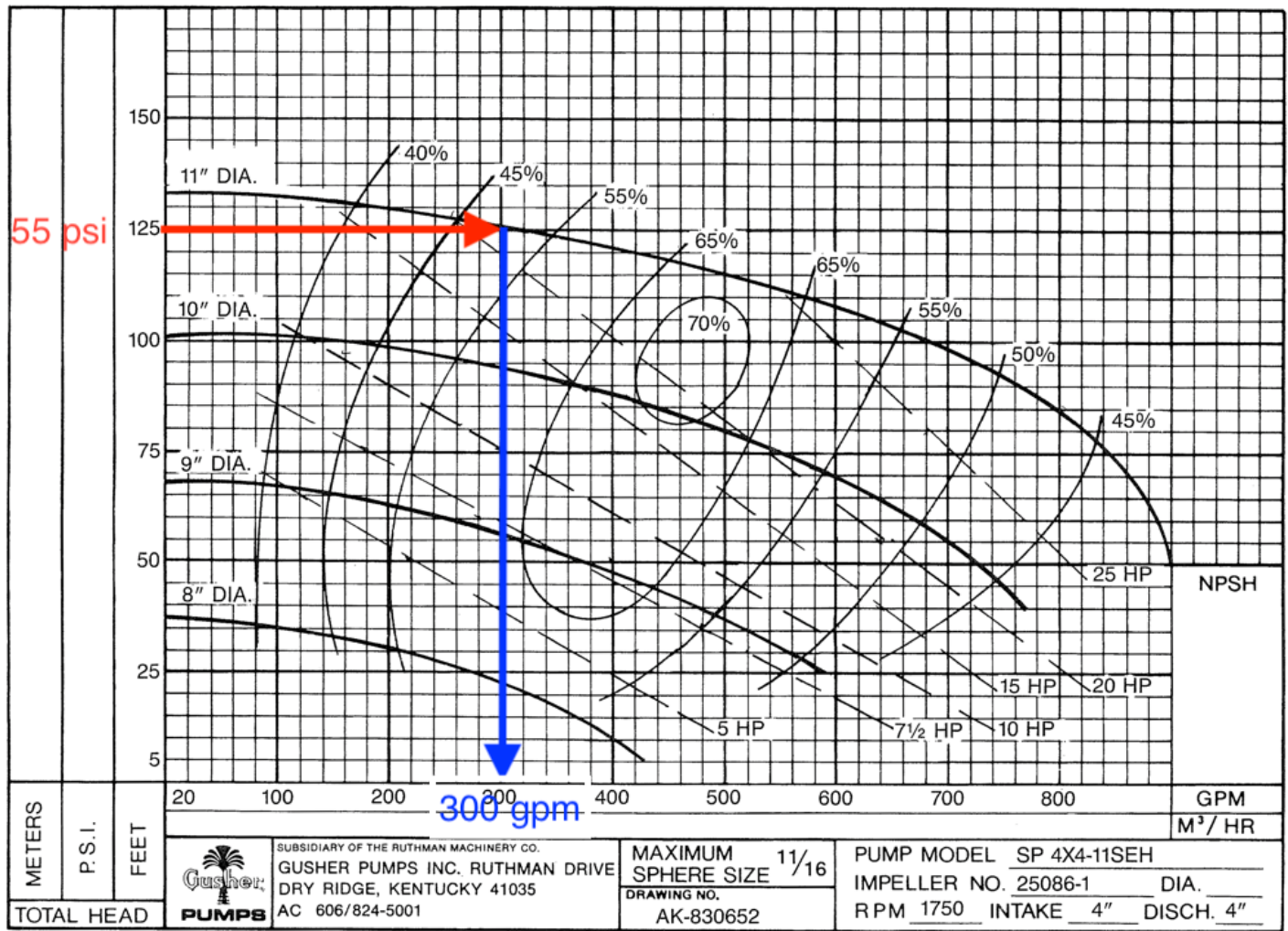
Starting Individual UF Element Operation

Steps to start a UF element back online while the others are in operation:

- Open the the permeate valve
- The next step is more complicated...
 - Place one hand on the return valve and crack it open
 - Place the other hand on the supply valve
 - Slowly (45 seconds), open the return valve more & slowly open the supply valve

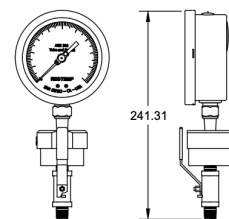
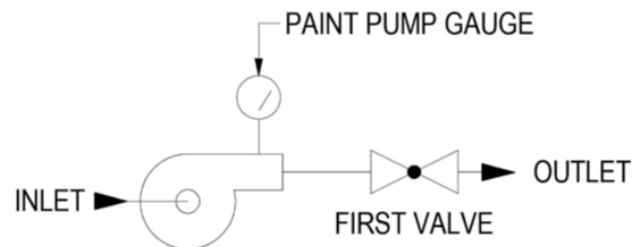


