Kuster Company
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K10 Geothermal PTS - SRO Tool

Operation & Service Manual

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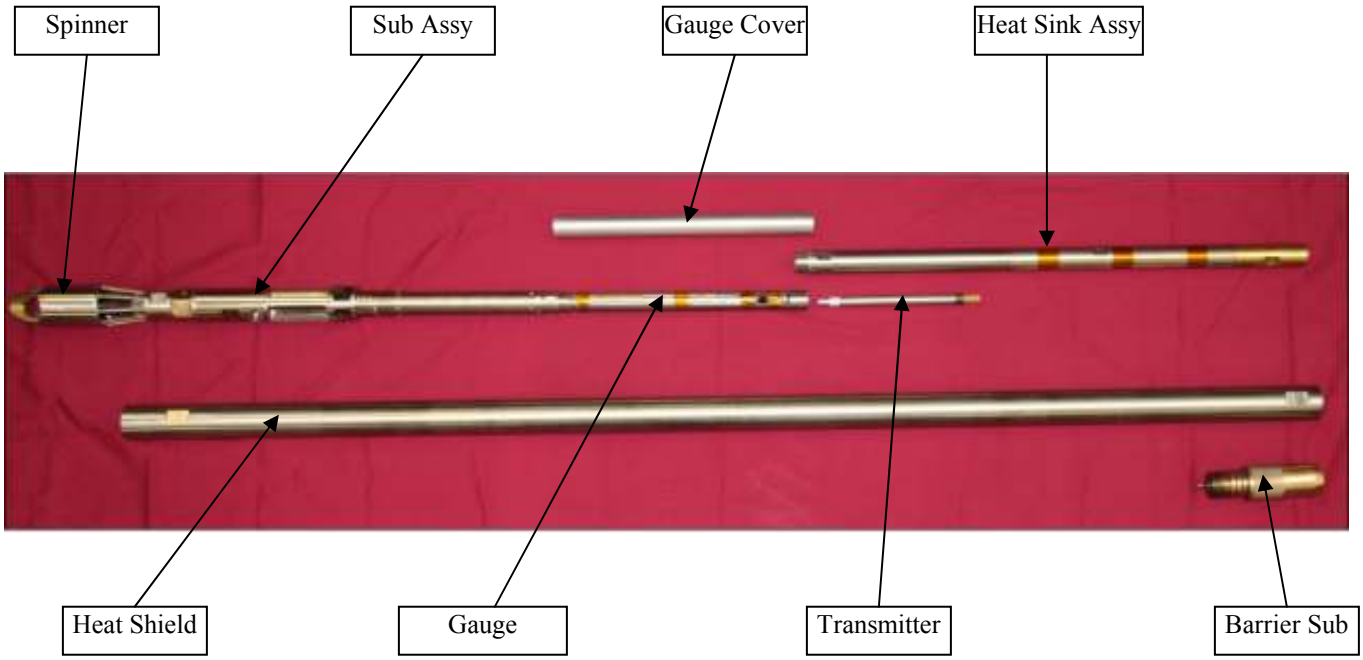
K10 PTS SRO MAIN COMPONENTS



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I. Scope.

The manual applies to the Kuster Company K10 Geothermal PTS-SRO Tool.

II. Purpose.

The purpose of this manual is to describe in sufficient detail all necessary steps to assemble, disassemble, and maintain the tool.

III. Description.

The Kuster K10 PTS SRO tool is a subsurface high temperature tool designed to continuously measure subsurface temperature, pressure and flow in real time. All data is displayed on and saved in surface SRO Box.

Features:

- Robust electronic section
- Piezoresistive pressure sensor
- Fast response RTD temperature sensor
- Real time data

The K10 PTS-SRO tool is able to be downhole for up to 6 hours at 300C and 4 hours at 350C. The electronic section of the instrument is encased in a pressure housing, which thermally protects it from the high geothermal temperatures. The pressure transducer senses well bore pressure through a capillary tube, while the RTD sensor remains exposed to the well bore for accurate and fast response temperature sensing and recording. Interchangeable flow meters and impellers allow you to choose what is best suited for the flow conditions. All materials meet NACE MRO175 specifications for corrosive well bore media.

Specifications

Dimensions:
Outside diameter:.....1.75"
Length:.....85"
Outer housing pressure collapse:.....5,000 psi

Pressure:
Range:.....up to 5,000 psi
Accuracy:.....0.05% F.S.
Resolution:.....0.0003% F.S.

Flowmeter/Spinner (Continuous):
O.D.:.....2-1/8" and 1-11/16"
Sensors:.....Reed switch/Magnetic
Data:.....Flow with directional sensing
Flow rate:.....100 RPM (Min)/20,000 RPM (Max)

Temperature:
Accuracy:.....0.015% F.S.
Resolution:.....0.002% F.S.
Downhole time:.....6 hours at 300C
.....4 hours at 350C

IV. Performance.

The K10 Geothermal PTS SRO Tool is designed for streaming bottom hole pressure and temperature and flow data to the surface in real time mode. It has been tested in a variety of time/temperature scenarios, but not all. There exists a complex relationship between external temperature, internal temperature, and down hole time.
If there is any doubt as to the suitability of the instrument for a planned survey, please contact Kuster Company.

V. Definitions.

Below are three essential definitions, which are used through out this document.

Note:
A note indicates a step, procedure, or process, which is necessary to highlight for successful operation.

