Diagnostics and Troubleshooting

For Teledyne Isco Syringe Pumps

TELEDYNE ISCO
A Teledyne Technologies Company

Syringe Pump Technical Bulletin
TB23

Overview

If a problem is suspected in the operation or performance of an Isco syringe pump, certain procedures are recommended for identifying the problem in the field. Steps for verification of pressure and flow rate accuracy, and checking for leaks, are provided in TB05 Field Verification Procedures. This bulletin explains how to proceed with troubleshooting once a problem has been identified, in these and other areas.

> ☑ ***Note***
>
> Systems using the updated pump controller (on sale beginning November 2011) are identified by the lighted display and the blue Dispense (DISP) button in the fourth row on the control panel. The two systems have several differences, including maintenance kits (see Table 1 below), manuals, and some procedures.

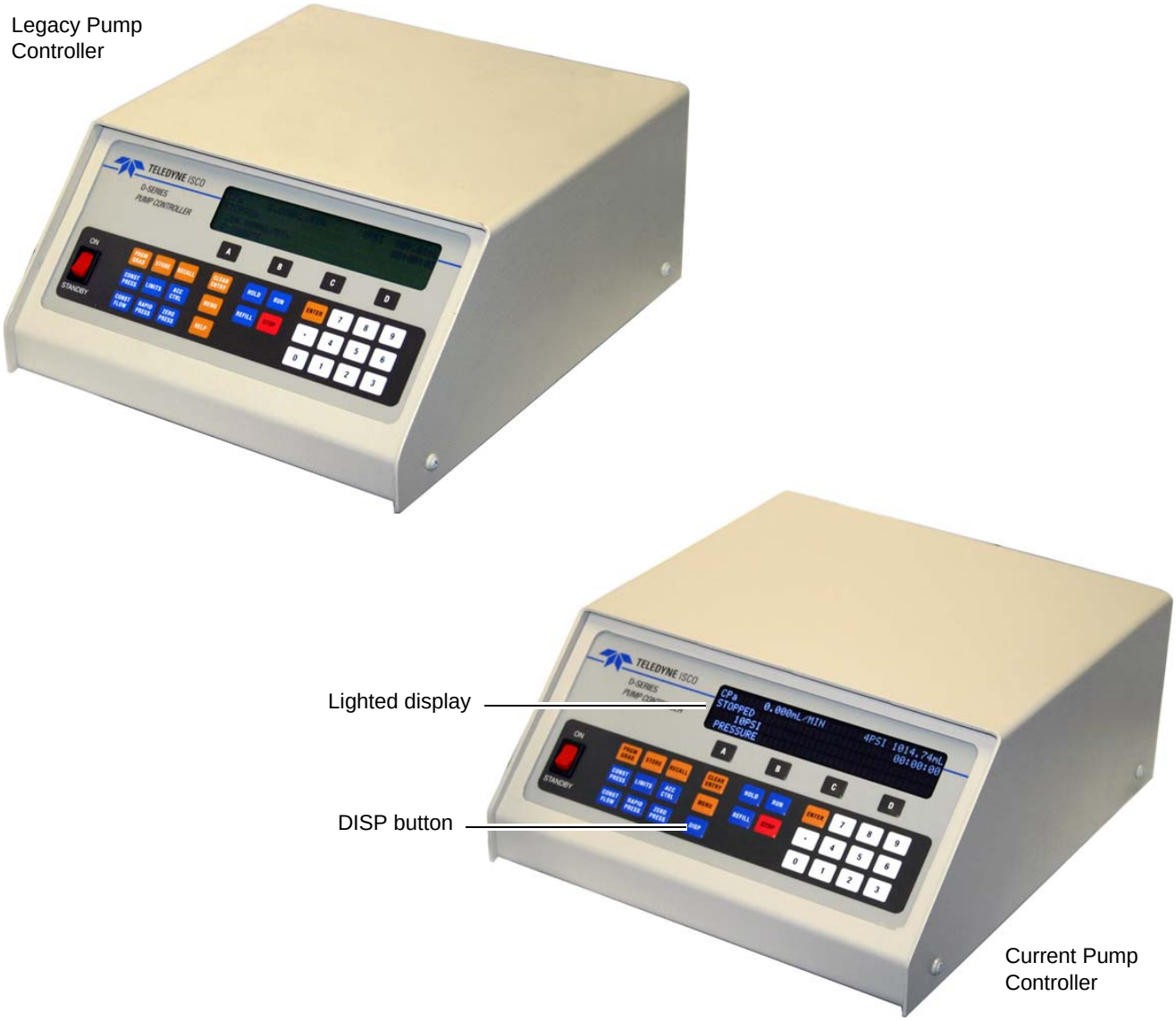


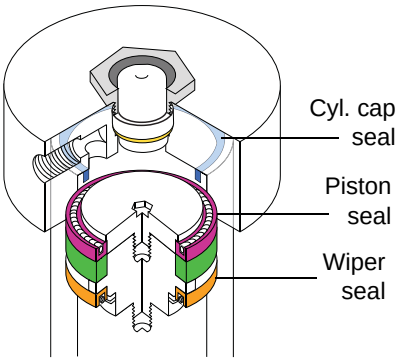
Figure 1: Identifying Legacy Controller and Current D-Series Controller

If troubleshooting identifies a need for servicing or replacement of components, refer to the *Pump Maintenance and Servicing* section of your manual (Section 5 of the Legacy manual; Section 8 of the current D-Series manual).

Table 1: Maintenance Kit Contents

Piston & Wiper Seals

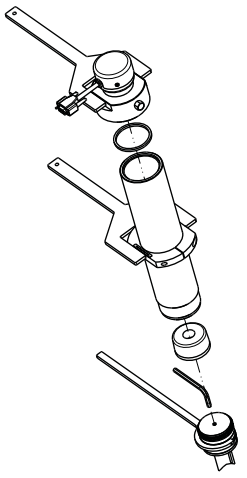
Cylinder Cap Seal



Wrench Package:

Various wrenches for use with most common part replacements.

NOTE: Wrench types and sizes may vary between pump models.



Package Numbers If Ordering Separately:

