

# Electrical Stability Tester, Model 23E

## Instruction Manual



**Manual No. 102149576, Revision B**  
**Instrument No. 102130986**

**fann**<sup>®</sup>

Fann Instrument Company

## Electrical Stability Tester Instruction Manual

©2012 Fann Instrument Company

Houston, Texas, USA

All rights reserved. No part of this work covered by the copyright hereon may be reproduced or copied in any form or by any means (graphic, electronic, or mechanical) without first receiving the written permission of Fann Instrument Company, Houston, Texas, USA.

Printed in USA.

The information contained in this document includes concepts, methods, and apparatus which may be covered by U.S. Patents. Fann Instrument Company reserves the right to make improvements in design, construction, and appearance of our products without prior notice.

FANN<sup>®</sup> and the FANN logo are registered trademarks of Fann Instrument Company in the United States and/or other countries. All other trademarks mentioned in the operating instructions are the exclusive property of the respective manufacturers.

### Contact FANN



#### Phone

TELEPHONE: 281-871-4482

TOLL FREE: 800-347-0450

FAX: 281-871-4358



#### Mail

Fann Instrument Company

P.O. Box 4350

Houston, Texas, 77210 USA



#### Location

Fann Instrument Company

15112 Morales Rd Gate 7

Houston, Texas, 77032, USA



#### Online

[www.fann.com](http://www.fann.com)

[fannmail@fann.com](mailto:fannmail@fann.com)

## **Table of Contents**

1	Introduction.....	5
1.1	Electrical Stability Measurements .....	5
1.2	Document Conventions .....	6
2	Safety .....	8
3	Features and Specifications.....	9
4	Equipment Setup .....	12
5	Operations .....	13
5.1	Self Test .....	13
5.2	Test Procedure .....	13
6	Calibration Check .....	17
6.1	Open Circuit Test.....	17
6.2	Self-Calibration .....	17
6.3	Calibration Standards .....	19
6.4	Probe Check.....	20
7	Troubleshooting and Maintenance.....	21
7.1	Maintenance .....	22
8	Accessories .....	24
9	Warranty and Returns.....	25
9.1	Warranty.....	25
9.2	Returns.....	25

## List of Figures

Figure 3-1 Model 23E Electrical Stability Tester .....	9
Figure 3-2 Electrical Stability Tester (Rear View) .....	10
Figure 5-1 Self Test Mode .....	13
Figure 5-2 EST Probe immersed in sample .....	15
Figure 6-1 Open Circuit Test .....	17
Figure 6-2 Self Calibration Mode .....	18
Figure 6-3 Sample Calibration Mode .....	19

## List of Tables

Table 3-1 Electrical Stability Tester, Model 23E Specifications.....	11
Table 7-1 Troubleshooting Guide .....	21
Table 8-1 Accessories.....	24

## 1 Introduction

The Fann Model 23E Electrical Stability Tester (EST) is a portable instrument that measures the electrical stability (ES) of an oil-based drilling fluid. The drilling fluid's electrical stability relates to its emulsion stability and oil-wetting capability. The ES Tester conforms to the electrical stability test procedure as described in the API Recommended Practice for Field Testing Oil-based Drilling Fluids, API RP 13B-2.

### 1.1 Electrical Stability Measurements

The electrical stability is measured by applying a steadily increasing sinusoidal alternating voltage across a pair of parallel flat plate electrodes submerged in the oil-based drilling fluid. The resulting current will remain very low until a threshold voltage is reached. At this voltage, conduction between the two electrodes occurs, resulting in a rapid increase in current. When this current reaches  $61\mu\text{A}$ , the peak voltage is measured and reported as the electrical stability for the drilling fluid or other material.

The composition of the oil-based drilling fluid controls the absolute magnitude of electrical stability in a complex fashion. Several properties influence the electrical stability of a given drilling fluid, such as

- Resistivity of the continuous phase (typically an oil)
- Conductivity of the non-continuous phase (typically water droplets with dissolved salts)
- Properties of suspended solids
- Temperature
- Droplet size
- Type of emulsifier
- Dielectric properties of the fluids
- Shear history of the sample

Consequently, interpreting the oil-wet state of a drilling fluid from a single ES measurement is not necessarily representative of the drilling fluid. Because many factors influence the measurement, the absolute magnitude of a single measurement is not very meaningful. It is recommended that several readings be taken to establish a trend. These measurements will reflect an accurate condition of the drilling fluid and provide a basis for drilling fluid treatments.

