

**Model 23D Electrical Stability Tester  
® Instruction Manual**

Part No. 357180001EA

Rev. B

For more information, please contact us:

[ExpotechUSA](#)  
[10700 Rockley Road](#)  
[Houston, Texas 77099](#)  
[USA](#)

[281-496-0900 \[voice\]](#)

[281-496-0400 \[fax\]](#)

E-mail: [sales@expotechusa.com](mailto:sales@expotechusa.com)

Website: [www.ExpotechUSA.com](http://www.ExpotechUSA.com)

## TABLE OF CONTENTS

<b>Section</b>		<b>Page</b>
1	Introduction.....	1
2	Safety .....	3
3	Test Procedure.....	5
4	Calibration check.....	9
5	Care of the Instrument.....	11
6	Troubleshooting.....	13
7	Specifications .....	15
8	Parts and Accessories.....	17
 <b>Figures</b>		
1	Model 23D Electrical Stability Tester.....	7
2	Model 23D Electricity Stability Meter (Rear View).....	8

# SECTION 1

## INTRODUCTION

The Electrical Stability (ES) of an oil based drilling fluid is the property of the material related to its emulsion stability and oil wetting capability. The electrical stability is determined by applying a steadily increasing sinusoidal alternating voltage across a pair of parallel flat plate electrodes submerged in the oil base 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 micro-amps, the value of the peak voltage at this point is measured and is reported as the (ES) value for the drilling fluid or other material.

The composition of the oil base drilling fluid controls the absolute magnitude of (ES) in a complex fashion. Several conditions influence the Electrical Stability of a given drilling fluid. The principal ones are:

- 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 used
- 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. Since so 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. This series of (ES) measurements will reflect an accurate condition of the drilling fluid on which drilling fluid treatments can be based.

The Fann Model 23D Electrical Stability Tester (EST) is a battery powered, portable instrument which meets the criteria outlined above and conforms to the test procedure as described in the API RECOMMENDED PRACTICE 13B-2, SECOND EDITION, DECEMBER 1,1991.

The Model 23D 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 parameters of the Emulsion Stability measurement have been standardized with respect to electrode size and spacing of the electrode and current flow deemed as conduction of the fluid. The two electrodes of equal size are spaced 0.155 cm (0.061 inches) apart. The current value considered as conduction is set at 61 microamps. An alternating voltage of a constant frequency (330 to 350 Hz) and a steadily increasing sinusoidal amplitude is imposed across the electrode. When the fluid between the immersed electrodes starts to conduct, and conduction increases to 61 micro amperes, this automatically stops the voltage ramp and freezes the peak voltage reading. At that point the peak voltage of the alternating field is read out and reported as the dielectric breakdown voltage.

The Model 23D is accurate in almost any situation. However, like most electronic devices, it is recommended that the temperature be allowed to stabilize before starting a test.

## **SECTION 2 SAFETY**

The Model 23D Emulsion Stability Tester is a battery (or AC Adapter battery eliminator) powered instrument, making the input power level safe.

The high voltage produced in the instrument as required for the EST measurement is only allowed to have a maximum current of 61 microamps. Recognized safety data shows it requires in the region of 50 to 60 milli-amps to cause minimal electrical shock. This is approximately 100 times the maximum current produced by the EST.

As stated above it would be improbable for this Emulsion Stability Tester to cause an electrical shock that could be felt by a person. It is also improbable that a spark might occur at the probe.

However, it is recommended that good laboratory practices be observed in controlling potentially hazardous and flammable materials using good ventilation and laboratory hoods.



## SECTION 3 TEST PROCEDURE

The following Test Procedure is in accordance with the API test procedure as described in API RECOMMENDED PRACTICE 13B-2, DECEMBER 1991.

Verify the Fann 23D Electrical Stability Tester is in calibration and operating properly. Refer to Section 4 for Calibration Checks and Section 6 for Troubleshooting.

1. Screen the sample to be used through a 12 mesh screen to remove large solids. A laboratory sieve or a Marsh Funnel can be used.
2. Place the sample in a beaker that can be heated on a controlled hot plate, or in a heated viscometer sample cup.
3. Adjust and maintain the temperature of the sample container and sample to  $50^{\circ}\text{C} \pm 2$ , ( $120^{\circ}\text{F} \pm 5$ ).
4. Clean the electrode body thoroughly by wiping with a clean paper towel. Pass the towel through the electrode gap a few times.
5. Swirl the electrode probe in the base oil used to formulate the drilling fluid. If the base oil is not available, another oil or a mild solvent (such as isopropanol) is acceptable. Clean and dry the electrode as before.

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

6. Immerse the probe in the sample, making certain that the fluid covers the electrode surfaces.
7. Stir briskly with the probe for at least 10 seconds to insure the sample temperature is  $50^{\circ}\text{C} \pm 2$  ( $120^{\circ}\text{F} \pm 5$ ). Use an accurate thermometer. The exact temperature should be recorded. Make sure the probe does not touch the sides or bottom of the container.
8. Push "ON" to turn the instrument electronics on. There is no "OFF" since the instrument shuts itself off approximately one minute after the last operation.