CAUTION:
A caution indicates a step, procedure, or process which if not followed correctly could result in damage to equipment.

WARNING:
A warning indicates a step, procedure, or process which if not followed correctly could result in damage to equipment and/or injury to personnel.

VI. Facilities & Equipment.

VII. Assembly

A. Flow Meter, Reference Drawing 18600-500.

1. Inspect Impeller, does it move freely?
2. Inspect Lower Bearing. Part #: 18600 - 509
3. Check O-ring
4. Inspect Upper Bearing. Part #: 18600 - 509
5. Inspect Magnet. Part #: 18600 - 507
6. Weight Balance - Non-Magnetic. Part #: 18600 - 506
7. Fill up the impeller housing with buffer fluid (see at the end of the manual how) and put aside.

CAUTION

Protect Magnet Hub with Protective Guard while Flow Meter is not installed with tool. So that magnet will not be able to magnetize any particular object.

B. Sub Assembly

CAUTION

Exercise caution when handling the Sub Assembly. Two particular areas, which are very susceptible to damage due to mishandling, are the wires coming from the flowmeter and temperature sensor to the board and the Insulator Tube. See Reference Drawing.

1. Unscrew the setscrew from the sub assembly completely and remove the gauge.

2. Inspect Sub Assembly, for damage, cleanliness, and serviceability. In particular, all threads should be looked at closely for signs of debris or damage.

3. Inspect outside diameter of O-ring glands for signs of damage or galling.

4. Inspect lead wires from temperature sensor for cuts, nicks and abrasions.

5. Install Metal C-ring (Part Number 18500-413)

6. Install O-rings, 2 each (Part Number 707-123)

7. Remove Gauge Bulkhead Cover (Part Number 18500-421)

8. Inspect external threads and O-ring glands on gauge bulkhead for damage, cleanliness and serviceability.

9. Install O-rings, 2 each, Part Number 706-015 (At higher temperatures O-rings should be replaced after each run).

Note: Kuster Company Hi-Temp Lubricant, Part Number 915-001, is the factory recommended lubricant to be used for this tool. It has been formulated for high temperature applications and as an anti-galling agent. Other substitutions could be acceptable, but have not been tested.

10. Lubricate the external threads of the gauge bulkhead and both O-rings with Hi-Temp Lubricant and set aside.

C. Gauge – Sub Assembly: See Reference Drawing

1. With nose of the gauge assembly pointed upward, pour about 10 cc of Kuster Company Transfer Fluid, (Part Number 901-103) into the nose cavity. To prevent from fluid leakage place thumb over the setscrew hole.

2. With the gauge maintained in a nose upward position, install the sub assembly until pressure can be felt. This will be approximately five turns or 0.3” of travel.

3. Secure the gauge sub assembly in a vice clamping mid-body on the gauge assembly. Using a wrench on the gauge bulkhead only. Slowly rotate sub assembly in a clockwise direction until the sub assembly bottoms out on the nose of the gauge assembly. The additional force felt is the silicone oil being forced up the capillary tube to the pressure port.

4. Once the gauge has bottomed out on the gauge bulkhead, secure the gauge assembly to the gauge bulkhead using the setscrew.

5. Install the 1/8”-27 NPT Plug (Part Number 18600 – 346) in filter cavity. Apply Kuster High Temp Lube on the thread. Do not over torque.

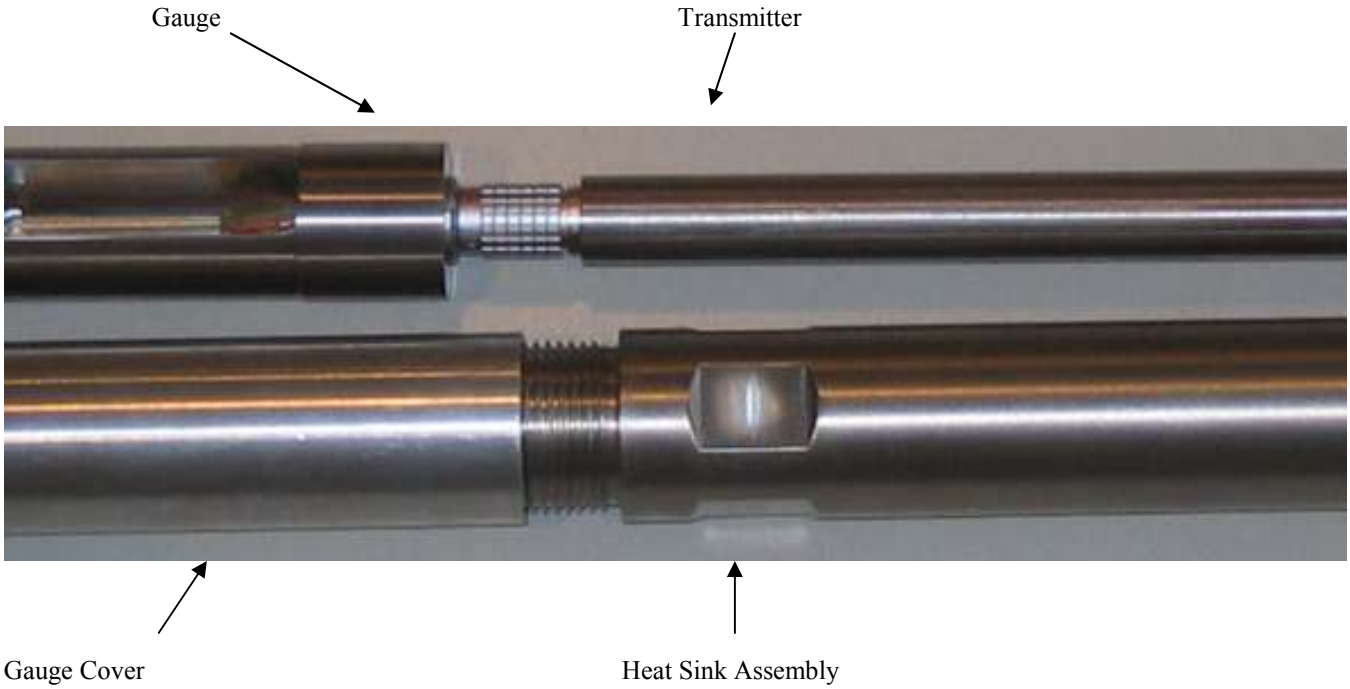
6. Connect the temperature sensor and flowmeter leads.
Note: Make sure to match the color wires when connecting.