The Model 23E is calibrated in peak volts which is the maximum voltage that the fluid experiences between the two electrodes. Peak voltage may be converted to root mean square (RMS) voltage by multiplying the peak voltage by 0.7071 if desired.

The electrical stability measurement has been standardized for the size, spacing of the electrodes, and current flow (considered as conduction of the fluid). The two electrodes are equal size and are spaced 0.061 in (0.155 cm) apart. The current value (conducting current) is set to 61 $\mu$ A. An alternating voltage of a constant frequency (340 Hz  $\pm$ 10 Hz) and a steadily increasing sinusoidal voltage are applied across the electrode. When the fluid between the immersed electrodes starts to conduct and conduction increases to 61  $\mu$ A, the voltage ramp automatically stops and the peak voltage reading becomes stable. At that point, the peak voltage is read and reported as the dielectric breakdown voltage.

## 1.2 Document Conventions

The following icons are used as necessary to distinguish elements of text.



---

**NOTE.** Notes emphasize additional information that may be useful to the reader.

---



---

**CAUTION.** Describes a situation or practice that requires operator awareness or action in order to avoid undesirable consequences.

---



---

**MANDATORY ACTION.** Gives directions that, if not observed, could result in loss of data or in damage to equipment.

---



---

**WARNING!** Describes an unsafe condition or practice that if not corrected, could result in personal injury or threat to health.

---



**ELECTRICITY WARNING!** Alerts the operator that there is risk of electric shock.

---

---



**HOT SURFACE!** Alerts the operator that there is a hot surface and that there is risk of getting burned if the surface is touched.

---

## 2 Safety

Safe laboratory practices and procedures should be observed while operating and maintaining the EST. Some test samples can be potentially hazardous or contain flammable materials. Use good ventilation and laboratory hoods when working with these samples.

The Model 23E Electrical Stability Tester is powered by two 9V batteries or AC (100-240V, 50/60 Hz). When the unit is operating on AC power, a circuit breaker will trip and shutdown the unit if a complete short occurs or the unit draws uncontrolled power.



The EST probe carries voltage power as high as 2000V. Do NOT touch the probe while testing is in progress.

---

The user should keep the probe away from electrical ground terminals.

Use care when testing water-based fluids. The probe must be immersed in the sample before the test is started.



Do NOT start the test and then immerse the probe into the sample because sudden breakdown of the fluid may cause current that is greater than 61 $\mu$ A to flow through the circuit.

