



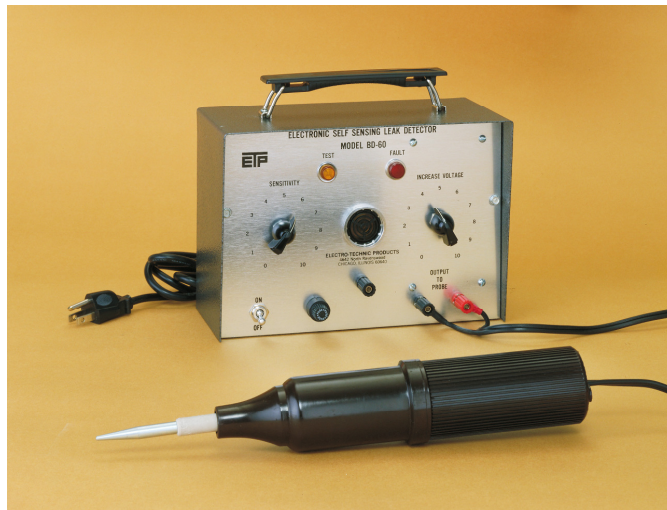
ELECTRO-TECHNIC PRODUCTS INC.

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Model BD-60 AUTOMATIC SENSING INSULATION LEAK DETECTOR OPERATING MANUAL



SECTION 1--GENERAL INFORMATION

1.1 Description

1.1.1 This automatic Sensing Insulation Leak Detector is an electronic, self-sensing instrument with a solid-state spark tester. Several model variations are available. All of them will detect small holes in:

- * plastic, glass, or rubber linings of metal tanks
- * linings of metal pipes, valves and fittings
- * thin coatings or paint on metal or concrete surfaces

1.1.2 Once adjusted for the thickness of a coating or lining, and for the electrode used, an audible tone and a light will automatically indicate when the probe is swept over a spot where a pinhole, crack, or tear is located.

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Leak Testers, Corona Treaters, Science Education Products

web site: www.electrotechnicproduct.com

e-mail: sales@electrotechnicproduct.com

- 1.1.3 The electronics of the system are contained in a metal cabinet, with a sloped visor to increase the visibility of the indicator lamps if used in a well-lit area. It has an 8-ft. line cord, and the circuitry is fused. A hand-held generator is attached to the front panel via a 6 ft. cord. Each model is furnished with several electrodes. Refer to the Packing List in Section 1.3 for the type of electrodes furnished with the specific model ordered. A variety of accessory electrodes are also available.
- 1.1.4 The Model BD-60 is the standard model operating from 115V. The Model BD-60V is identical to the Model BD-60 except that operation is from 230 volts. It is supplied with a line cord and plug polarized (per US Standards) for this voltage.
- 1.1.5 The Model BD-60T is intended for use for Tank Lining Testing. It is the same as the Model BD-60, except that it comes with accessory electrodes appropriate for tank lining testing. The Model BD-60TV is identical to the Model BD-60T except that operation is from 230 volts. It is supplied with a line cord and plug polarized (per US Standards) for this voltage.

Four models are available for different input voltages:

Model BD-60, 115 V, 50/60 Hz Model BD-60V, 230 V, 50/60 Hz
 Model BD-60T, 115 V, 50/60 Hz Model BD-60TV, 230 V, 50/60 Hz

1.2 Specifications

Tester Voltage Output – 2,000 to 40,000 volts

The following table is a typical range, but will vary from unit to unit, and is dependent upon which electrode is being used. A certificate of calibration, provided with each unit, will give the actual outputs for that particular unit.

POSITION NO.	0	2	4	6	8	10
Voltage	2,000	6,000	16,000	29,000	37,000	40,000

Voltage Waveform – pulsated DC signal; Pulse Width Frequency – 400 to 500 kHz

Trip current levels: Minimum: 0.5 mA; maximum: 25 mA, depending upon voltage and sensitivity settings.

