Trillium 40 Axis Spring Tensioner Wire Replacement Instructions

1 Overview

The objective is to replace the broken axis spring tensioner wire. This requires the following tasks:

1. Remove the seismometer cover.
2. Remove the circuit board.
3. Remove the axis assembly.
4. Remove the broken spring wire and inspect the axis assembly.
5. Install the replacement spring wire.
6. Reinstall the axis assembly onto the base.
7. Reinstall the circuit board and replace the desiccant.
8. Reinstall the seismometer cover.
9. Test the seismometer.

2 Requirements

2.1 Work environment and handling of components

- Carry out all disassembly and assembly work in a Class 10000 clean room.
- Wear attire appropriate for use in a clean room.
- Wear gloves or finger cots (latex or equivalent) when handling the axis assembly and the spring tensioner wire.
- Handle the axis assembly with care as some components can be damaged easily.
- The spring tensioner wire is 80% nickel, 20% chromium. The wire manufacturer provides the following general hazard information for this material:

  All materials should be handled by qualified personnel familiar with laboratory procedures and who are familiar with the nature of the material and any necessary precautions which should be taken in the handling, use and storage of the products.

  - *Irritant – Non-corrosive chemicals which, through immediate, prolonged or repeated contact with the skin or mucous membrane may cause inflammation.*
  - *Harmful – Chemicals which may cause death or acute or chronic damage to health when inhaled, ingested or absorbed via the skin.*
- Electrostatic discharge may damage components on the circuit board. Take appropriate precautions when handling the circuit board to avoid damaging the components.
- Do not remove the desiccant pack from its sealed shipping canister until you are ready to install it in the seismometer, just prior to reinstalling the seismometer cover. The desiccant pack should not be exposed to the atmosphere for more than 15 minutes cumulative over the life of the desiccant pack.

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2.2 Tools

- Bench vise with soft jaws large enough to hold the axis assembly (the axis assembly is 5.5 cm wide and 8 cm deep at the base)
- Torque screwdriver/wrench
  - 10–100 oz·in, 0–50 lb·in, 0–300 lb·in (about 0–1 N·m, 0–6 N·m, 0–35 N·m)
  - M1.5, M2, M2.5, and M3 ball end hex bits
  - 30 mm hex socket
- M1.5, M2, M2.5, and M3 ball end hex screwdriver
- 4 mm wrench
- Side cutters
- Tweezers
- Needle-nosed pliers
- Vernier caliper

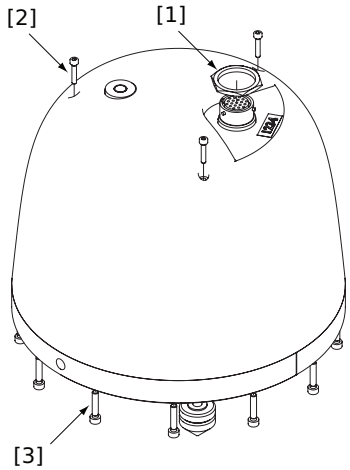
2.3 Repair kit contents

Quantity	Description
30 cm	Replacement spring tensioner wire (this is thicker gauge than the original wire)
2	Alignment pins
3	Self-sealing M3 screws
1	Desiccant pack ▸ Do not remove the desiccant pack from its sealed shipping canister until you are ready to install it in the seismometer, just prior to reinstalling the seismometer cover. The desiccant pack should not be exposed to the atmosphere for more than 15 minutes cumulative over the life of the desiccant pack.
2	Nylon tie wraps
1	Silicone grease

3 Procedures

3.1 Remove the seismometer cover

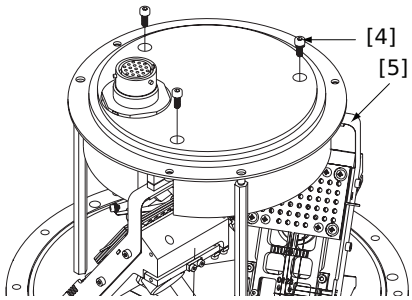
1. Remove the connector nut [1].
2. Using a 2.5 mm hex screwdriver, remove the 3 M3 screws [2]. Make sure the circuit board drops a short distance down onto the 3 standoffs inside the seismometer.
3. Place the seismometer at the edge of the workbench top so that 2 of the feet are close to the workbench edge. Remove the 12 M4 screws [3] which fasten the cover to the base, rotating the seismometer by 120° as required to access all of the screws.
4. Carefully lift the seismometer cover straight up to remove it from the base.



3.2 Remove the circuit board

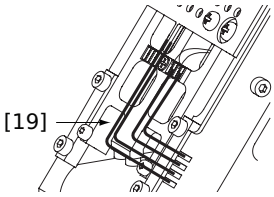
Warning Electrostatic discharge (ESD) may damage components on the circuit board. Take ESD precautions when handling the circuit board to avoid damaging the components.