---

### 3 Features and Specifications

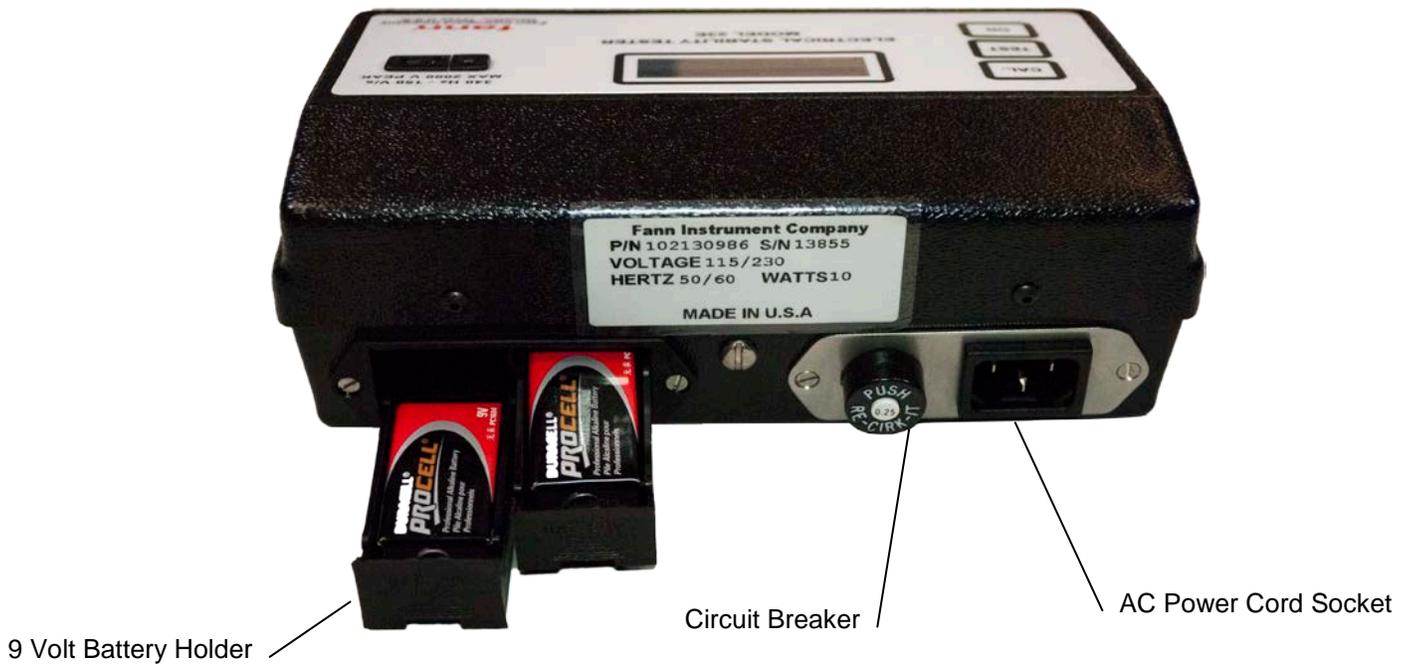
The Fann Model 23E Electrical Stability Tester (EST) is a battery or AC-powered, portable instrument which conforms to the electrical stability test procedure described in API RP 13B-2. See Figure 3-1 (front view) and Figure 3-2 (back view).

The components include the testing unit (electronics), an electrode probe, two calibration standards, a power cord, batteries, and a plastic carrying case.

The specifications are listed in Table 3-1.



Figure 3-1 Model 23E Electrical Stability Tester



**Figure 3-2 Electrical Stability Tester (Rear View)**

**Table 3-1 Electrical Stability Tester, Model 23E Specifications**

<b>Category</b>	<b>Specification</b>
Operating Temperature Range	32°F to 122°F (0 °C to 50°C)
Maximum Probe Temperature	300°F (149°C)
Storage Temperature Range	-4°F to 158°F (-20°C to 70°C) (without batteries)
Accuracy	± 2% of Expected Reading
Time before Auto Power Off	3 minutes
Output Frequency	340 Hz ± 2 Hz
Output Wave Form	Sinusoidal, <1% total harmonic distortion
Output Voltage Range	0 V to 2025 V ± 25 V peak to ground (1432 Volts RMS)
Breakdown Peak Output Current	61 µA
Peak Volts Readout	Backlit Digital LCD
Voltage Ramp Rate	150 ± 10 V/sec
Power Supply	Two, 9 Volt alkaline batteries 100-240 VAC, 50/60 Hz, 10 watts
Battery Life	Approximately 250 tests
Probe and Cable Length	24 in. (61 cm)
Probe Electrode Spacing	0.061in. (0.155cm)
Meter Dimensions (Width x Depth x Height)	8.3 x 5.1 x 2.8 in. 21 x 13 x 7.1 cm
Weight	4 lb (1.8 kg)

## **4 Equipment Setup**

The Model 23E EST should be placed in a position where there is easy access to the AC power outlet if operating with AC power.

Consideration should also be given to the location where samples are prepared and equipment is cleaned when the test is completed. There should be sufficient storage area nearby for commonly used tools, as well as consumables.

In addition to the Model 23 EST, you will also need the following equipment to perform an electrical stability test:

- 12-mesh screen or Marsh Funnel
- Thermometer, 32°F to 220°F (0°C to 104°C)
- Glass beaker or viscometer sample cup (heating cup)
- Hot plate or heating source

## 5 Operations

### 5.1 Self Test

The first check that the instrument performs is the Self Test.