1000D	60-1247-093
500D	60-1247-068
260D	60-1247-067
100D	60-1247-067
65D	60-1247-130

Control Panel Label -
Depending on use, the most frequently pressed keypad buttons may eventually wear out.

Motor Brush Set :
Inspect the top brush, which is easier to access.
New brushes are 1.1 cm long. Replace both brushes before the top brush wears to a length of 0.4 cm.
Other option: replace entire motor.

Port Plug

Cable Ties & Mounts

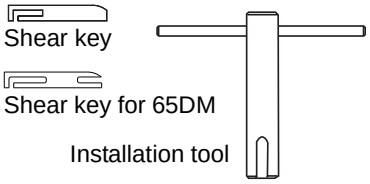
Tubing Connectors

Zero Volume Nut & Ferrule (100D/260D)

Fuses

Universal Sensor Harness (100D/260D/500D)

Shear Key w/ Installation Tool -
If the pump motor fails to stop in the event of an overpressure situation, the shear key may require replacement.



Maintenance Kit Part Numbers

Legacy (Older Controller):		D-Series (Current Controller):	
1000D	68-1249-104	1000D	60-1247-060
500D	68-1249-102	500D	60-1247-072
260D	68-1249-101	260D	60-1247-073
100DM/DX	68-1249-100	100DM/DX	60-1247-074
65D	68-1249-111	65D	60-1247-087
65DM	Call Factory	65DM	60-1247-094

Troubleshooting Tables

On the following pages, Tables 2 through 5 provide basic syringe pump troubleshooting information.

Under "Additional Information" are references to relevant sections of the D-Series user manual included with your pump, as well as online documents containing detailed instructions for the solutions outlined in the tables.

Many test procedures and repairs listed here require accessing the interior of the controller or pump module. Instructions for doing so are provided in the section following the tables.

