



**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: [Kuster@kusterco.com](mailto:Kuster@kusterco.com)

---

# K10 PT Geothermal Instrument

## Operation & Service Manual

---



**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

---

**CONTENTS**

I.	Scope.....	3
II.	Purpose.....	3
III.	Description.....	3
IV.	Specifications.....	3
V.	Performance.....	3
VI.	Definitions.....	4
VII.	Facilities & Equipment.....	5
VIII.	Assembly.....	5
IX.	Operation.....	7
X.	Maintenance.....	8
XI.	Storage.....	9
XII.	References.....	10
XIII.	Technical Support.....	10
XIV.	Assembly with two 7.5" Roller Centralizers.....	12
XV.	PT Geothermal Major Subassemblies.....	13
XVI.	Heat Shield Performance Curves.....	15
XVII.	K10 PT Geothermal Gauge Operational Checklist.....	19



**Kuster Company**

2900 E. 29th Street  
Long Beach, CA USA 90806  
Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

---

**I. Scope.**

The manual applies to the Kuster Company K10 HT EMR Geothermal Tool .

**II. Purpose.**

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

**III. Description.**

The K10 HT EMR Geothermal Tool is a wireline conveyed, sub-surface, electronic pressure and temperature memory recorder. It is specifically designed to operate in the geothermal environment for up to six hours at temperatures up to 600°F (315.6°C). The tool consists of three major components: the sub assembly, the gauge assembly and the flask assembly.

**Features:**

- o Robust electronic section.
- o Piezoresistive pressure sensor.
- o Fast response RTD temperature sensor.

**IV. Specifications.**

**Dimensions**

Diameter.....1.75"  
 Length.....60"  
 Outer housing pressure collapse.....5000psi

**Pressure**.....Up to 5,000 psi

Pressure Accuracy.....0.024%F.S.  
 Pressure Resolution.....0.0003%

**Temperature**

Temperature Accuracy.....0.15%F.S.  
 Temperature Resolution.....0.002%F.S.  
 Down hole time.....6 hours @ 300°C

**Electronics**

Power.....single or double "AA" Battery  
 Number of data sets.....1,400,000  
 Minimum sample range.....1 sec  
 OS.....Windows 98 and higher



**V. Performance.**

The K10 HT EMR Geothermal Tool is designed for geothermal bottom hole pressure and temperature work. It has been tested in a variety of time/temperature scenarios, but not all. There



**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

---

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.

**VI. Definitions.**

There are three specific definitions, which are used through out this document, which are necessary to understand.

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.



**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

---

VII. Facilities & Equipment.

VIII. Assembly

A. Sub Assembly – See Reference Drawing

CAUTION

Exercise caution when handling the Sub Assembly, which are subject to damage due to mishandling, the Insulator Tube, Part Number 18500-407.

1. Inspect Sub Assembly, Part Number 18500-423, for damage, cleanliness, and serviceability. In particular, all threads should be looked at closely for signs of debris or damage.
2. Inspect outside diameter of O-ring glands for signs of damage or galling.
3. Inspect lead wires from temperature sensor for cuts, nicks and abrasions.
4. Install Metal C-ring, Part Number 18500-413.
5. Install O-rings, 2 each, Part Number 707-123.
6. Remove Gauge Bulkhead Cover, Part Number 18500-421, if installed.
7. Inspect external threads and O-ring glands on gauge bulkhead for damage, cleanliness and serviceability.
8. Install O-rings, 2 each, Part Number 706-015.

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.

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

B. Gauge – Sub Assembly: See Reference Drawing

1. With nose of Gauge Assembly pointed upward, pour into the nose cavity 10-15 cc of Kuster Company Transfer Fluid, Part Number 901-103.
2. With the Gauge Assembly maintained in a nose upward attitude, install the sub assembly until pressure can be felt. This will be approximately 5 numbers of 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 sub at the top.
4. Once the gauge has bottomed out on the gauge bulkhead, secure the gauge assembly to the gauge bulkhead using the setscrew.
5. Install 1/8"-27 NPT Plug, Part Number in filter cavity.
6. Connect the temperature sensor 2-Pin Micro Connector. Match the colors, when connect.



**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

---

7. Using High Temperature Polyimide Tape (Kapton), Part Number 18730-006, tape down all wires in the region shown on drawing.

8. Programming the tool. All software related issues are covered in the K10 Software Manual.

*Note: When programming the tool, the computer time is synchronized with the tool and is kept active for approximately 5 minutes without power. You must connect the battery to the tool within the 5 minute time period in order to retain the time stamp. If the time period is going to be longer than 5 minutes, the start time can be set manually by using the "Set Start Time" option from the drop down menus.*



## Kuster Company

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

---

### C. Flask Assembly

1. Lubricate the external threads on the Gauge Bulkhead with Temperature Lubricant and install Gauge Cover.
2. Inspect battery to ensure that it:
  - Has sufficient Ah remaining for the survey.
  - Has sufficient voltage to start the tool.
  - Is clean, dry and serviceable.
3. Install battery.
4. Verify that the LED on the battery emits four flashes approximately 1 second apart and four flashes approximately 10 seconds apart.
5. Record the time that the battery was connected.
6. Lubricate the external threads on the heat sink and install Heat Sink on to Gauge Cover hand tight.
7. Lubricate remaining threads and O-rings on Sub Assembly.
8. Secure flask open end up and install Sub-Gauge Cover-Heat Sink assembly. Slowly screw assembly together until the Metal C-ring bottoms out. Tighten payload to heat shield and torque between 90-100 ft/lbs.
9. Remove plug from filter cavity and install filter with wrench hand tight.
10. Lubricate remaining external threads on sub and install Temperature Probe Cover.
11. Install bull nose.

## IX. Operation

### A. Rigging up.

1. Connect entire pre-assembled unit to wireline. Note that the pin on the flask is a 1.25"-8 UN-2A thread.
2. Tighten unit to rope socket using the 1.62" wrench flats nearest the pin.
3. The rigging up of the lubricator and associated equipment remains the same as any other bottom hole pressure work.
4. 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.