1. For each of the 3 flex circuits, remove the M3 screw [4] that holds the flex circuit connector to the circuit board.
2. Reaching under the circuit board, gently pull each of the 3 flex circuit connectors [5] downwards out of the socket in the circuit board. Rest each connector on top of the respective axis frame.
3. Place the circuit board aside, using appropriate precautions against electrostatic discharge.

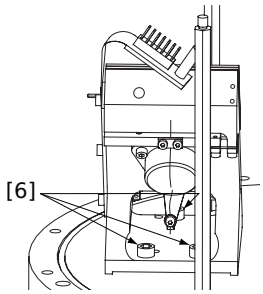


3.3 Remove the axis assembly

Caution Do not move the 4 wires [19] that run down the centre of the axis assembly to the flex circuit. If these wires do get moved out of position, you will need to reposition them correctly after you have replaced the spring tensioner wire.

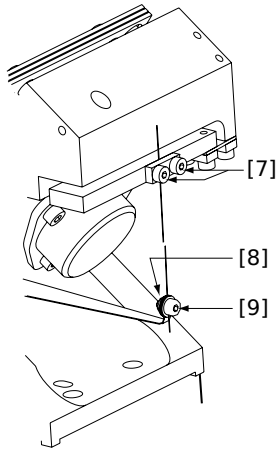


1. Remove the 3 M4 screws [6] that hold the axis assembly to the base.
2. Lift the axis assembly off the base.



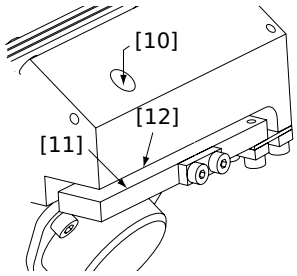
3.4 Remove the broken spring wire and inspect the axis assembly

1. Loosen the clamping mechanisms at both ends of the wire.
   a) Loosen the 2 screws [7] on the tensioner clamp, using the 1.5 mm hex screwdriver.
   b) Hold the nut [8] with the 4 mm wrench and loosen the screw [9] with the 1.5 mm hex screwdriver.
2. Remove the broken pieces of wire.
3. Ensure that there are no obviously broken or loose components on the axis assembly. If there are, report the findings to Nanometrics (see Section 4 “Technical support” on page 7).

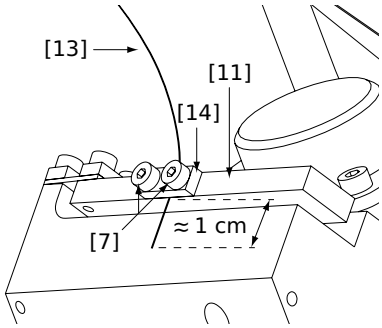


3.5 Install the replacement spring wire

1. Adjust the tensioner adjusting screw [10] until the tensioner arm [11] is parallel to the frame edge [12].
   - With the Vernier caliper, measure the parallelism between the tensioner arm and the frame edge. Measure at each end of the tensioner arm.
     - Ensure parallelism to within 0.3 mm, to allow enough adjustment range for mass centring during normal operation.

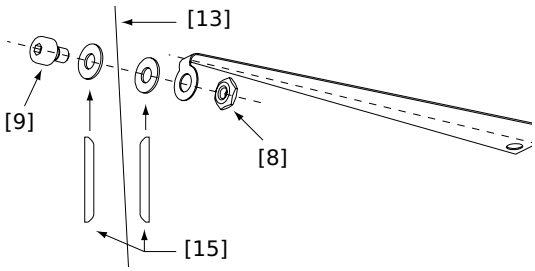


2. Clamp the axis assembly in the bench vice upside down, with just the top of the frame in the vice and with the spring and tensioner arm facing toward you.
3. Cut a 10 cm length of the replacement spring tensioner wire. Ensure that there are no sharp bends or kinks in the wire.
4. Pass one end of the wire [13] between the tensioner arm [11] and the clamp [14]. Leave approximately 1 cm of wire protruding below the clamp.

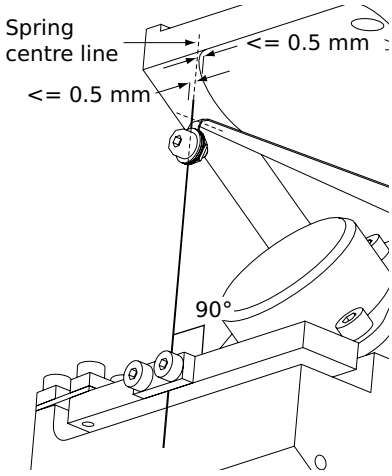


Caution Do not over-tighten the screws [7] as that will damage the wire. You will torque the screws to a specified value at completion of assembly.