Table 2: General Troubleshooting

Symptom	Cause	Solution	Additional Information
Fluid leaking from drip pan	Damaged pump seals	Replace pump seals	See sections on Fluid Leakage later in this bulletin. D-Series Manual Sections: *Seal Cleaning and Replacement; Wear Ring Cleaning and Replacement*
Fluid leaking onto the worm gear			
Fluid leaking from where the cylinder cap meets the cylinder	Failed cylinder cap seal	Replace cylinder cap seal	
Pump runs, never reaches set pressure	Shear key broken (worm gear is turning but ball screw is not)	Replace shear key	D-Series Manual Section: *Overpressure Conditions*
	Gross leak; Pump has no restriction	Tighten fittings; Clean or replace piston seal; Add restriction/pressure downstream.	D-Series Manual Sections: *Seal Cleaning and Replacement Back Pressure Regulation*
	Pumping Gas	Isco pumps are designed for pumping liquids and supercritical fluids. If pumping CO_2, use a dip tube and take necessary measures to ensure that the CO_2 remains in a liquid state.	D-Series Manual Sections: *CO2 Cylinder Connection Package; Temperature and Pressure Controls*; Technical bulletin TB08 CO_2 Applications and Tech Notes For additional support, contact a Teledyne Isco Applications Specialist.
Pump cannot be set to desired pressure	Factory specified maximum pressure exceeded, or user-set pressure limit exceeded.	Set pump to a lower pressure.	
Pump will not run or refill; No error message.	Universal sensor harness (limit sensor) failure. Pump B or C not connected to AC Power. Software has been updated without a controller reset.	Verify operation of the limit sensors (2 total). Connect AC Mains Power to the pump. Perform a controller reset. Refer to Technical bulletin TB09 Flash Memory Upgrade.	D-Series Manual Section *Motor Control/Limits*
Controller will not power up	Pump cable not attached. Pump module not powered on. 5VDC unavailable.	Verify 5VDC on controller board and on power drive CBA. Calibration (Legacy controller only) or fuse replacement may be necessary.	D-Series Manual Section: *Test Points*

Table 3: Displayed Messages

Symptom	Cause	Solution	Additional Information
FAILURE POSITION A/B/C The pump speed does not correctly correspond with the amount of power required to run the motor.	Temporary software hangup	Hard system reset	D-Series Manual Section: *Resetting the System*
	Tachometer sensor failure; A to D converter failure (Verify by using a different controller.)	Replace or align the tach sensor.	
	Older pumps may have a bad tachometer sensor or alignment.		
	Worn motor brushes	Replace entire motor, or just the brushes.	D-Series Manual Section: *Motor Brushes*
	Fuse 101 blown	Replace F101.	
	Universal sensor harness (limit sensor) failure	Verify operation of the limit sensors (2 total). Replace harness if either sensor fails.	D-Series Manual Section: *MOTOR CONTROL/LIMITS*
	Cylinder screwed too tightly into the mounting block	Using the cylinder wrench (see Table 1) to back the cylinder off and tighten it properly.	Refer to technical bulletin TB22 Care and Maintenance.
	Failed drive transistor on motor drive board	Replace motor drive board.	
FAILURE PRESSURE A/B/C (A, B, C OVER PRESSURE)	Pressure has exceeded maximum range of the pump. Constant Flow Mode, models 260D, 500D, & 1000D: Pressure has exceeded that specified in the graphs shown in Section 1 of the user manual.	Set pump to a lower pressure.	
Pump will not run; CYLINDER EMPTY message displayed	Pump empty; Piston at top of cylinder	Refill the pump.	
Pump will not refill; CYLINDER FULL message displayed	Pump full; Piston at bottom of cylinder	Run the pump.	
CYLINDER EMPTY message displayed, but piston is not at top of cylinder (cylinder not really empty)	Universal sensor harness (limit sensor) failure	Verify operation of the limit sensors (2 total). Replace harness if either sensor fails.	D-Series Manual Section: *MOTOR CONTROL/LIMITS*
CYLINDER FULL message displayed, but piston is not at bottom of cylinder (cylinder not really full)			
VALVE ERROR	Cycle power. If the message reappears, repair or replace the valve package.	Electric Valves: Valve or valve motor failure; repair kits available. Air Valves: May be restorable w/ new seal kit.	D-Series Manual Section: *Electric Valve Motor Calibration*

☑ *Note*

Error messages can only be removed by correcting the problem and restarting the controller.
If diagnostics indicate CBA component failure (other than fuses), replace the CBA.