**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

---

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 submerge 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 18500-400, Sheets 1-6 for clarification.**

**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 Temperature Probe Cover and Bull Nose.

2. Remove Filter and install plug

3. Install Temperature Sensor Protector.

4. Remove Heat Shield and set in case or reinstall Temperature Probe Cover and Bull Nose.

5. Remove Heat Sink.

6. Remove Gauge Cover

**WARNING**

Do not attempt to remove the battery unless it is cool to the touch. Safety glasses should be worn when removing the battery. It is a good practice to let the battery be exposed to ambient air for 10 minutes following removal of the heatsink and prior to removing the battery.

7. Remove battery by grasping at the base. Do not pull on the battery cell itself.

**E. Downloading Tool.**

1. All steps necessary to remove data from the tool are covered in the software manual.

**X. Maintenance.**

**A. Temperature Probe Cover.**

1. Wash completely with solvent.

2. Inspect for damage and serviceability.

3. Store in case.

**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.



**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

---

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

4. 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 Temperature sensor 2-pin micro connector.

3. Remove Gauge Assembly 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 component.

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

3. Flush capillary tube with solvent.

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.

XI. Storage.

Geothermal tools should be stored in the case when not in use.



**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: [Kuster@kusterco.com](mailto:Kuster@kusterco.com)

---

**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 29<sup>th</sup> Street

Long Beach, CA 90806

Telephone 562 595 0661

Facsimile 562 426 7897

Email [kuster@kusterco.com](mailto:kuster@kusterco.com)

John Jacobson, General Manager: [johnjacobson@kusterco.com](mailto:johnjacobson@kusterco.com)

Igor Yevdayev, Engineering: [igoryevdayev@kusterco.com](mailto:igoryevdayev@kusterco.com)

Javier Serrano, Engineering: [jserrano@kusterco.com](mailto:jserrano@kusterco.com)