9. Push and release "TEST" 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 as the dielectric breakdown voltage, (Electrical Stability reading).

**NOTE:** If the instrument reading ramps to over 2000 and starts flashing all zeros, the sample breakdown voltage is greater than  $2020 \pm 25$  peak volts.

10. Determine the repeatability of the test by running a duplicate test. Repeat steps 4 through 9 above. The (Electrical Stability) readings should not differ by more than 5 percent. For example, with an initial electrical stability of 900 peak volts, the repeated test should range between 855 - 945 volts (5 percent of 900 peak volts = 45 peak volts).

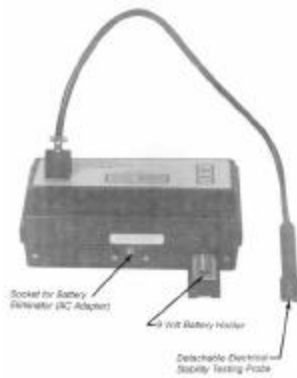
11. Record the average of the two or more readings as the Electrical Stability of the oil base drilling fluid.

**NOTE:** "RESET" may be pressed to zero the voltage reading before starting a new test. However, this is not necessary since a reset is automatically performed whenever "TEST" is pressed.

12. If the readings differ more than 5 percent, refer to Sections 5 and 6.



**Fig.1**  
**Model 23D Electrical Stability Tester**



**Fig. 2**  
**Model 23 Electrical Stability Meter (Rear View)**

## **SECTION 4 CALIBRATION CHECK**

No standard fluid has been invented to test the performance of the combined Model 23D instrument and its electrode probe. However, performance checks can be done on the instrument and the electrode probe separately.

### **A. Electronics Checks**

Test the Model 23D electronics with "calibration standards" as follows:

1. Unplug the probe from the instrument.
2. Press "ON" and then "TEST". The voltage reading should increase to over 2000 and then start flashing all zeros to indicate over range. If it does not, refer to Section 5, Troubleshooting.
3. Two "calibration standards" are supplied with the instrument. One is high range and the other is low range. Each standard is marked with the reading expected from the instrument. Insert one of these standards into the probe socket in place of the probe.
4. Push "ON" to turn the instrument electronics on. Then push and release "TEST" to start the automatic voltage ramp. The instrument should ramp as if a test is being run and should stop at or very near the "calibration standard" labeled voltage.
5. Repeat steps 3 and 4 using the other calibration standard.
6. If the instrument does not read each of the "calibration standards" peak voltage within  $\pm 10$  volts or repeat the reading within  $\pm 5$  volts, the Electrical Stability Tester is not operating correctly. Contact Fann Instrument Company concerning factory repair.

### **B. Probe Check**

Before performing these steps to check the probe, check the EST calibration as detailed above. Test the Model 23D Probe as described below:

1. Unplug the probe from the instrument.
2. Inspect the probe cable for cracks in the insulation or other evidence of damage.
3. Check to determine if the probe has been thoroughly cleaned of all

deposits in the keyhole-shaped gap of the electrodes.

4. Check for moisture or deposits between the three pins of the plug at the end of the probe cable.
5. Check the spacing between the electrodes of the probe. The gap should be 0.160 cm to 0.155 cm (0.63 inches to 0.061 inches). (A 1/16 drill bit shank can be used as a gauge)
6. Plug the probe into the Model 23D Electrical Stability Tester. Hold the dry probe in the air and press "TEST". The peak voltage should ramp to the over range condition (flashing zeros). If it does not, it is an indication that there is an electrical path between the two electrodes by some means other than through the fluid. Clean the plug and the electrode end of the probe, then re-test. Should the probe continue to fail the test, replace it.
7. Immerse the probe in fresh tap water and run a test. The electrical stability reading should be less than 3 volts. A reading of greater than 3 volts is evidence that something is insulating the electrodes from contacting the fluid, or that the probe wiring is damaged. Clean the surface of the electrodes in the probe and the pins of the plug. Dry the probe carefully, then re-test.
8. If the electrode probe does not pass these test steps, the probe probably has failed internally and should be replaced. Contact Fann Instrument Company for factory replacement.

## **SECTION 5 CARE OF THE INSTRUMENT**

The Fann Model 23D Electrical Stability Tester will work reliably for a long time if kept clean and 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.

The following information will help ensure accurate reliable operation of the Model 23D Emulsion Stability Tester.

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.

**NOTE:** 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 safely cleaned with a cloth or sponge dampened with a mild detergent.

Replace batteries using the following procedure.