Table 4: Flow Rate Troubleshooting

Problem	Cause	Solution	Additional Information
Total volume collected < calculated, AND: • Pressure > 500psi • (Calculated Volume – Collected Volume) ÷ Collection Time is out of specified leak rate • Flow rate > 0.25ml/min	Seal leakage	Replace seals. Inspect wear ring and cylinder.	D-Series Manual Sections: *Section 1.2 - Specification Tables* *Seal Cleaning and Replacement;* *Wear Ring Cleaning and Replacement*
	Leakage outside pump: External tubing fittings, or valves.[a]	Repair or replace leaking component.	
	Cylinder cap seal	Replace seal and tighten cylinder cap.	D-Series Manual Section: *Seal Cleaning and Replacement* Technical Bulletin TB05 Field Verification
Total volume collected < calculated AND pressure < 500psi	Standard seals are generally more effective at pressures > 500psi.	Add backpressure resistance. Use low pressure seals.	Technical Bulletin TB10 Low Flow Operation Contact Teledyne Isco's application specialists for further assistance. 402-465-2086 or 800-775-2965
Total volume collected < calculated but still within specified leak rate	Low flow applications often require special laboratory and equipment precautions.		D-Series Manual Section: *Section 1.2 - Specification Tables* Technical Bulletin TB10 Low Flow Operation Contact Teledyne Isco's application specialists for further assistance. 800-775-2965

☑ *Note*

Although minute fluctuations within the µL range at set pressure are considered normal, low flows in particular can benefit from smaller cylinder capacities, back pressure regulation, control of the ambient and fluid temperatures. For details, refer to TB10 Low Flow Operation and TB07 Temperature Control Jacket Setup, and D-Series Manual Section *Back Pressure Regulation*.

a. For valve leakage, see the procedure "Valves" on page 7. Instructions for calibrating new electric valve motors is provided in the D-Series user manual.

Table 5: Pressure Troubleshooting[a]

Symptom	Cause	Solution	Additional Information
Pressure reading is somewhat inaccurate when compared with an external calibrated gauge.	Incorrect calibration	Calibrate the pressure transducer.	D-Series Manual Section: *Calibration*
	Pressure transducer has drifted		
Pressure drifts out of calibration after it has been calibrated.	Pressure transducer has failed.	Replace the transducer	
Pressure reading is grossly inaccurate when compared with an external calibrated gauge, does not reflect large changes in pressure, and/or does not read zero when open to atmosphere.			
	Pump drive board fuses F102 and F104 are open.	Replace fuses. Replace pump drive board and/or pressure transducer.	D-Series Manual Section: *Pump Case Top Removal,* *Test Points*
	Controller electronics are damaged.	Repair/replace controller board.	
Pump does not maintain pressure when ports are closed. (Leak check failure)	Seal leakage	Replace seals; Inspect wear ring and cylinder.	D-Series Manual Sections: *Seal Cleaning and Replacement;* *Wear Ring Cleaning and Replacement*
	Leakage outside the pump (external tubing, fittings, or valves)	Repair or replace leaking component.	
	Cylinder cap seal	Replace cylinder cap seal and tighten cylinder cap.	D-Series Manual Section: *Calibration*
Pump sounds like it is running, but the piston does not move up the cylinder.	An overpressure condition has broken the shear key.	Before replacing the shear key, ensure that the pumping system is properly installed and programmed.	D-Series Manual Section: *Overpressure Conditions*

a. See "Incorrect or Unstable Pressure Reading" on page 6 for additional troubleshooting information.

Accessing Internal Components

The following information applies across many troubleshooting areas. Refer back to this section when investigating more specific issues.

⚠ DANGER

Risk of electric shock. Disconnect the electric power before servicing. Only trained service personnel may remove the case top.

Controller Case Top Removal

Troubleshooting for a number of issues can be done on the controller main circuit board. Remove the four screws holding the case top in place (two screws on each side). Lift the cover straight up and off.

Figure 2: Controller case top screws (2 of 4 shown)

Pump Case Top Removal

Some maintenance and troubleshooting procedures require accessing the pump module interior. Remove the four screws holding the case top in place (two screws on each side). Lift the cover straight up and off.

Figure 3: Pump case top screws (2 of 4 shown)

Incorrect or Unstable Pressure Reading

If the pressure is out of specification, has a constant reading of 0psi, or will not stabilize, check the following points.

Incorrect or Zero Pressure

1. Ensure that fuses **F102** and **F104** are not blown.
2. Cylinder cap screwed on too tight, or not tight enough.
3. A - D Converter failure
4. Optical sensor (limit sensor) failure
5. Damaged pressure transducer
6. Shear key broken (indication of failure to automatically stop in overpressure condition). Shear key replacement procedures are available in Section 5 of the legacy manual, and Section 8 of the current manual.