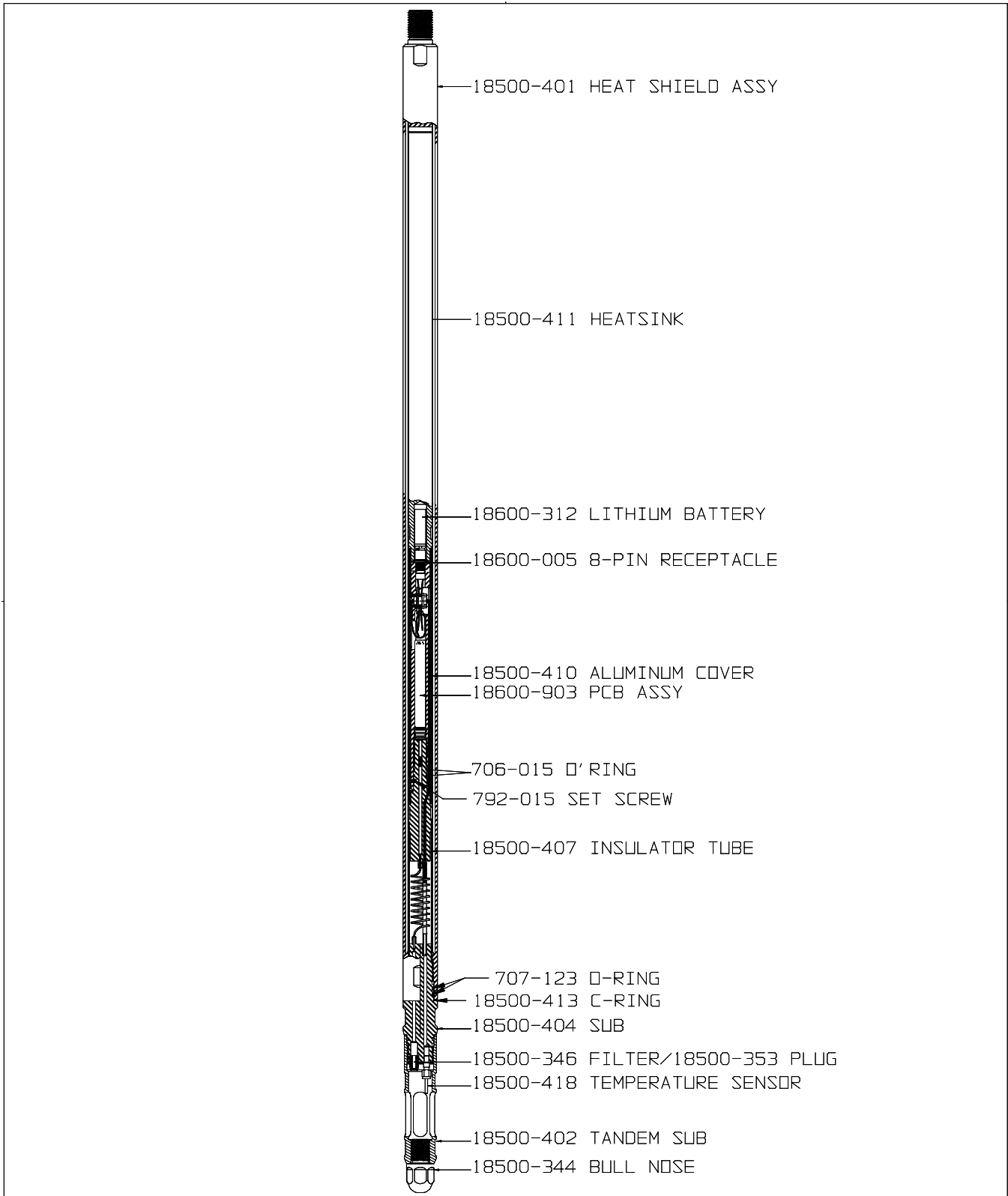


**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com





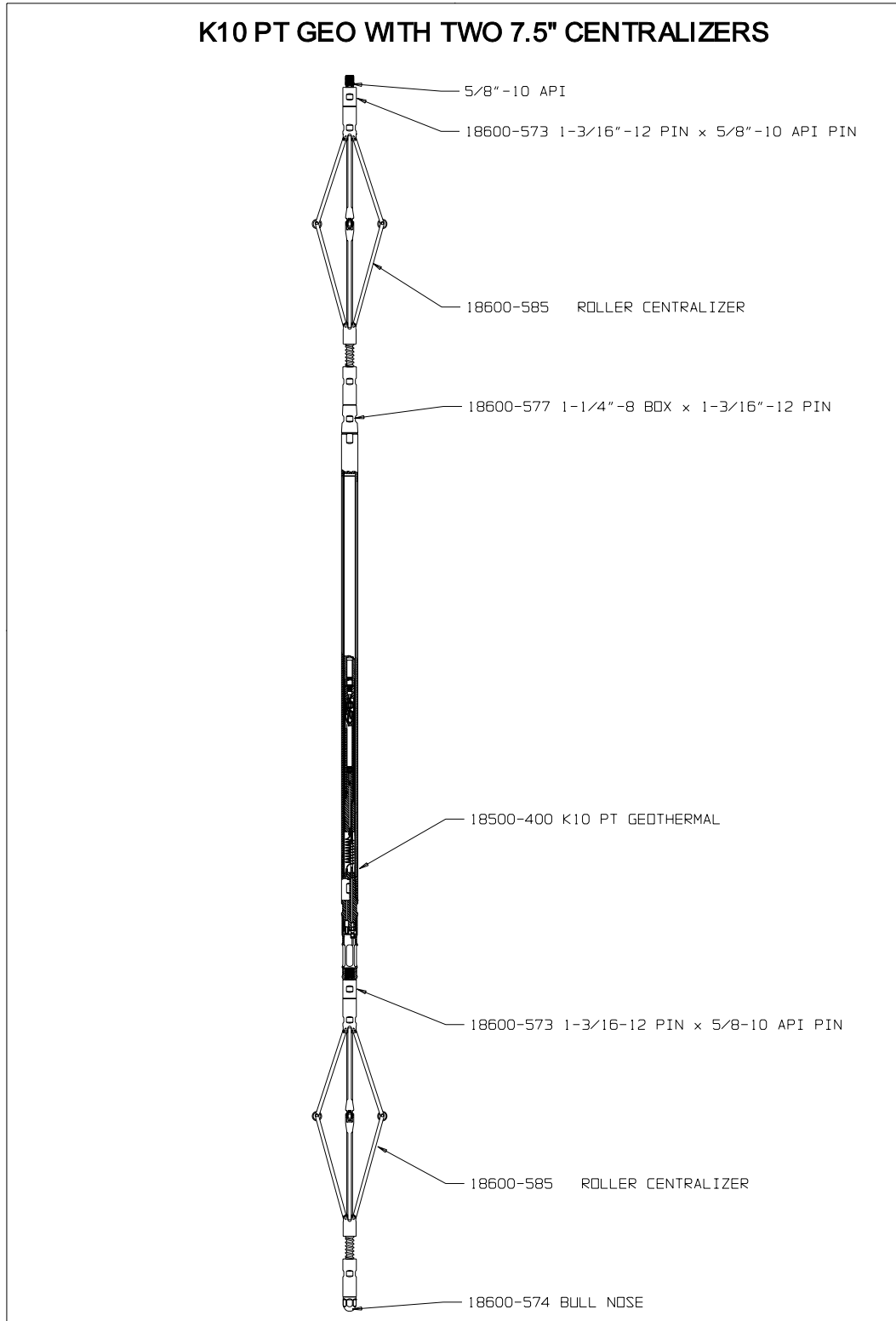
**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

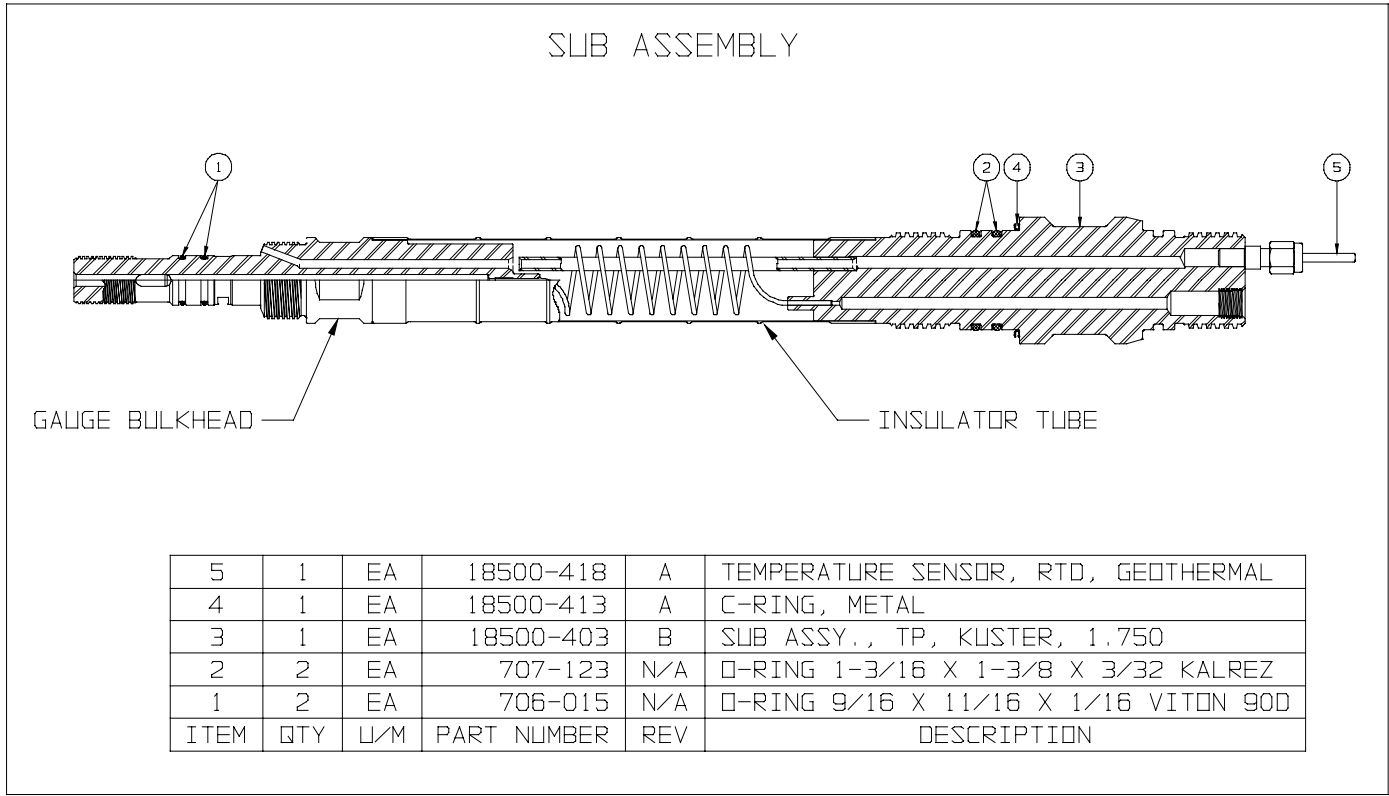
Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