1. Push the **ON** button. Wait for the following messages to appear (Figure 5-1).



Figure 5-1 Self Test Mode

2. Follow the instructions on the screen: a) remove the probe if it is connected; b) press the **TEST** button.
3. Wait for the Self Test to complete. The voltage will ramp to approximately 2000 volts, and then the screen message will say “READY.” The instrument is ready for your samples.

### 5.2 Test Procedure

The following test procedure is in accordance with API Recommended Practice for Field Testing Oil-based Drilling Fluids, API RP 13B-2.

Before starting the test, verify that the Electrical Stability Tester is calibrated and operating properly. Refer to Section 6 for calibration instructions and Section 7 for troubleshooting and maintenance.

1. Pour the sample over a 12 mesh screen to remove large solids. A laboratory sieve or a Marsh Funnel can be used.

2. Put the sample in a glass beaker or viscometer sample cup. The sample will be heated.
3. Heat the sample and maintain the temperature at  $50^{\circ}\text{C} \pm 2^{\circ}\text{C}$  ( $120^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ).



---

Do NOT connect the electrode probe to the instrument.

---

4. Clean the electrode body thoroughly with a paper towel. Pass the paper towel through the electrode gap a few times.
5. Swirl the electrode probe in the base oil that was used to formulate the drilling fluid. If the base oil is not available, use another oil or a mild solvent (e.g., isopropanol). Clean and dry the electrode.



---

Do NOT use detergent solutions or aromatic solvents, such as xylene to clean the electrode probe or cable.

---

6. Push the **ON** button to start the instrument electronics. Next, the instrument will require you to run the Self Test. Complete the Self Test.



---

There is no OFF button. The instrument shuts itself off approximately three minutes after the last operation.

---

7. Now, connect the electrode to the instrument.
8. Immerse the probe in the sample, making certain that the fluid covers the electrode surfaces. See Figure 5-2.



Figure 5-2 EST Probe immersed in sample



---

Make sure that the probe does not touch the sides or bottom of the container.

---

9. Stir briskly with the probe for at least 10 seconds making sure that the sample temperature is  $50^{\circ}\text{C} \pm 2^{\circ}\text{C}$  ( $120^{\circ}\text{F} \pm 5^{\circ}\text{F}$ ). Use a thermometer to measure the temperature.



---

Do NOT move the electrode probe during the measurement.

---

10. Push and release the **TEST** button to start the automatic voltage ramp. Do not move the electrode probe during the measurement. The ramp will stop at the breakdown voltage. Record this reading as the dielectric breakdown voltage (electrical stability reading).



---

If the instrument reading ramps to greater than 2000 volts and dashed lines flash on the screen, the sample breakdown voltage is greater than 2025 V  $\pm$  25 V (peak).

---

11. Determine the repeatability of the test. Repeat steps 4 through 9. The electrical stability readings should not differ by more than 5%. For example, with an initial electrical stability of 900 peak volts, the repeated test should range within 855 volts to 945 volts (5 % of 900 peak volts = 45 peak volts).
12. Record the average of the two (or more) readings as the electrical stability of the oil-based drilling fluid.



---

The instrument holds the last reading. You may press the **TEST** button again to reset the reading and start another test.

---

13. If the readings differ by more than 5%, perform troubleshooting and maintenance on the instrument as described in Section 7.

## 6 Calibration Check

A standard fluid is not available to test the performance of both the Model 23E and its electrode. However, performance checks can be done on the instrument and the electrode separately.

### 6.1 Open Circuit Test

1. Unplug the probe from the instrument.
2. Press the **ON** button, and then run the Self Test as described in Section 5.1.
3. Next, press the **TEST** button. The voltage reading should increase to more than 2000 volts, and then a dashed line will flash on the screen to indicate the reading is over range as shown in Figure 6-1. If it does not, see Section 7 for trouble shooting.



Figure 6-1 Open Circuit Test

### 6.2 Self-Calibration

The Model 23E has a self-calibration feature. You should regularly perform a self-calibration test, especially when the readings from the calibration standards are greater than 2%.