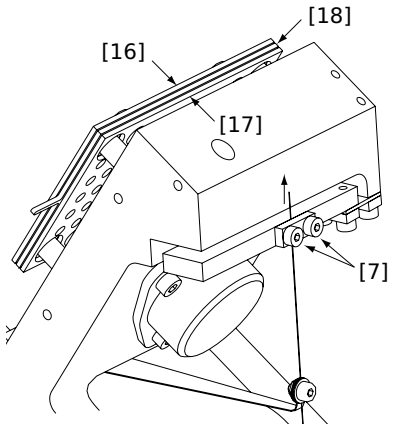
5. Lightly tighten the 2 screws [7] just enough to hold the wire so that it will not move in the clamp.
6. At the spring, loosen the screw [9] and nut [8] and open a gap between the 2 washers [15] to approximately 3 mm.
   - Ensure that the washers have the rounded edges facing each other. If the washers are not in the correct position, reassemble them with the rounded edges facing each other.
7. Pass the free end of the wire between the 2 washers.



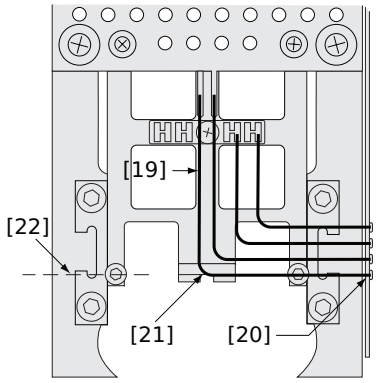
8. Lightly pinch the wire between the 2 washers by tightening the screw. Hold the nut with your fingers to keep it from spinning.
   - Ensure that the wire is positioned properly. It must meet these conditions:
     - The wire protrudes from between the 2 washers on the centre line of the spring. The wire is not offset by more than 0.5 mm to either side of the spring centre line.
     - The wire is perpendicular to the tensioner clamp edge on the tensioner arm.
9. Hold the nut [8] with the 4 mm wrench and torque the screw to 22 oz·in (0.16 N·m).
   - If the wire rotates off the centre line or out of the vertical position at the clamp while you are torquing the screw, correct the position of the wire.



10. Remove the axis assembly from the bench vise and place the axis on the bench top in the upright position.
11. Hold the top end of the wire that is protruding above the tensioner clamp. Ensure that you have a firm grip on the wire.
12. Loosen the 2 screws [7] and pull the wire up through the clamp until an even gap appears between the top [16] and bottom [17] capacitor plates in relation to the centre [18] capacitor plate.
13. With the wire centred between the 2 screws [7], torque the 2 screws to 22 oz·in (0.16 N·m) to clamp the wire.
14. With side cutters, cut off the excess spring wire above the tensioner arm clamp and below the end of the spring.



Caution Handling the 4 wires [19] risks damage to the wires or connections. Adjust the positions of the wires **only** if it is absolutely necessary. Make any necessary corrections very gently to prevent damage to the wires or connections.

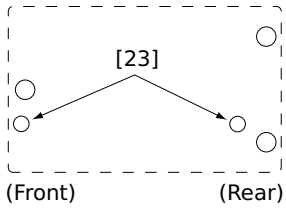


15. Ensure the 4 wires [19] that run down the centre of the axis assembly are in the correct position.
    - There should be no kinks in the wires
    - There should be only 2 bends in each of the wires:
      - Where they leave the flex circuit solder pads [20]
      - Where they bend toward the capacitor plates and the boom PCB [21]

      You can use an alignment pin from the kit as a bend radius guide if you must correct bends at [20] and [21].
    - The wires must be positioned as follows:
      - Parallel with the face of the boom
      - Parallel with each other
      - Parallel with the axis of pivot rotation [22] along the horizontal runs
      - The wires must not touch each other, and must not touch the boom or the frame except at the solder points.

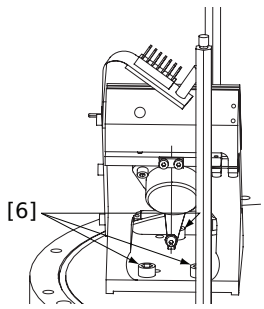
3.6 Reinstall the axis assembly onto the base

1. Place the 2 alignment pins into the alignment holes [23] on the baseplate where the axis is to be reinstalled.
2. Align the hole at the front edge of the axis and the slot toward the rear of the axis with the alignment pins.
3. Lower the axis onto the base. Ensure that the three feet of the axis assembly are resting on the base.
4. Insert the 3 M4 screws [6]. Torque each screw to 22 lb·in (2.5 N·m).