#### XIV. Assembly with two 7.5" Roller Centralizers





XV. PT Geothermal Major Subassemblies





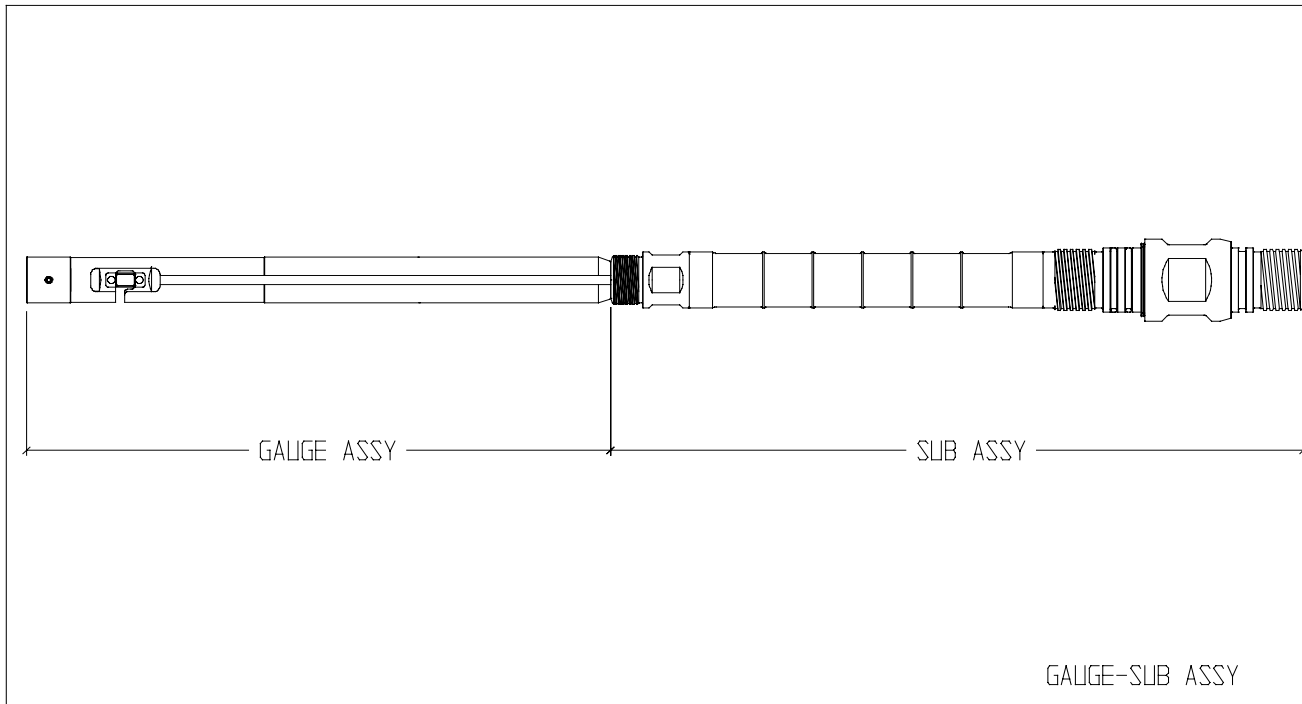
**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