1. Press the **ON** button. Run the Self Test, following the instructions on the screen. Refer to Section 5.1.
2. Press **CAL**. Remove the probe and then press **CAL** again. These instructions will also appear on the screen as shown in Figure 6-2.



**Figure 6-2 Self Calibration Mode**

- The calibration is in progress when the voltage ramps up to approximately 1200 V. Wait for the voltage to ramp up twice; after the first ramp, there will be a brief pause and the calibration process will repeat. Then a message will appear, “Calibration Completed.” Now, the instrument is ready for your tests.



**End of Self Calibration**



---

If the instrument display reads, “Calibration Fail” or “Calibration Unstable,” then repeat the self-calibration procedure. If the problem persists, contact Fann Instrument Company for assistance.

---

### 6.3 Calibration Standards

Two calibration standards are supplied with the instrument— high range and low range. Each standard is marked with the reading expected from the instrument.



Fann Instrument Company makes the calibration standards and tests them for voltage. Each calibration standard has a unique voltage reading.

1. Push the **ON** button to start the instrument electronics. Complete the Self Test.
2. Insert one of the calibration standards into the probe socket in place of the probe.
3. Then push and release the **TEST** button to start the automatic voltage ramp. The instrument should ramp as if a test is being run. It should stop ramping when the voltage reaches within 2% of the standard calibration voltage. See Figure 6-3; the calibration standard in this figure is 1757 volts and the actual reading is 1741.



**Figure 6-3 Sample Calibration Mode**

4. Repeat steps 2 and 3 using the other calibration standard.
5. If the instrument does not read peak voltage of the calibration standards within 2% of the standard calibration voltage, then perform the self-calibration (Section 6.2) and repeat the manual calibration. If the problem persists, then either the calibration standards or the equipment is malfunctioning. Contact Fann Instrument Company for assistance.

## 6.4 Probe Check

Before checking the probe, check the EST calibration as provided in Section 6.1, 6.2 and 6.3. Then, test the Model 23E probe as follows:

1. Unplug the probe from the instrument.
2. Inspect the probe cable for cracks in its insulation or other damage.
3. Make sure that the probe has been thoroughly cleaned. Examine the keyhole-shaped gap in the electrode for any deposits.
4. Also examine the three pins on the plug (at the end of the probe cable) for moisture or deposits.
5. Confirm that the space between the electrodes of the probe is approximately 0.155 cm to 0.160 cm (0.061 in. to 0.063 in.). You can use a 1/16-in drill bit shank as a gauge.
6. Plug the probe into the EST. Hold the dry probe in the air and press the **TEST** button. The peak voltage should ramp to > 2000 volts (flashing dashed line). If it does not, then an electrical path exists between the two electrodes by some means other than through the fluid. Clean the plug and the electrode end of the probe, and then test it again. If the probe continues to fail the test, replace it.
7. Immerse the probe into fresh tap water and run a test. The electrical stability reading should read less than 3 volts. A reading greater than 3 volts means that something is insulating the electrodes and keeping them from contacting the fluid. It may also mean that the probe wiring is damaged. Clean the surface of the electrodes and the plug pins. Dry the probe carefully, and then test again. If the probe continues to fail this test, then replace it.
8. If the electrode probe does not pass these steps, then the probe has probably failed internally and should be replaced. Contact Fann Instrument Company for a replacement.

## 7 Troubleshooting and Maintenance

Troubleshooting and regular maintenance procedures are described in this section. If more extensive maintenance or service of the instrument is required, please contact Fann Instrument Company.