Input Electrical Requirements – 50/60 Hz, single phase

Model BD-60, BD-60T: 115 V, Model BD-60VAC, BD-60TV: 230 VAC

Dimensions – Power Source: 9-1/4 x 4-3/4 x 7 in. high (23.5 x 12.1 x 17.8 cm)

Probe Handle: 2 x 10 in. without electrode (5.1 x 25.4 cm)

Weight: Net, 8.8 (4 kg); Shipping, 10.9 lbs (4.9 kg)

1.3 Packing List

1.3.1 Carefully remove the instrument and accessories from the packing material. Check all parts against this Packing List. Notify Electro-Technic Products, Inc. of any shortages immediately.

1.3.2 Packing List for Models BD-60 (Product No. 16001) or BD-60V (Product No. 16021xx):

<i>Quantity</i>	<i>Product No.</i>	<i>Description</i>
1	011-0019-1	Handle Assembly
1	12101	Electrode Tip Standard
1	12201	Electrode Tip, Spring
1	12461	Electrode Shorting Block
1	085-0044-3	Instruction Manual
1	X004-10	Certificate of Calibration

1.3.3 Packing List for Models BD-60T (Product No. 16031) or the Model BD-60TV (Product No. 16021xx):

<i>Quantity</i>	<i>Product No.</i>	<i>Description</i>
1	011-0019-1	Handle Assembly
1	12101	Electrode Tip Standard
1	12201	Electrode Tip, Spring
1	12131	Electrode, 12 in. T-Tip
1	12141	Electrode, Fan Tip
3	12461	Electrode Shorting Block
1	085-0044-3	Instruction Manual
1	X004-10	Certificate of Calibration

1.4 Accessory Equipment

Accessory Electrodes for the Model BD-60



Accessory Peak Voltage Calibrator



Accessory Electrode Extension Rods



12441 Electrode Extension, with 12141 Fan-Tip Electrode



Shown in use. Note hand-hold grip.

Three Electrode Extension Rods are available, all include hand-hold grips as shown above. They can be used with all of the accessory electrodes shown above.

12441 Electrode Extension, 4 ft., 1244101 Electrode Extension, 10 ft., 3 sections.

124101-1 Electrode Extension, 12 ft., 3 sections

Accessory Electrodes for Testing Outer Diameters of Pipes



Brush Electrodes, (SKU Series 12471) ½, 1, 1.5, 2.5, 3, 4 in. Each electrode has a hand grip to move the electrode over the length of the pipe.

Accessory Electrodes for Testing Inner Diameters of Pipes

Individual brush electrodes are available for inner diameters of $\frac{3}{4}$, 1, 1.5, 2, 3 and 4 in. They require a Electrode Extension Rod, described above.



Individual electrode discs, for testing inner diameters of 5, 6, 8, 10, 12, 14 and 16 in diameters are available. They require the electrode disk attachment and guide roller for a given pipe inner diameter. The BD-80 handle is built in. An assembly for testing 6 in. inner pipe linings is illustrated at the left. Contact Electro-Technic for further details and a price quotation.

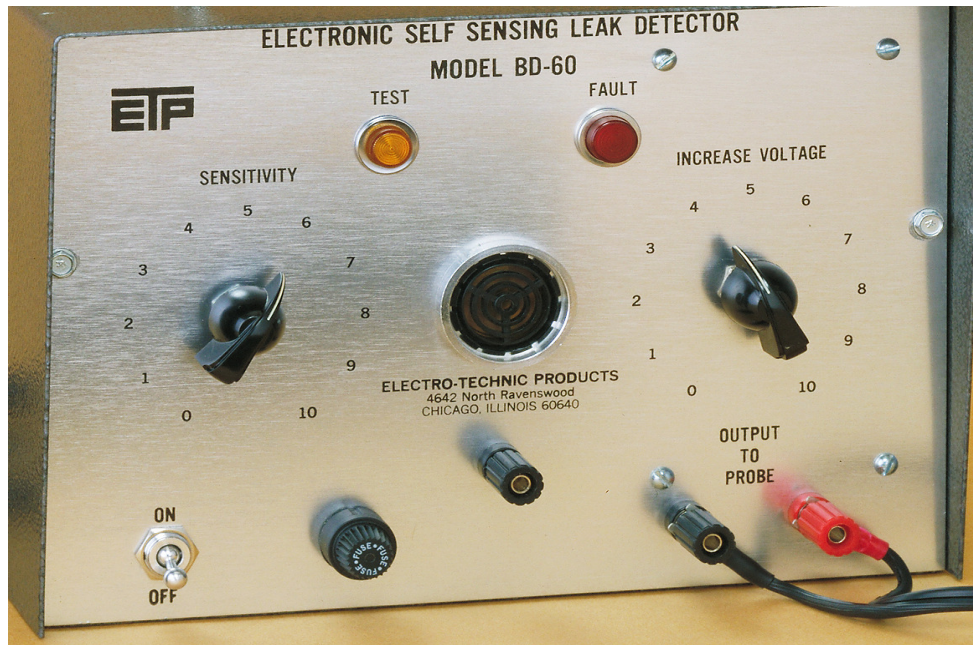
1.5 Warranty Repair / Replacement Information