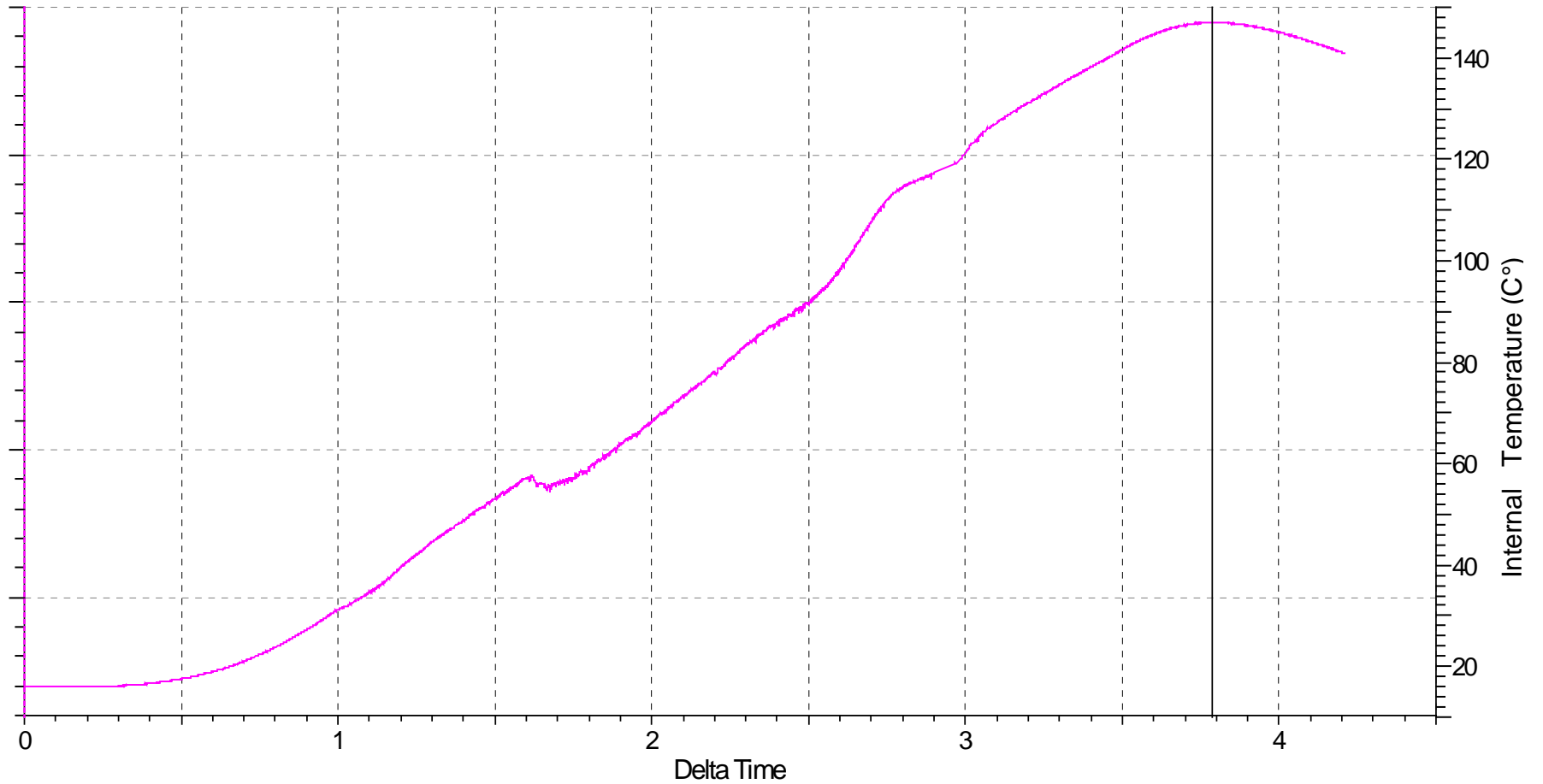
---





XVI. Heat Shield Performance Curves

KUSTER GEO 400C BATH TEST





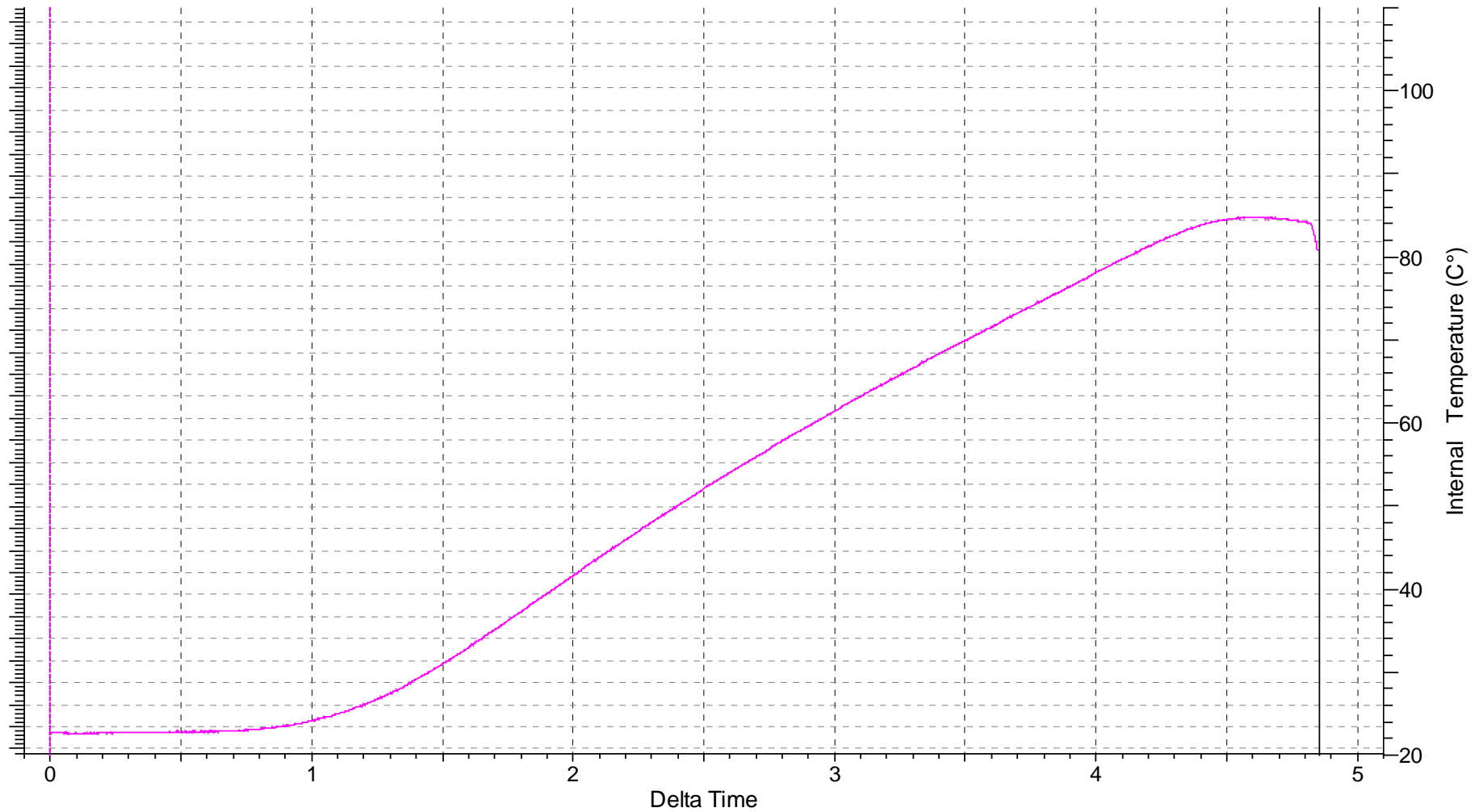
**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