7. Using High Temperature Polyimide Tape (Kapton) (Part Number 18730-015), tape down all wires in the region shown on drawing.

D. Tool Assembly

8. Connect Transmitter to the gauge..

9. Lubricate external threads on the Gauge Bulkhead with hi-temp Lubricant and slide Gauge Cover over Transmitter and Gauge.



10. Lubricate the external threads on the Heat Sink Assembly and install it onto the Gauge Cover.

11. Lubricate remaining threads and O-rings on Sub Assembly (At higher temperatures O-rings and C-ring suppose to be replaced after each run).

12. Secure Heat Shield's open end and slide Sub-Gauge Cover-Heat Sink assembly into it. Slowly screw assembly together until the Metal C-ring bottoms out. Tighten payload to heat shield and torque between 90-100 ft/lbs.

13. Lubricate O-rings and C-ring on Heat Shield Barrier. Slowly screw it into the Heat Shield until the Metal C-ring bottoms out. Tighten to the heat shield with the torque between 90-100 ft/lbs. (At high temperatures O-rings and C-ring suppose to be replaced after each run).

14. Remove plug from filter cavity and install filter (Part # 18600-535) with wrench hand tight.

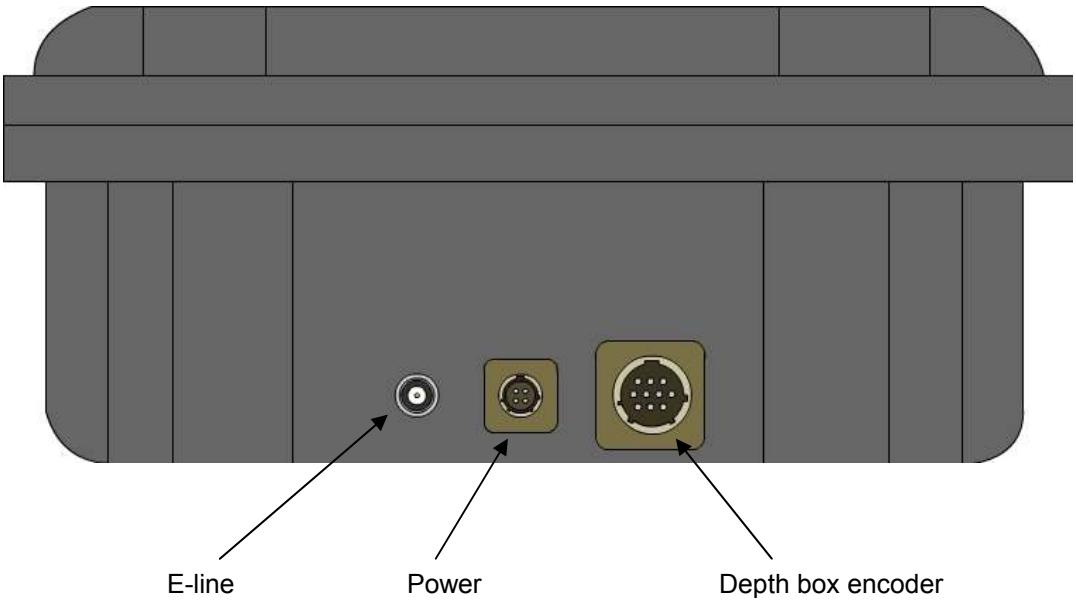
15. Lubricate remaining external threads on sub.

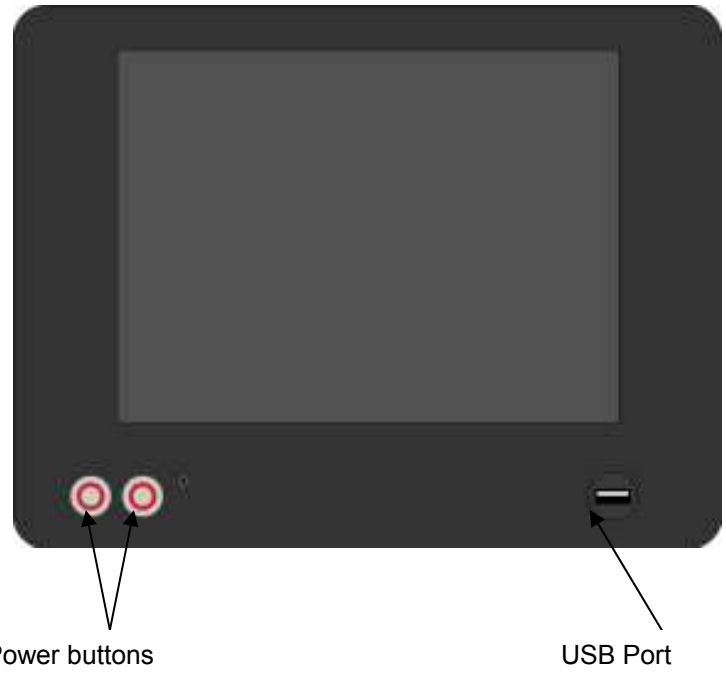
16. Install flow meter assembly. (See detailed procedure below)