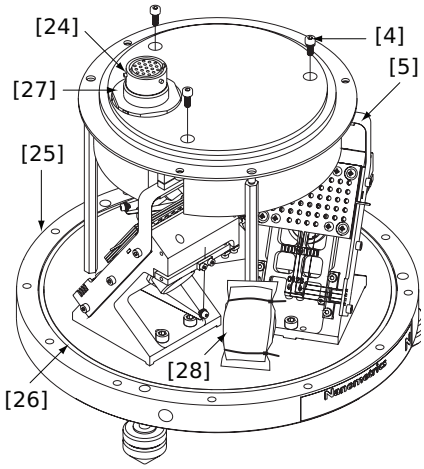
Caution The alignment pins will interfere with operation if they are left in the seismometer. Ensure that you remove the alignment pins.

5. Remove the 2 alignment pins. You will likely need to use needle-nose pliers to do this.



3.7 Reinstall the circuit board and replace the desiccant

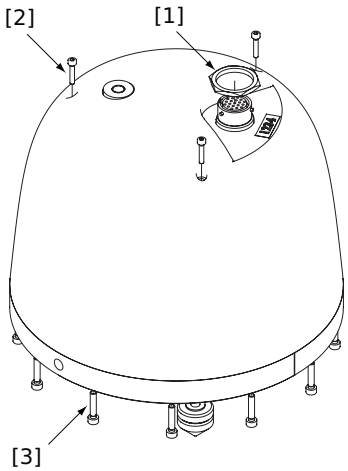
1. Orient the circuit board so that the PCB connector [24] is positioned as shown relative to the South line [25] inscribed on the base, and then place the circuit board onto the 3 standoffs.
2. Plug each flex circuit connector [5] into the respective socket on the circuit board.
3. Thread each of the M3 screws [4] through the circuit board into the standoff on the flex circuit. Torque the screws to 9 lb·in (1 N·m).
4. Remove the base O-ring [26] and PCB O-ring [27]. Carefully wipe the old silicone grease off of the O-rings and out of their respective grooves in the base and the PCB connector flange.
5. Apply a light coating of silicone grease to both O-rings using the grease supplied in the kit. Reinstall the O-rings.



6. Apply a light coating of silicone grease to the O-rings on the M3 self-sealing screws from the kit. Set the 3 screws aside on a clean surface.
7. Remove and discard the desiccant pack from the seismometer.
8. Remove the new desiccant pack [28] from its sealed shipping canister. Secure it to a standoff using the supplied nylon tie wraps.
   - Complete the next procedure (3.8) within 15 minutes of installing the new desiccant pack.

3.8 Reinstall the seismometer cover

1. Ensure that the base O-ring and PCB O-ring are properly seated in their respective grooves.
2. Orient the seismometer cover so that the connector hole in the cover is aligned with the PCB connector. Carefully lower the cover straight down onto the base.
3. Grasp the PCB connector and carefully pull it up until the circuit board lies flush against the inside of the cover. Spin the nut [1] loosely onto the connector to hold the circuit board in place.
4. Loosely thread the 3 replacement M3 self-sealing screws [2] into the circuit board through the cover.
5. Slide the assembled seismometer to the edge of the bench top so that 2 of the feet are close to the edge.
6. Loosely thread 4 of the M4 screws [3] through the base and into the cover. If necessary, rotate the cover slightly to align the hole in the cover with the hole in the base.



7. Rotate the seismometer 120° and repeat step 6. Repeat until all of the screws are in place. At this point you may turn the sensor upside-down to make it easier to torque the screws.
8. Torque the 12 base screws [3] using this pattern:
   a) Torque one of the screws to 22 lb·in (2.5 N·m).
   b) Rotate the seismometer 120° to select the next screw to torque.
   c) Repeat this pattern until you have torqued all of the screws [3] to 22 lb·in (2.5 N·m).
9. Torque the 3 cover screws [2] to 9 lb·in (1 N·m).
10. Torque the connector nut [1] to 90 lb·in (10 N·m).

3.9 Test the seismometer

1. Apply power to the sensor and check that the current stays below 125 mA. When the sensor is level the power consumption should be about 0.6 W.
2. Carry out a coherence test with another Trillium 40 Seismometer.

Once you have ensured correct operation, the seismometer is ready to be used.

4 Technical support

If you need technical support, please submit your request via the Nanometrics customer support site, or by email or fax. Include a full explanation of the problem. Before returning a unit for repair, request an RMA number.

Customer support site:	http://support.nanometrics.ca/
Email:	techsupport@nanometrics.ca
Fax:	To: Support, at +1 613-592-5929