### KUSTER GEO 300C BATH TEST





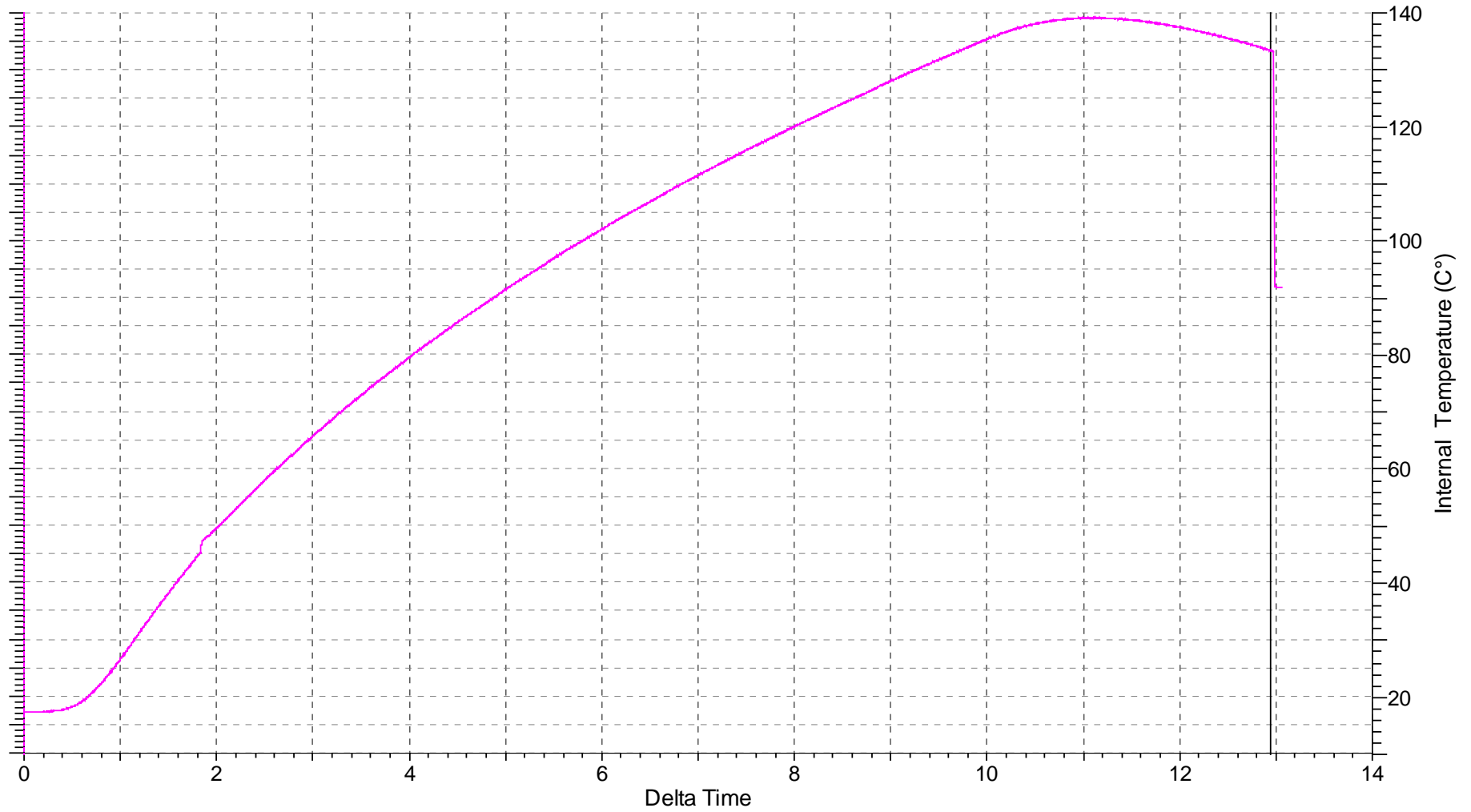
**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