17. Screw the plug back and repeat the procedure with the plug on opposite side.

VIII. Operation

A. Rigging up.





1. Connect entire pre-assembled tool to wireline.

2. Connect E-line to SRO box

3. Connect Depth encoder cable to SRO box

4. Connect Power cable to SRO box

5. Power up the SRO box by pushing the red buttons

6. Dependent upon wellhead conditions, if there is significant pressure and/or temperature difference at surface, a 15-minute period of stabilization should be observed within the lubricator with the valve open.

B. Running the tool.

WARNING

Exceeding down hole time and temperature combinations could cause injury to personnel or damage to equipment.

1. The tool is run from this point forward like any other down hole recorder.

2. The tool should be run no faster than 150 feet/minute.

3. The tool should be pulled out of the hole no faster than 150 feet/minute.

C. Rigging Down

CAUTION

Do not submerse the tool in any liquid to advance the normal cooling rate, damage to equipment could occur.

1. Immediately after separating the Heat Shield Assembly from the rope socket, the tool should be placed horizontally on the ground or some other heat sink to allow it to cool as fast as possible.

D. Disassembly. Refer to Drawing 18500-500.

CAUTION

Do not attempt disassembly of tool until the exterior temperature reaches 115°F or you are able to hold it at the thread with your bare hand for a minute without discomfort.

1. Remove Flow Meter and Bull Nose.

CAUTION

Disassemble and clean flow meter after each run. Calcium build up or corrosion may occur, which will make disassembly very difficult. The flowmeter disassembly and assembly procedure is covered later in this manual.

2. Remove Heat Shield Barrier

3. Remove Heat Shield.

4. Remove Heat Sink.

5. Remove Gauge Cover

E. Downloading Data from SRO Box (covered in SRO software manual).

IX. Maintenance.

A. Temperature Probe Cover.

1. Inspect for damage and serviceability.

B. Heat Shield.

1. Wash with solvent internal threads and O-ring surfaces.

2. Inspect internal threads and O-ring surfaces for damage, signs of galling, and serviceability.

3. Wash the exterior of the heat shield with solvent to remove any corrosive residue left from the well bore media.

4. Install Dust covers on open sides to protect.

5. Store in case.

C. Heat Sink.

1. Wash external threads with solvent.

2. Inspect external threads for damage and serviceability.

3. Store in case.

D. Gauge Cover.

1. Wash completely with solvent.

2. Inspect internal threads for damage and serviceability.

3. Store in case.

E. Gauge – Sub Assembly.

1. Remove Kapton tape.

2. Disconnect micro connectors.

3. Remove Gauge from Sub Assembly.

4. Gauge Assembly. The Gauge Assembly requires no operator maintenance. Store in case.

F. Sub Assembly.

1. Remove all O-rings, the metal C-ring and discard them. These consumable parts are a “one time use only” components.

2. Wash external threads and O-ring glands with solvent.

3. Flush capillary tube with solvent and dry if possible with a very low pressure air.

4. Inspect all external threads and O-ring glands for damage, signs of galling, and serviceability.

5. Install Temperature Sensor Protective Cover.

6. Install Gauge Bulkhead Protective Cover.

7. Store in case.

G. Flow Meter Disassembly.

There is sequence of maintenance for Flow Meter Assembly.

1- Snap ring from top of Magnet Holder

2- Unscrew cap screw on the top of the magnet hub

3- Unscrew set screws and remove magnet hub from the shaft.

4- Remove Shim(s)

5- Remove Bushing from the shaft.

6- Remove flow meter nose.

7- Unscrew two setscrews from the impeller. You need to line up impeller set screw with a hole in the cage body and unscrew it using Allen wrench, which comes with the field kit. Then turn the impeller 180° and unscrew the second set screw.

8- Remove the impeller from the shaft. If you have difficulties of doing that use Impeller puller, which comes with the field kit. There is a procedure of using the impeller puller.

Screw the Impeller puller housing onto the impeller. Note, that it is a left hand thread.
Screw Impeller puller plunger into the puller's housing. Using two open-end wrenches that come with the field kit, push the impeller from the shaft.

9- Unscrew the flow meter's cage

10- Unscrew bearing cap from flow meter body.

11- Take snap rings from the lower and upper ball bearings.

12- Remove the bearings off the shaft.

13- Remove the shaft.

- If you intended to reuse bearings, use the contact cleaner to wash them.
- Remove all o'rings and install new one.

How to Replace Magnet:

If you would like to replace the magnet in the magnet hub, you need to:

a) Take the snap ring from the hub.
b) Remove the magnet that needs to be replaced.
c) If Magnet is not coming out from Magnet Hub, try to push it out from the backside of the Magnet Hub.
d) Put a new one in.