- 1.5.1 If the unit requires repair, forward it freight prepaid to Electro-Technic Products, Inc. Please request a Return Authorization Number prior to sending it in.
- 1.5.2 Electro-Technic Products, Inc. reserves the right to repair or replace any unit sent in for warranty repair.
- 1.5.3 If found to be out of warranty, or damaged due to improper use, it will be repaired for a minimal labor and parts charge. We will advise the customer prior to any work being done.

SECTION 2--INSTALLATION

2.1 Installation

- 2.1.1 Locate the Model BD-60 within 6 ft. (1.8 m) from the surface to be leak tested.
- 2.1.2 The Generator Handle is terminated with color-coded, shielded banana plugs. Attach each to the matching binding posts on the front panel.
- 2.1.3 With the Power Switch in the OFF position, insert the line cord plug into its matching three wire grounded receptacle. This insures that the chassis is grounded. Operation in any other way will result in a potential shock hazard and may affect the performance of the instrument. Never use a line cord plug adapter.
- 2.1.4 If you are testing lining that are at least $\frac{1}{4}$ in. (6 mm) thick, the electrodes furnished, or purchased will require installation of a 12461 shorting block, except for the 12201 Spring Tip Electrode. All other Electro-Technic electrodes have a plastic spacer in between the electrode tip and the base that fits into the socket of the Generator Handle. This spacer separates the two metal parts. A spark must jump this gap before the voltage can be applied to the electrode tip. This spacer/air gap effectively isolates the electrode tip from line voltage in the unlikely event of a short in the Tester. This is important for the Model BD-10A and BD-10AS High Frequency Generators, but an isolation transformer provides protection for the Model BD-60. Push the black plastic block over the white plastic spacer of the electrode. Make certain the spring clips of the block make contact with both metal parts of the electrode.
- 2.1.5 For testing lining greater than $\frac{1}{4}$ in. (6 mm) the Shorting Block need not be installed on the electrode. To install the electrode, with or without the shorting block, press it into the tip of the generator handle. To remove, grasp its base firmly, and with a gentle twisting motion, pull out from the generator tip. Never insert or remove the electrode while power is on. Never remove the electrode by screwing it out.



SECTION 3—OPERATION.

3.1 Front Panel Operating Controls

- 3.1.1 Power ON/OFF Switch. A toggle switch located in the lower left hand corner.
- 3.1.2 Sensitivity Adjust Knob. Located in the middle left side. It adjusts or “tunes” the sensitivity of the circuitry as it detects the induced current of the corona over a good surface relative to the current when a spark arcs through a pinhole or flaw to the metal subsurface. It is numbered 0 through 10. Turning it clockwise increases the sensitivity.
- 3.1.3 Increase Voltage Adjust Knob. Located in the middle right side. It sets the proper voltage applied to the electrode for the application. It is numbered 0 through 10. Turning it clockwise increase the voltage. This is an important setting, especially when testing thin coatings.