### KUSTER GEO 250C BATH TEST





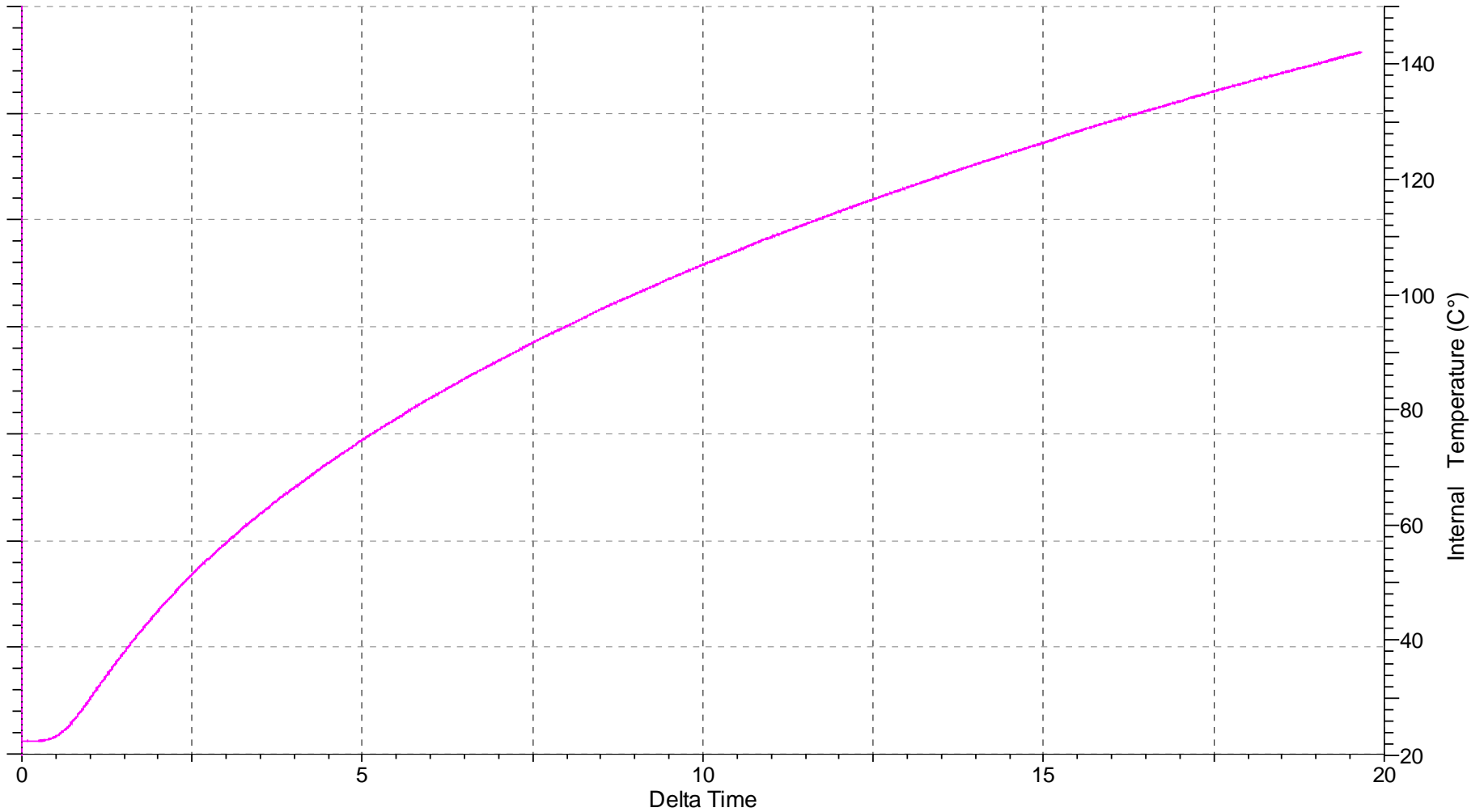
**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

### KUSTER GEO 200C BATH TEST





**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: [Kuster@kusterco.com](mailto:Kuster@kusterco.com)

---

---

XVII. K10 PT Geothermal Gauge Operational Checklist

---

Objective. The objective of this document is to provide step-by-step instructions on the preparation, use, and post-operative maintenance of the K10 PT Geo Gauge. For more detailed instructions consult the K10 Service Manual and the K10 Software Operation Manual.



**Kuster Company**

2900 E. 29th Street  
Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

---

Definitions.

Note – A step, procedure, or piece of information that is necessary to highlight.

CAUTION – A step or procedure that if not followed could prevent operational use of the equipment.

WARNING – A step or procedure that if not followed could cause damage to equipment or personnel.

Preparation

- Receive well survey tasking.
- Select tool.
- Meets temperature requirements.
- Meets pressure requirements.
- Verify o-rings are suitable for well bore conditions.
- Verify current calibration and DWT check.
- Select battery.
- Meets temperature requirements.
- Has sufficient Charge(Ah) remaining.
- Visually inspect battery.
- Connector is clean, dry, and serviceable.
- Insulation wrap has no cuts or abrasions.

WARNING

Under no circumstances is the temperature rating of the batteries to be exceeded.

- Assembly

- Inspect Sub Assembly, Part #18500-423 for damage, cleanliness and serviceability. In particular, threads should be looked at closely for signs of debris or damage.
- Inspect outside diameter of O-ring glands for signs of damage of galling.
- Inspect lead wires for temperature sensor for cuts, nicks and abrasion
- Install metal C-ring
- Install o-rings, 2 each, 707-123
- Inspect external tread and O-ring glands of Bulkhead for damage.
- Install O-rings, 2 each, part #706-015
- Lubricate the external thread and O-rings of the bulkhead with Kuster Hi-Tem Lubricant (915-001) and set aside.
- Take the set screw off the nose cavity and close the hole with your thumb.
- With nose of Gauge assembly pointed upward, pour 27 cc of Kuster company Transfer Fluid into the nose cavity.
- With Gauge assembly maintained in upward attitude, install sub assembly until it bottoms out on the nose of the gauge assy. You will notice that oil is coming out of the pressure port. As soon as it happens, install Pressure port plug.



## Kuster Company

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

---

- Install Temperature Probe Cover
- Lined up the grooves with the Temp leads and secure gauge assembly to the gauge bulkhead using a setscrew.
- Clean up whole assembly thoroughly and connect temp sensor 2-pin micro connector. Match the colors when connect.
- Using High Temp Kapton tape, secure temp sensor leads inside the groove.

### Note

See Software Operation Manual for a more detailed explanation of programming and programming options. This checklist is intended for a simplified, fixed rate well test.

- Program The Tool
- Turn on the computer.
- Start K10 Program
- Connect gauge to PC through I-Box.
- Communication LED will be on steady bright for approximately 10 seconds during the POST (Power On Self Test) and then go out for approximately 2-3 seconds. Then it will flash 4 times with 2 second interval, and then flash continuously every 1 second as the tool samples, but does not record. Any other sequenced flashing than indicated above may be an error code.
- Click Update button. Gauge information will appear in the Active Tool dialogue box, and button turned out green.
- Select the Program Tool page.
- Select the desired sample rate.
- Click Program now button.
- Disconnect gauge from the I-box.