Note:

1. ***Depending on the temperature, replace magnet after every 1- 3 runs. Every run is preferable.***
2. ***There is only one magnet in the hub. The other piece is just a non-magnetic blank part for the balance.***
3. ***Bearing replacement is at the customer discretion. Having new bearings for every survey is preferable.***

If PTS CENTRALIZER is going to be used, it is need to be done as follows.

1. Remove flow meter nose.
2. Unscrew two setscrews from the impeller. You need to line up impeller set screw with a hole in the cage body and unscrew it using Allen wrench, which comes with the field kit. Then turn the impeller 180° and unscrew the second setscrew.
3. Remove the impeller from the shaft. If you have difficulties of doing that use Impeller puller, which comes with the field kit.
4. Unscrew the flow meter's cage
5. Replace a flow meter's cage with the centralizer and assemble in the reverse order.

Flow Meter Assembly

Here is the procedure to assemble Flow Meter.

1. Put upper bearing on impeller shaft

2. Insert shaft into a flow meter housing.
3. Fix bearing with a snap ring
4. Put the lower bearing on the shaft and fix it with the snap ring as well
5. Put bushing bearing on the shaft with smaller diameter ahead.
6. Install shim(s) on the top of the bushing
7. Install magnet hub assembly on the shaft. Be sure to line up set screws with the flats on the shaft. Do not tighten them at that time.
8. Install a cap screw inside the hub and tight it up. Do not over-torque.
9. Tight up magnet hub's set-screws on the flats of the shaft.
10. Install bearing cap on impeller body.
11. Install impeller on the shaft lining up set-screw of impeller with shafts flats and the hole in the cage. At the same time, impeller should be flushed up with shaft end.
12. Tighten up the set-screws with the Allen wrench through the hole in the cage.
13. Install a flow meter nose and tighten up.

Filling the impeller housing with buffer fluid:

This procedure need is for protecting impeller bearings from the well fluids. Preferably it is need to be implemented right before running tool into the hole.

1. Assemble flow meter with the gauge

2. Remove one filler plug from impeller housing.
3. Insert fluid bottlenose tight inside the housing.

4. Squeeze the bottle and fill the housing with the oil until oil comes out of the bearing cap.
5. Install filler plug back and tight it up.

6. Turn the tool 180 and repeat the procedure on the second hole.

X. Flow Meter Part Numbers

	Part #	Description
1.	18600 – 506	Weight Balance – Non Megnetic
2.	18600 – 507	Magnet, Alnico, 1/8”x1/2”

3.	18600 – 509	Bearing
4.	18600 – 510	K10 PTS Sub Assembly
5.	18600 – 520	K10 PTS Spinner Assy 2-1/8” O.D. Impeller 10”
6.	18600 – 525	K10 PTS Spinner Assy 1-11/16” O.D. Impeller 10”
7.	18600 – 530	Impeller Assy PTS 2-1/8” O.D., 5” Pitch
8.	18600 – 531	Impeller Assy PTS 2-1/8” O.D., 10 Pitch
9.	18600 – 533	Impeller Assy PTS 1-11/16” O.D. 5” Pitch
10.	18600 – 534	Impeller Assy PTS 1-11/16” O.D. 10” Pitch
11.	18600 – 535	Filter PTS, 1/8” NPT
12.	18600 – 536	Impeller Puller PTS
13.	18600 – 537	Impeller Puller Housing
14.	18600 – 538	Impeller Puller Bolt
15.	18600 – 539	Impeller Puller Plunger
16.	18600 – 540	Impeller Puller Plunger Assy

XI. Storage.

Geothermal PTS tool should be stored in the case when not in use.

XII. References.

A. Performance curves.
B. Drawings.
C. Bill of Materials.
D. Calibration Verification Table.

XIII. Technical Support.

Technical support can be obtained by contacting:
Kuster Company
2900 East 29th Street, Long Beach, CA 90806
Telephone +1 562 595 0661, Facsimile +1 562 426 7897
Email kuster@kusterco.com
John Jacobson, General Manager, johnjacobson@kusterco.com
Javier Serrano, Engineering, javierserrano@kusterco.com
Igor Yevdayev, Engineering, igoryevdayev@kusterco.com

The PTS tool can be used with a 4.6” or 7.0” O.D. centralizer, which can be purchased from Kuster company as an accessory.

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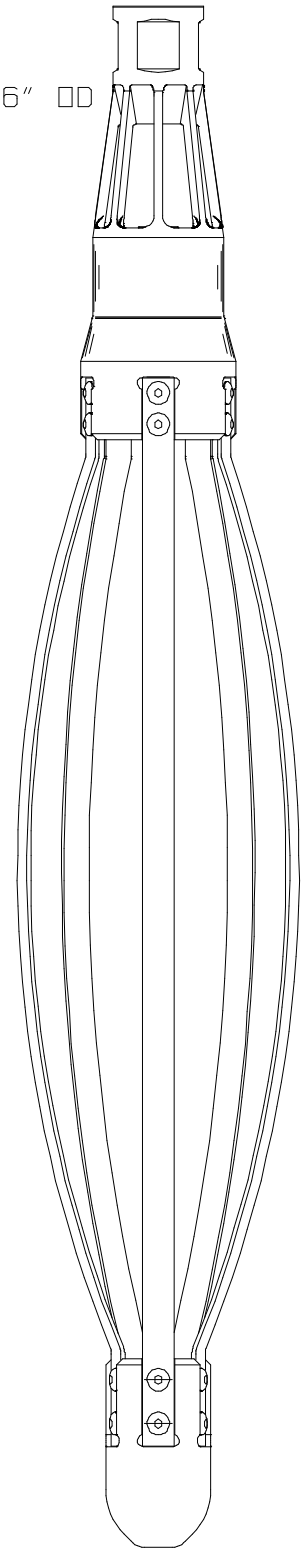
PTS CENTRALIZER