**Table 7-1 Troubleshooting Guide**

<b>Problem or Symptom</b>	<b>Possible Cause</b>	<b>Corrective Action</b>
Does not activate when the ON button is pressed.	Missing or weak batteries.	Replace the batteries.
	Did not firmly press the ON button.	Press the button again with more pressure.
LOW BATTERY message.	Weak batteries.	Replace the batteries.
Voltage readings obtained with calibration standards are incorrect.	Dirty calibration standards.	Clean and thoroughly dry connector pins.
	Damaged calibration standards.	Replace them.
	Out of calibration.	Repeat self-calibration. If problem persists, return the instrument to Fann.
Probe does not pass the performance check.	Probe failure.	Replace the probe.
ES Tester does not read > 2000 volts (flashing dashed line) when a probe is not connected.	The connector is contaminated with conductive deposits.	Clean and thoroughly dry the connector.
	Internal calibration loss.	Perform self calibration and try again.
Self calibration gives message, "CALIBRATION FAIL."	Instrument failure.	Return the instrument to Fann for repair.
Self calibration gives message "CALIBRATION UNSTABLE."	Internal calibration loss.	Perform self calibration again.

## 7.1 Maintenance

The following information will help ensure accurate reliable operation of the Model 23E.

### 7.1.1 Cleaning and Protecting the Instrument

The Fann Model 23E Electrical Stability Tester will work reliably for a long time if kept clean— free of dirt, corrosive fluids, and solvents. Be especially careful to avoid exposing the instrument to fluid spills into the probe connector or into the battery compartments. Although the carrying and shipping case is watertight, the instrument case is not.

Avoid rough handling of the instrument.

Clean the electrode body thoroughly by wiping with a clean paper towel. Pass the towel through the electrode gap a few times. Pass the towel through the electrode gap a few times to clean and dry the electrode.



---

Do NOT use detergent solutions or aromatic solvents, such as xylene to clean the electrode probe or cable.

---

The instrument case and its carrying case can be cleaned with a cloth or sponge dampened with a mild detergent.

### 7.1.2 Replacing the Batteries

Replace batteries using the following procedure.



---

Proper installation is important. Place the batteries in the drawers with the terminals as shown in the bottom of the drawer.

---

1. Battery life should be adequate for approximately 250 tests. Battery life will be less if the average breakdown voltages are greater than 1000 volts.
2. Remove both batteries if the instrument will be stored for a long time or if the instrument will be used with AC power for a long time.



---

When batteries are left unused for a long time, they may leak and cause corrosion damage to the instrument.

---

3. Replace the batteries with fresh 9 volt alkaline batteries (P/N 205643) or equivalent whenever the LOW BATTERY message comes on.
4. The battery holders are on the back of the EST. Lift and remove the battery holders. Remove the used batteries. Place the new batteries in the holders. Put the battery holders back into the EST. Refer to Figure 3-2.

The instrument may be operated with AC power. The required AC power is 100-240 VAC, 50/60 Hz, 10 watts.

### 7.1.3 Storing Calibration Standards

Calibration standards should be kept clean of anything that might form a conductive film or deposit between the pins of the plug. Avoid exposing these standards to moisture, especially salty atmospheres. Store these standards in sealed plastic bags or a sealed jar.

## 8 Accessories

**Table 8-1 Accessories**

<b>Part Number</b>	<b>Description</b>
208557	EST Probe
209066	Calibration Standard Set
209067	Calibration Standard, High Range
209068	Calibration Standard, Low Range

## 9 Warranty and Returns

### 9.1 Warranty

Fann Instrument Company warrants its products to be free from defects in material and workmanship for a period of 12 months from the time of shipment. If repair or adjustment is necessary, and has not been the result of abuse or misuse within the twelve-month period, please return, freight prepaid, and correction of the defect will be made without charge.

Out of warranty products will be repaired for a nominal charge.

Please refer to the accompanying warranty statement enclosed with the product.

### 9.2 Returns

For your protection, items being returned must be carefully packed to prevent damage in shipment and insured against possible damage or loss. Fann will not be responsible for damage resulting from careless or insufficient packing.

Before returning items for any reason, authorization must be obtained from Fann Instrument Company. When applying for authorization, please include information regarding the reason the items are to be returned.

Our correspondence address is:

**Fann Instrument Company**  
P.O. Box 4350  
Houston, Texas USA 77210

Telephone: 281-871-4482  
Toll Free: 800-347-0450  
FAX: 281-871-4446

Email [fannmail@fann.com](mailto:fannmail@fann.com)

Our shipping address is:

**Fann Instrument Company**  
15112 Morales Road  
Gate 7, Houston, Texas USA 77032