### -Finishing Assembly-

- Install battery.
- Verify that battery is sampling-you suppose to see a double flash, when gauge records a sample.
- Record the time that the battery was connected.
- Lubricate external thread on the Gauge Bulkhead and install Gauge Cover.
- Lubricate external thread and install Heat Sink on the top of the Gauge Cover. Hand tight it.
- Lubricate external thread and O-rings on Sub Assembly
- Slide the whole assembly into the Heat Shield (Flask).
- Slowly screw assembly together until metal C-ring bottoms out.
- Tighten to Heat Shield with 90-100 ft/lbs torque.
- When ready to put tool into lubricator, unscrew Temperature Probe Cover, remove plug from the pressure port and replace it with a filter.
- Lubricate thread and install Temp Probe Cover back.
- Install Bull nose.
- Running Well Survey.
- Connect entire unit to wireline. Note that the pin on the flask is a 1.25"-8 UN 2A thread.
- With the lubricator pressured up, allow the instrument at least fifteen minutes within the lubricator to stabilize before running in the hole.

### CAUTION



**Kuster Company**

2900 E. 29th Street  
Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

---

The tool should not run into the hole faster than 50m/minute. Damage to gauge could occur if this limitation is not adhered to.

RIH

**WARNING:**

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

POOH

**CAUTION**

After tool is out of the well do not submerge it in any liquid to advance the normal cooling rate. Damage to equipment could occur.

Tool should be place horizontally on the ground and cool down. Do not disassembly tool until you are able to hold it at the thread with your bear hand without discomfort.

- Remove Temperature Probe Cover and Bull Nose.
- Remove Filter and replace with a plug.
- Install Temperature Probe (Sensor) Protector.
- Remove Heat Shield, clean it, dry it and set in case
- Remove Heat Sink and Gauge Cover

**WARNING:**

Do not attempt to remove the battery unless it is cool to the touch. It is a good practice to let the battery be exposed to ambient air for 10 min prior removing from the gauge.

- Important: Remove battery by grasping at the base. Do not pull on the battery cell itself.
  - Downloading Data From Gauge.
  - Start K10 Program.
  - Connect gauge to PC through I-box
  - Communication LED will be on steady bright for approximately 10 seconds during the POST (Power On Self Test) and then go out for approximately 2-3 seconds. Then it will flash 4 times with 2 second interval, and then flash continuously every 1 second as the tool samples, but does not record. Any other sequenced flashing than indicated above may be an error code.
  - Click Update button. Gauge information will appear in the Active Tool dialogue box, and button turned out green.
  - Click Download Data button, give file a name and file would be downloaded to the computer.
- Data manipulation is covered in the software manual.

Servicing Gauge.

**Materials Required.**

- A clean workbench with good lighting.



**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

---

- 1 each Kuster High Temperature Thread Lube, P/N 915-001.
- Silicone oil – Dow Corning 200 Fluid (50cs to 200cs viscosity or similar)
- H<sub>2</sub>S Inhibitor Oil – TRETOLITE KONTOL K-142 OR KP-12 manufactured by PETROLITE.
- Varsol or similar solvent.
- Clean rags.

Service Tool

CAUTION

Pipe wrenches should never be used on Kuster instruments.

Note

See attached diagram for reference to parts and part numbers.

-Temperature probe Cover

- Wash completely with solvent
- Inspect for damage and serviceability.
- Store in case.

-Heat Shield.

- Wash with solvent internal thread and O-ring surfaces.
- Inspect them for damage, signs of galling and serviceability.
- Wash the exterior of the heat shield with solvent to remove any corrosive residue left from the well-bore media.
- Store in case.

-Heat Sink

- Wash external thread with solvent.
- Inspect it for damage and serviceability.
- Store in case.

-Gauge Cover.

- Wash completely with solvent
- Inspect internal threads for damage and serviceability.
- Store in case.

-Gauge-Sub Assy.

- Remove Kapton tape.
- Disconnect Temperature sensor 2-pin connector.
- Remove Gauge Assembly for Sub Assembly.
- Gauge assembly requires no maintenance. Store in case.



**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

---

-Sub Assembly

- Remove all O-rings, metal C-ring and discard them. These consumable parts are "one time use" only components.
- Wash external threads and O-ring glands with solvent.
- Flush capillary tube with solvent.
- Inspect all external threads and O-ring glands for damage, signs of galling, and serviceability.
- Install Temperature Probe Cover or Protector.
- Install Gauge Bulkhead Protective cover
- Store in Case.

Run Sheet

Oil Company Name: \_\_\_\_\_

Contact Name: \_\_\_\_\_

Report Required By (YY/MM/DD): \_\_\_\_/\_\_\_\_/\_\_\_\_



**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

---

Well No.: \_\_\_\_\_

Field and Pool: \_\_\_\_\_

Status: \_\_\_\_\_

Type Of Test: \_\_\_\_\_

Estimated Bottom Hole Pressure: \_\_\_\_\_

Estimated Bottom Hole Temperature: \_\_\_\_\_

Shut-In-Date (YY/MM/DD/HR:MM:SS)

Start: \_\_\_\_\_ / \_\_\_\_\_

End: \_\_\_\_\_ / \_\_\_\_\_

On Bottom: \_\_\_\_\_ / \_\_\_\_\_

Off Bottom: \_\_\_\_\_ / \_\_\_\_\_

Duration: \_\_\_\_\_

Battery Information

Pre-Test Battery Stats



**Kuster Company**

2900 E. 29th Street

Long Beach, CA USA 90806

Telephone 562-595-0661 Fax 562-426-7897 E-Mail: Kuster@kusterco.com

---

Gauge S/N	Battery S/N	Voltage	Total hours used

Notes:

5.3.1. Kuster Company supplies on all tools a general purpose o-ring of fluorocarbon compound suitable for most applications. However, it is the decision of each individual end user to determine which o-rings are best for his/her own application. Selection of inappropriate o-rings for well bore conditions may damage the tool and nullify any warranty policy. Consult the factory if you are unsure what type of o-ring is best for your application.