18600-501 TRIM KIT 4.6" OD

18600-542 LEAF SPRING
5 REQUIRED



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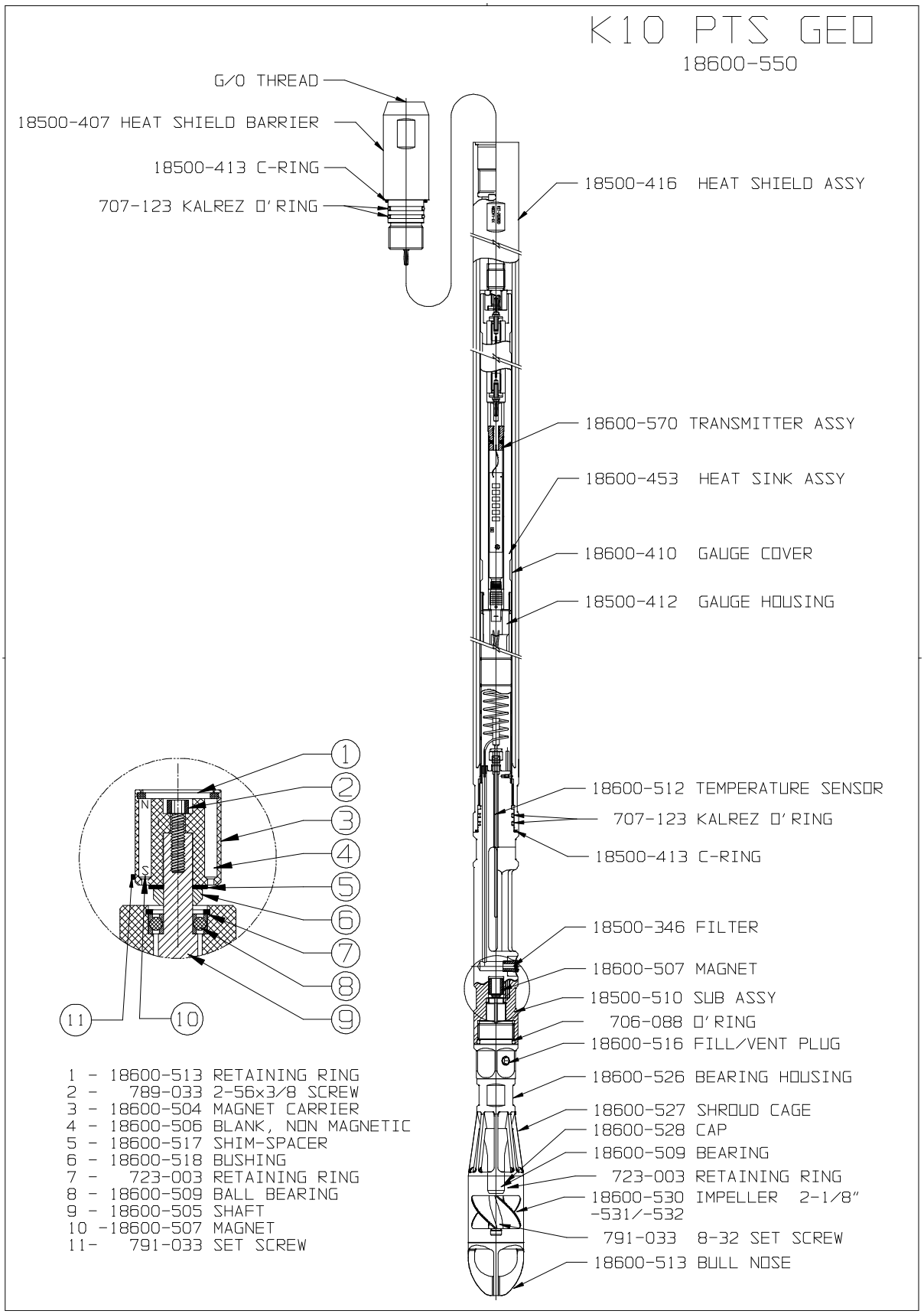
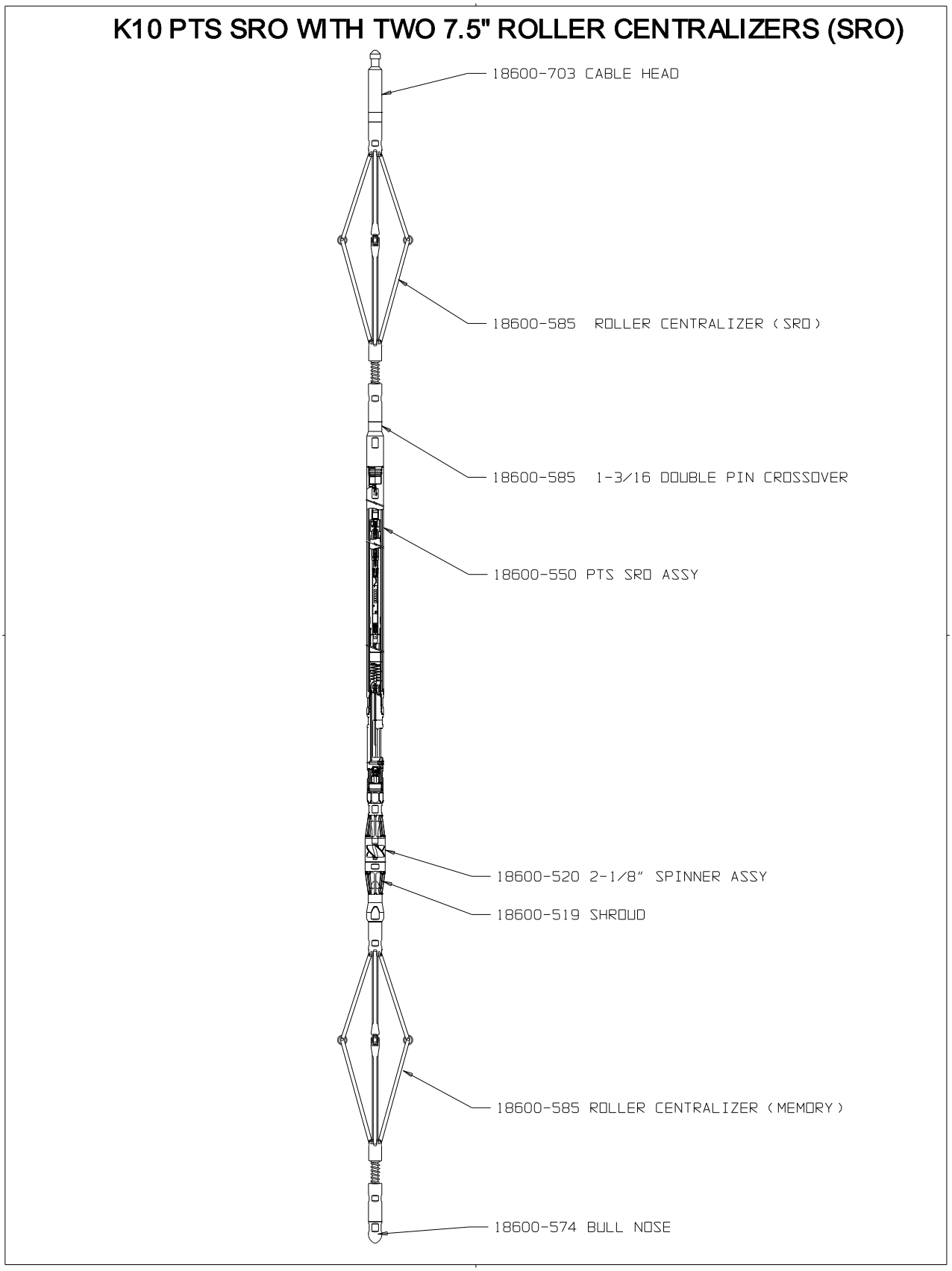
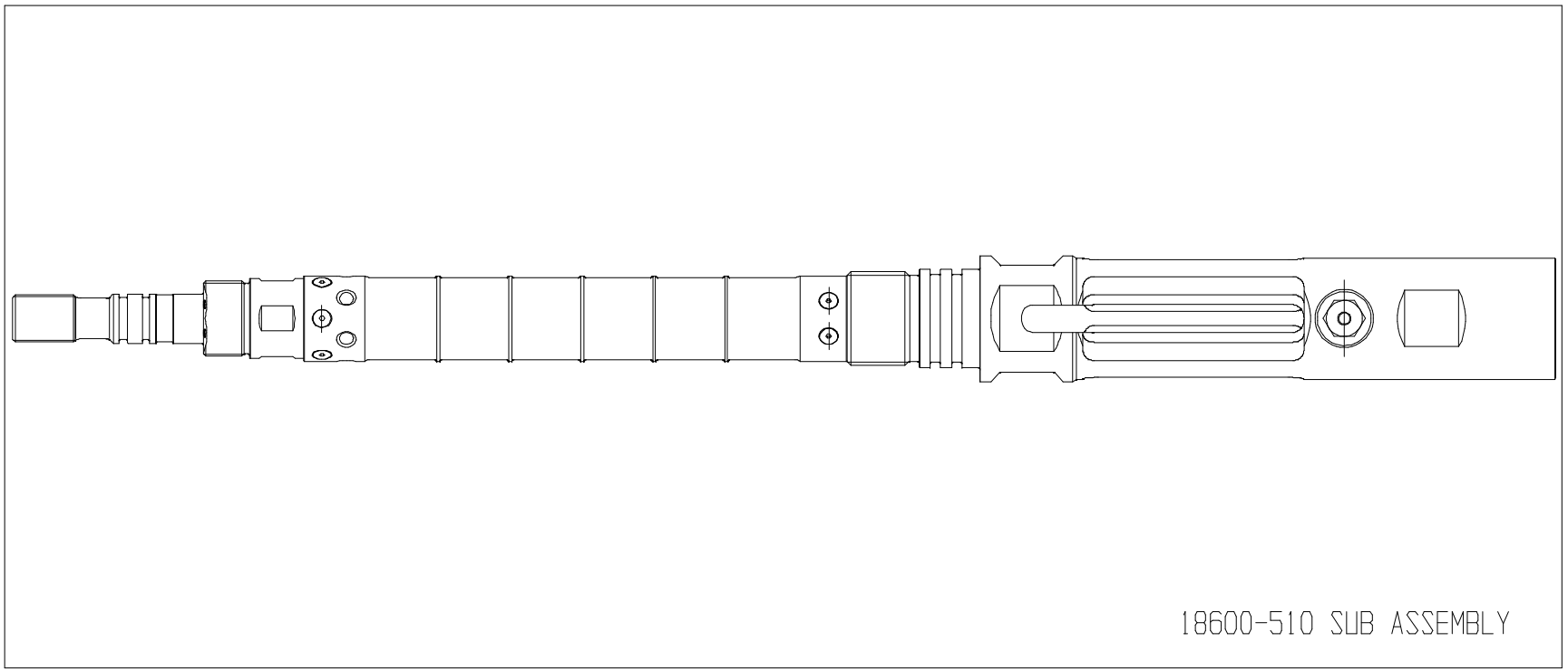