Low Cost Paint Flow Meter

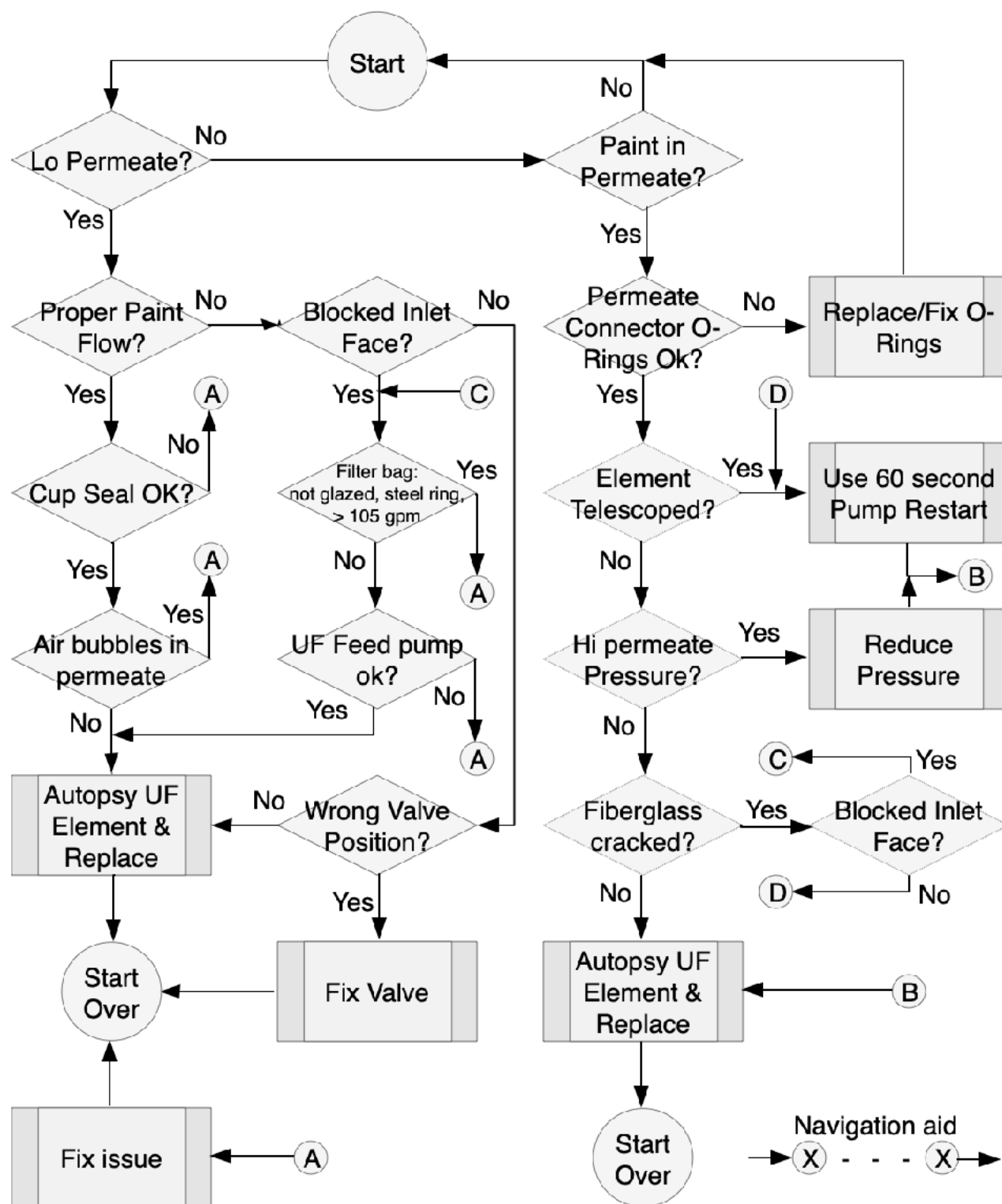


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- Use a 10 cm (4 in) calibrated high quality pressure gauge with gauge guard filled with glycerin
- Pressure gauge must be installed on pump volute BEFORE the first valve. Most pumps already have a pressure gauge port somewhere on the volute (i.e. housing).
- Estimate paint flow from the pressure reading on the pump curve
- **Example:** pressure is 3.75 Bar (~55 psi) & pump has 28 cm (11 inch) diameter impeller
 —> Find pressure on vertical axis, move over to the 11" impeller curve, then move down to read the flow on the horizontal axis, which is 300 gpm



Spiral UF Element Trouble Shooting



Trouble Shooting Guide

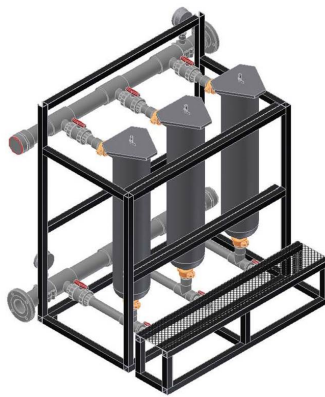
- Flow chart style: circle - start/continue; diamond - decision/choice; rectangle - action
- Follow the arrows as you continue the path based upon your answers
- Sometimes you will have to jump to a different location - use the letter to navigate to the next

UF Glossary of Terms

- **7640 Element:** 7.6" diameter (nominal) x 40" long - Industrial standard 8" UF Element and requires 320 lpm (85 gpm) of paint flow
- **7940 Element:** 7.9" diameter x 40" long, about 15% more UF membrane area than the 7640, produces 11 lpm (2.9 gpm) of permeate and requires 370 lpm (100 gpm) of paint flow
- **Feed & Bleed:** Paint is circulated through UF Elements and a side feed stream is introduced [at 20 x permeate rate] while an equal amount is returned back to the paint tank
- **MWCO:** Molecular weight cutoff, used to describe the smallest pore size a particle can fit through
- **Painted Through-Put:** Maximum painted production rate (surface area/min)
- **Pre-filter:** 25 micron bag filter or cartridge filter ahead of the UF system, for a #2 filter bag, limit the flow rate to 400 lpm (105 gpm) of paint max
- **Single Pass:** Paint travels only once through UF and returns
- **UF Membrane:** Polymer UF membranes are cast on a non-woven substrate. Particles < 0.1 micron can pass through the membrane
- **Ware:** Object that is painted



#2 Pre-filter bag with plastic collar



Stand alone Bag filter vessels forming a Duplex system



New Spiral UF element condition



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