Overpressure Condition

If an overpressure condition occurs, the pump will stop running. It will either stop automatically and display an error message, or the shear key will break, in which case the motors keeps running but pressure is not developed.

This can be caused by an electrical problem, such as failure of fuse **F102**, or damage to the pressure transducer.

It can also occur if the cylinder has been screwed too tightly into the mounting block. The cylinder should be screwed in by hand until it bottoms out against the stop ring in the cylinder mount. When it stops, back it off until the transducer cable is pointing straight back.

Use the wrenches and cylinder clamp from the maintenance kit, to hold the cylinder in place while screwing the cap onto the cylinder.

Unstable Pressure

Densification inside the tubing associated with high viscosity applications can cause clogs. Ensure that temperature and other factors affecting viscosity are carefully maintained. For solutions, refer to TB17 High Temperature and High Accuracy Options.

Fluid Leakage

Although slight leakage during normal operation is expected, leakage exceeding specifications (refer to TB05 Field Verification Procedures) may signal a problem. Areas to check are listed, in order of likelihood, along with possible causes:

Damaged seals

- Pump seals are a consumable item that becomes worn over time. Replace cylinder cap seal, piston seal, and wiper seal annually. Replace more often for applications involving heavy use or harsh/ abrasive substances.

- Dirt or other solids on the seal can cause leakage. If removed and rinsed with distilled water, a seal may still be usable, but reused cap seals may leak.
- The seals are easily damaged. Use great care during handling not to leave debris or fingernail imprints on the seal's surface.
- If the cylinder cap is not screwed on tight enough, the cap seal may not be able to prevent leaks.

Fittings

- Problems with the fittings can cause leakage.
- Inspect all plugs, ferrules, and tubing connections for damaged surfaces and threads.
- Ensure that all fittings are properly tightened.

Surface finish

- Visually inspect the inside of the cylinder for scratches by shining a flashlight down inside; the surface should have a mirror finish. Some scratches or score marks may be repaired at the factory. If the marks are very deep, however, the cylinder must be replaced.
- If the surface of the piston is damaged, the piston must be replaced.
- The piston retainer can function normally as long as there are no scratches or marks on the sealing surface.

Valves

- Pumping caustic substances or fluids containing particulates can shorten the life of valve packages, usually causing leakage to occur. Options are available from Teledyne Isco for reducing or preventing damage of this nature. These options are discussed in TB04 Pumping Salt Solutions and Brines and in the Custom Pumps Brochure.
- Leakage may be accompanied by a VALVE ERROR message. Cycle power and see if the message reappears. If it does, repair or replace the valve package.

  Valves may not be closing properly. For example, if the inlet valve opens but the outlet does not fully close, a vacuum can be created.

  The valve seals may become worn, or a valve may be impaired by thickening of viscous fluids. In electric valves, it is also possible for a motor to fail.

  Failure of electric valves may be further indicated by leakage from the small opening in the side of the valve body (see Figure 4).

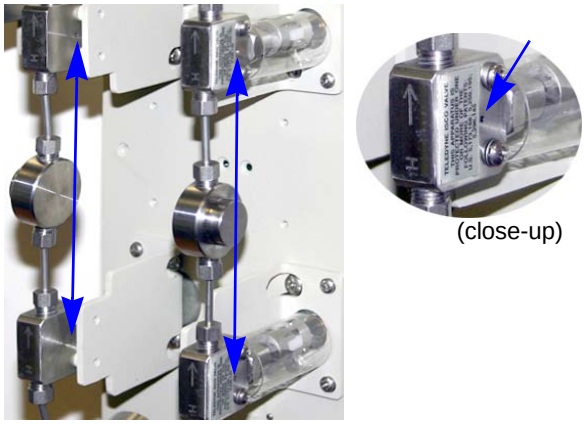


Figure 4: Weep hole on electric valves

Air valve packages can often be restored. Seal kits are available for this type of valve. Kits available:

1000D	60-5364-168
500D, 260D, 100DM/DX	60-5364-071
65D	60-5364-299

Electric valves or motors can be replaced. Replacement motors require current adjustment before operation can resume. Refer to the D-Series user manual section: *Electric Valve Motor Calibration*.

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