3.2 Front Panel Status Indicators

- 3.2.1 Test Indicator Lamp. An red lamp located at the top, left center. It is lit when a test is in progress, but is off when a fault (leak) is encountered.
- 3.2.2 Fault Indicator lamp. A red lamp located at the top, right center. It works in conjunction with the Test Indicator Lamp. It is lit when a fault (leak) is detected, and remains lit for about 3 to 4 seconds. During this time, the test is interrupted, and no voltage is applied to the electrode.
- 3.2.3 Fault Indicator Alarm. A horn located in the middle of the panel. It sounds an alarm for about 3 to 4 seconds when a fault is detected.

3.3 Front Panel Terminal Connections

3.3.1 Output to Probe Terminals. Two color-coded binding posts, black and red, located at the lower right corner. These provide power to the Generator Handle and its electrode. The illustration above show the Generator Handle connected to these terminals.

3.3.2 Ground Terminal. A black binding post located at the lower center of the panel. This provides electrical earth ground through the grounded power line cord. When testing the lining or coatings of a small metal object, the metal may require connection to this terminal. For better accuracy, if the part under test can be grounded to the BD-60 chassis terminal, then it should be. If not, a higher voltage may be needed to perform the test.

3.4 Calibration

3.4.1 The Model BD-60 circuitry is factory calibrated, and a Certificate of calibration is furnished. Yearly recalibration is recommended. Factory calibration service is available for a nominal charge. It includes test data for all output positions with a number of electrodes, and is traceable to a NIST standard. Request a Return Authorization Number prior to returning to the factory for calibration.

3.4.2 The following protocol is used when factory calibration is preformed.

Position 0	2 kV $\pm$ 1 kV
Position 2	6 kV $\pm$ 3 kV
Position 4	16 kV $\pm$ 3 kV
Position 6	29 kV $\pm$ 3 kV
Position 8	37 kV $\pm$ 3 kV
Position 10	40 kV $\pm$ 3 kV, but at least 1 kV higher than position 8

3.5 Adjustment for Leak Detection of Coatings

3.5.1 A coating is a non-conducting film generally in the range of 10 to 20 thousands of an inch, or 10 to 20 mils. Coatings generally have a break down voltage of between 200 to 400 V/mil. The manufacturer of the coating should provide the exact break down voltage for the coating. For a 10 mil coating, the voltage setting should be between 2 and 4 kV, to compensate for coatings which may typically not of uniform thickness, or for coatings with a pebbled-type surface.

3.5.2 To adjust the model BD-60 for coating leak detection application, select an area that represents the average thickness of the coating to be tested, and make certain that this test surface does not have any pinhole leaks or similar flaws. Also mark an area that has a know pinhole. Better yet, create a test medallion of small area with the same coating thickness and metal substrate as the part to be tested, and create a pinhole in one area of this medallion.

- 3.5.3 Turn the Sensitivity Adjust Knob completely counterclockwise to the “0” position. Set the Voltage Adjust Knob to the “0” position, which is approximately 2 kV. Use the 12201 Spring Tip Electrode, or any other electrode with a shorting block installed. Turn power ON, and position the electrode over an area that is free of pinholes. Then position the electrode over a known pinhole, and then turn the Sensitivity Adjust clockwise until the Fault Lamp is lit. Try to reduce this setting by one position and repeat the test.
- 3.5.4 If the Fault Lamp does not light even for the maximum position 9 of the Sensitivity Adjust Knob, then the voltage is set too low. Repeat Step 3.5.3, but with the Voltage Adjust Knob in position “2”, which will give a voltage of approximately 8 kV.
- 3.5.5 If the voltage is set too high for very thin coatings, there is a risk that the corona is high enough to exceed the dielectric break down of the coating material, causing a pinhole to be created, especially if the electrode lingers for too long over a single point of the coating. If the electrode is held above the surface, the total voltage required to set the coating will be greater than if it makes contact with the surface, as the spark must then travel through both the air (the distance the electrode is held above the surface, and the distance through the coating. This is why it is recommended that the electrode always makes contact with the surface. For delicate coatings, consider using the Model 12141 Fan Tip Electrode, or either one of the brush electrodes, Models 12401 or Model 14241.