K10 PTS SRO WITH TWO 7.5" ROLLER CENTRALIZERS (SRO)
18600-703 CABLE HEAD
18600-585 ROLLER CENTRALIZER (SRO)
18600-585 1-3/16 DOUBLE PIN CROSSOVER
18600-550 PTS SRO ASSY
18600-520 2-1/8" SPINNER ASSY
18600-519 SHROUD
18600-585 ROLLER CENTRALIZER (MEMORY)
18600-574 BULL NOSE



18600-510 SUB ASSEMBLY

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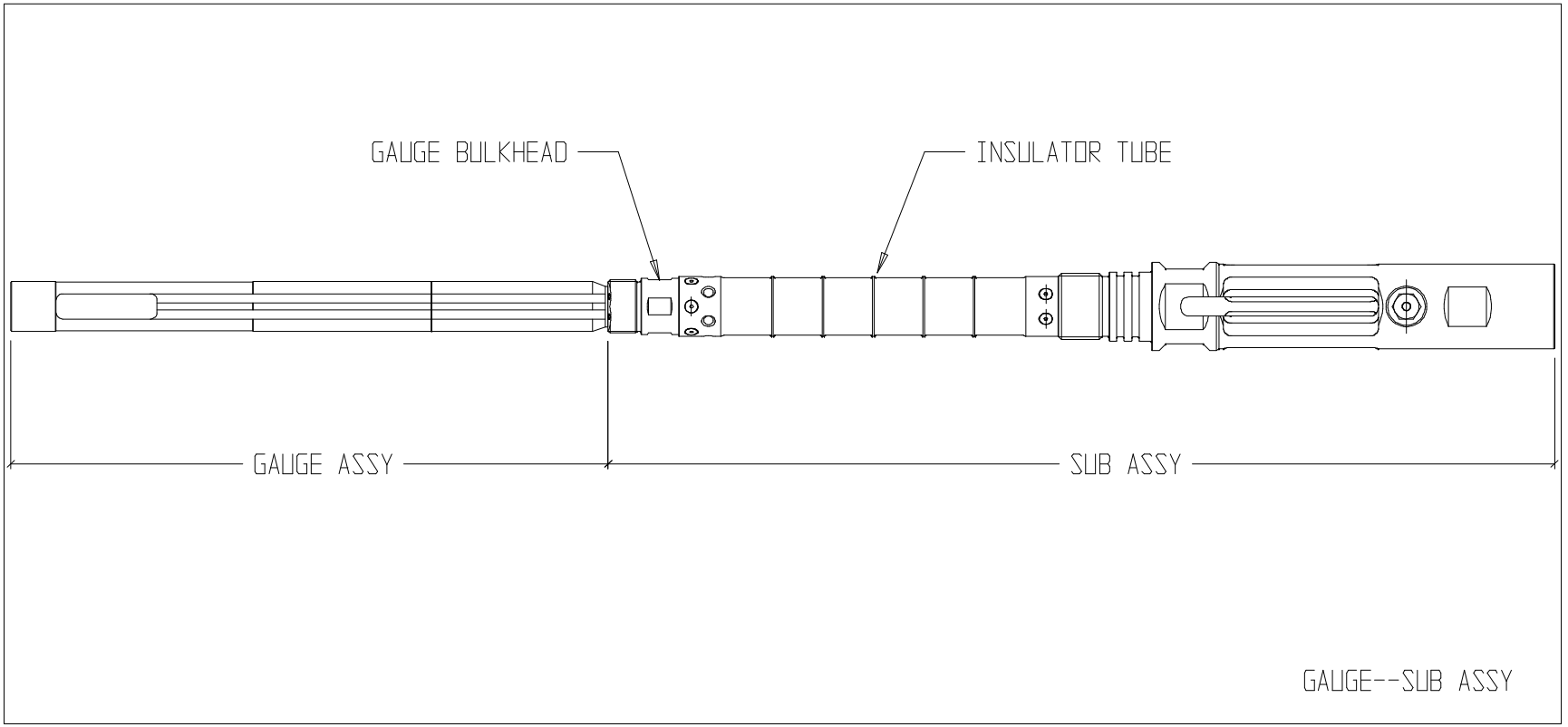

Bench Test Setup

Connect BNC cable and the load box to the transmitter as shown above and turn on SRO box by pushing both red buttons.