Leaks

GENERAL COMMENTS

The most common cause of early rotor seal failure is surface scratches caused by abrasive particles. These particles can be debris from the sample or mobile phase, or salt crystals from buffer solutions. In the case of metal injectors, particles or burrs from the tubing or fittings can also cause scratching.

In some orientations of the injector, a leak between the stator and stator ring will appear as though the leak is at a fitting in the stator. Likewise, a leak at a fitting may appear as though the leak is between the stator and stator ring. Confirm the true source of the leak before making adjustments.

The following practices provide maximum rotor seal lifetime: 1) Check all tubing for burrs and flush it before connecting to the system. 2) Filter particles from the mobile phase and filter samples if they are not clean. 3) Install a filter between the pump and injector to protect the injector from particles from the pump or mobile phase. 4) Frequently flush the injector with water when using buffers, especially before shutting down.

LEAKS
Symptoms, Causes and Solutions

Leaks can appear at three locations in the injector: (1) needle port, (2) vent tubes, or (3) the gap between the stator and stator ring.

A leak can be caused by a damaged rotor seal, but there are many leak problems that do not require seal replacement. In the latter case a simple adjustment of the injector, without disassembly, can fix the leak. Read through all three symptoms before taking action.
Leaks

Symptoms

SYMPTOM #1

When the syringe is inserted, the needle travels along the needle port tube for about 4.5 cm before it reaches the needle seal. During this time the friction is low. Then the tip of the needle enters the needle seal and travels another 3 mm, during which time the friction is higher. The needle is stopped by contact with the ceramic stator face.

Failure of the needle seal is more likely when vent tube #6 is plugged by buffer salt crystals. Check that tube if you suspect Cause A.

Leakage out the needle port will occur when using the wrong syringe. When the needle is too short the tip will not reach the needle seal. When the needle is too small in diameter the seal will not grip it tightly enough. The needle should be .028 inches O.D. (#22 gauge) x 2 inches (5.08 cm) long and 90° point style (square-cut end). Do not use a beveled, pointed, or tapered needle.

It is normal for fluid to pass from the port as the needle is inserted. It displaces fluid left in the port after flushing.

Leakage out the needle port during loading will cause non-reproducible analytical results. See symptom #7.

SYMPTOM DESCRIPTION

Fluid leaks out the needle port only while loading the loop, i.e. while depressing the plunger of the syringe (see Fig. 3).

Slowly insert the syringe needle all the way into the needle port and notice the friction:

- If friction increases slightly during the last 3 mm of travel, and the needle then comes to a hard stop, see Cause A

- If the friction does not increase, the needle does not penetrate the needle port as far as previously, and the stop seems somewhat soft, see Cause B

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CAUSE A
The needle is penetrating the needle seal (see Fig. 4), but the seal is not gripping tightly enough to prevent leakage around the needle. Some (or all) of the sample flows back into the needle port tube and out the needle port. See comments.

SOLUTION
Push in on the plastic needle guide with the eraser tip of a pencil (see Fig. ). This pushes on the needle port tube, which compresses the needle seal, reducing the hole diameter.

CAUSE B
The needle is not penetrating through the hole in the needle seal. The diameter of the hole has decreased due to cold flow of the teflon. Most (or all) of the sample flows back into the needle port tube and out the needle port.

SOLUTION
Remove the rotor seal from the injector and use the needle of your syringe (22-gauge) to increase the diameter of the hole by pushing the needle through it. Replace the rotor seal if the needle seal is damaged beyond repair.
Leaks

Symptoms (continued)

SYMPTOM #2

When in the INJECT position, the siphoning may continue until the vent tube and needle port are empty. When in the LOAD position, the siphoning may continue until the vent tube, needle port, and loop are empty.

If you use a long vent tube to go below the fluid level in a low waste reservoir, there will be a large siphoning force, and special precautions may be needed. (One reason to make such a connection is to prevent evaporation from the end of the tube, which can result in buffer salt crystallization and blockage.) If you are loading excess sample to completely fill the loop, air sucked into it prior to inserting the syringe may be displaced. But if you are partially filling the loop, air may not be displaced completely. In this case, you can prevent air from entering the loop by inserting the syringe (containing the next sample to be loaded) just before returning to LOAD, while still in the INJECT position. This will prevent siphoning from the loop.

When the loop empties due to siphoning, it fills with air, the presence of which can cause the system pressure to decrease when the handle is turned to INJECT. See symptom #10.

SYMPTOM DESCRIPTION

Fluid leaks out the needle port or vent tube(s), but eventually stops (see Fig. 6):

- If the fluid leaks out the vent tube(s), see Cause A.
- If the fluid leaks out the needle port, see Cause B.

CAUSE A
The vent tube(s) is lower than the needle port, which causes fluid to siphon out (see Fig. 7).

SOLUTION
Adjust the vent tube(s) so that its outlet is at the same horizontal level as the
needle port.

CAUSE B
The vent tube(s) is higher than the needle port, which causes fluid to siphon out (see Fig. 8).

SOLUTION
Adjust the vent tube(s) so that its outlet is at the same horizontal level as the needle port.
Leaks

Symptoms (continued)

SYMPTOM #3

**COMMENTS**

Most models are set at the factory for 5000 psi (345 bar). But sealing pressure may decrease as the seal wears.

Sometimes a small scratch on the rotor seal can be "temporarily" repaired by adjusting for higher pressure (see Appendix B). Try this if you want to operate while waiting for a replacement seal. If the handle becomes harder to turn after adjusting, you should loosen the injector back to the original setting when you install the new rotor seal.

Using a needle with a pointed tip or too small a diameter will severely damage the rotor seal and stator face assembly. The tip can enter port #4 of the stator face, where it is broken off when the handle is turned to INJECT. The protruding tip then scratches the rotor seal. The needle should be .028 inches O.D. (#22 gauge) x 2 inches (5.08 cm) long and have a 90° point style (square-cut end). Do not use a beveled, pointed, or tapered needle.

In some injector orientations, a leak between the stator and stator ring will appear as though the leak is at a fitting in the stator. Likewise, a leak at a fitting may appear as though the leak is between the stator and stator ring. Confirm the true source of the leak before making adjustments.

**SYMPTOM DESCRIPTION**

Fluid leaks continuously out of the needle port or vent tubes, or from between the stator and stator ring (see Fig. 9):

- If the system pressure has increased lately—due, for example, to use of a higher flow rate, different column, or partial plugging of a column frit—and especially if it is above 4000 psi (276 bar), see Cause A.
- If the system pressure has been stable, see Cause B
CAUSE A
The system pressure may have exceeded the current sealing capability of the injector.

SOLUTION
Adjust for higher pressure operation by (depending on the model) either tightening the pressure adjusting screw (see Fig. 10) or loosening the set screws and then tightening the stator screws (see Fig. 11). For details see the procedure in the section "Adjusting for Leakage" or "Adjusting for Higher Pressure" in the operating instructions for the injector. See Appendix B for these instructions. If adjusting for higher pressure does not eliminate the leak, see Cause B.

CAUSE B
A scratch on the rotor seal allows high pressure mobile phase to escape. This is referred to as cross-port leakage.

SOLUTION
Replace the rotor seal. Examine the ceramic surface of the stator face assembly and replace the assembly if it is chipped or cracked, or if any of the six holes are blocked.