### **CAUTION**

**PROPER INSTALLATION IS IMPORTANT  
PLACE BATTERIES IN THE DRAWERS WITH THE  
TERMINALS  
AS SHOWN IN BOTTOM OF DRAWER.**

1. Battery life should be adequate for about 500 tests. Battery life will be less if the average breakdown voltages are greater than 1000 volts.
2. All four of the batteries should be removed if the instrument is going to be stored for a long period or the instrument is going to be used with the battery eliminator. The batteries may leak and cause corrosion damage to the instrument.
3. Replace batteries with fresh 9-volt alkaline batteries (Part No. L4409) or equal whenever the "LOW BATTERY" light flashes.
4. Batteries are accessed from the back of the (EST). Lift and withdraw four battery drawers. Remove the bad batteries. Place

new batteries in drawers terminals to the open end, plus (+) battery terminal to left as shown in bottom of drawer. Replace drawers in the EST. Refer to Fig. 2.

5. If batteries are not immediately available, interchange the left pair of battery drawers with those on the right. This may allow as many as 50 additional tests. This works because one set of batteries is depleted faster than the other. The difference between the energy level of the pairs represents a reserve that can be tapped by swapping the pairs. This reserve can only be used once before batteries have to be replaced.
6. When temporarily removing the batteries, try to replace them back into the original position. This will help ensure that the 50 test reserve will not be prematurely used.

The instrument may be operated from an optional AC adaptor. There is an adaptor available for 115 volts operation (Part No. 35719) and one for 230 volts operation (Part No. 35731). The adaptor does not recharge batteries, It merely allows operation from an AC power source.

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

## SECTION 6 TROUBLESHOOTING

The following should aid in localizing and correcting problems with the Model 23D

SYMPTOM	CAUSE OF ACTION
Does not activate when "ON" is pressed.	<ol style="list-style-type: none"> <li>1. Batteries missing or exceedingly weak. Replace.</li> <li>2. Inadequate pressure used to press the "ON" button. Press harder.</li> </ol>
"LOW BATTERY" light flashes.	<ol style="list-style-type: none"> <li>1. Batteries weak. Replace.</li> </ol>
Voltage readings obtained with calibration standards are incorrect.	<ol style="list-style-type: none"> <li>1. Calibration standards are dirty. Clean connector pins and dry thoroughly.</li> <li>2. The calibration standard has been damaged. Replace.</li> <li>3. Instrument is out of calibration. Return for repair.</li> </ol>
Probe does not pass the performance check.	<ol style="list-style-type: none"> <li>1. Replace.</li> </ol>
Does not over-range with no probe connected.	<ol style="list-style-type: none"> <li>1. Instrument's connector contaminated with conductive deposits. Clean.</li> <li>2. Out of calibration. Check instrument calibration using calibration standards.</li> </ol>

## SECTION 7 SPECIFICATIONS

Meets API (American Petroleum Institute) specification "RP 13B-2"	
Output Frequency	340 ± 2 Hz
Output wave form	Sinusoidal
Output voltage range	0 to 2025 V ± 25 V peak to ground (1432 RMS)
Breakdown peak output current	61 micro-amps
Peak Volts readout	Digital LCD 4 digit
Time before auto reset	1 minute
Voltage ramp rate	150 ± 10 V/second
Power supply	Four, 9-Volt alkaline batteries Optional: 115 Volt or 230 Volt AC adaptor to (12 ± 3 VDC dual output)
Battery life	Approximately 500 tests
Case dimensions	9 X 7.9 X 3.5 in. (22.9 X 20.1 X 8.9 cm)
Complete weight	4 lbs (1.8 kg)
Meter dimensions	8.3 X 5.1 X 2.8 in (21 X 13 X 7.1 cm)
Probe and cable length	24 inches (61 cm)
Probe electrode spacing	0.061 in (0.155 cm)
Maximum probe temperature	300°F (149°C)
Accuracy	Cal. Standard; ± 10 V - sample, ± 3% of reading
Repeatability	Cal. Standard; ± 5 V - sample, ± 2% of reading
Operating temperature range	32° to 122°F (0° to 50°C)
Storage temperature range	-4° to 158°F (-20° to 70°C) (without batteries)

## SECTION 8 PARTS AND ACCESSORIES

### Replacement Parts

PART NO.	DESCRIPTION
33291	Probe for EST Meter 23D
35712	EST Meter 23D
35721	Calibration standard (high range)
35722	Calibration standard (low range)
B1011	Case for EST Meter 23D
L4409	Batteries (4 required)

### Accessories

35719	Battery eliminator (AC adaptor) 115 volt
35731	Battery eliminator (AC adaptor) 230 volt
35720	Calibration standard set of seven
N7900	Thermometer, Dial, 0 - 220 °F (0 - 100 °C,









For more information, please contact us:

[ExpotechUSA](#)  
[10700 Rockley Road](#)  
[Houston, Texas 77099](#)  
[USA](#)

[281-496-0900 \[voice\]](#)

[281-496-0400 \[fax\]](#)

E-mail: [sales@expotechusa.com](mailto:sales@expotechusa.com)

Website: [www.ExpotechUSA.com](http://www.ExpotechUSA.com)