3.6 Adjustment for Leak Detection of Linings

- 3.6.1 A coating is a non-conducting film generally in the range of 10 to 20 thousands of an inch, or 10 to 20 mils. Coatings generally have a break down voltage of between 200 to 400 V/mil. The manufacturer of the coating should provide the exact break down voltage for the coating. For a 10 mil coating, the voltage setting should be between 2 and 4 kV, to compensate for coatings which may typically not of uniform thickness, or for coatings with a pebbled-type surface.
- 3.6.2 To adjust the model BD-60 for coating leak detection application, select an area that represents the average thickness of the coating to be tested, and make certain that this test surface does not have any pinhole leaks or similar flaws. Also mark an area that has a know pinhole. Better yet, create a test medallion of small area with the same coating thickness and metal substrate as the part to be tested, and create a pinhole in one area of this medallion. If ¼ in. rubber lining is being tested, Electro-Technic has a test medallion, SKU 12191.
- 3.6.3 To set sensitivity, Turn the Sensitivity Knob to the 0 position, and the Voltage Adjust Knob to the 9 position. The breakdown voltage of most linings will be greater than the 40,000 V maximum output of the Model BD-60. Sweep the electrode over the test medallion over the area without a pinhole, and increase the sensitivity until you reach the 9 position. If the alarm sounds over a good area, this is called a false trigger. Then reduce the sensitivity until this false trigger stops. This is then the correct setting for the sensitivity.

3.6.4 Then sweep the electrode over the lining, or test medallion, and over an area where a known pinhole is located. The Fault Indicator lamp should light only when the electrode passes over the pinhole. Once the pinhole is detected, pull the electrode away from the pinhole and wait for the logic on the Model BD-60 to reset back to the test mode. This delay should be approximately 2 seconds.

3.6.5 Some linings have cracks or tears that are at an angle, rather than perpendicular, to its surface. Increasing the voltage output is required to locate this type of defect. See the Figures 1a, and 1 b below. Figure 1a shows a linings without a pinhole. No spark discharge is seen. In Figure 1b, when a pinhole is present, a spark discharge can be seen between the electrode and the pinhole. The pinhole depicted is oblique, and is longer than the thickness of the linings. The voltage must be adjusted higher to see these types of pinholes.

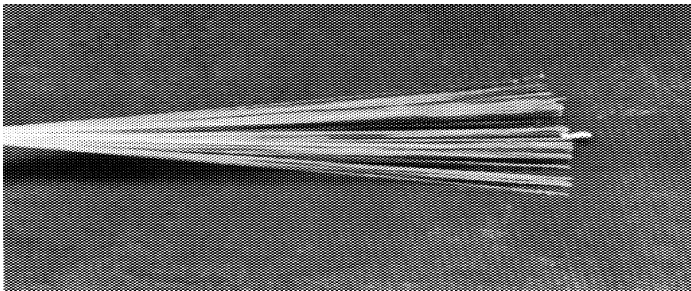
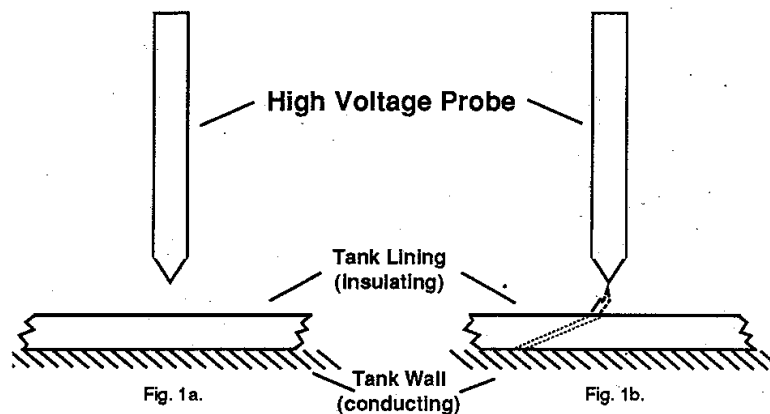


Photo at left shows a pin hole located in a sheet of rubber with a metal backing, using the 12141 Fan Tip Electrode

NOTE

The Adjustment Procedure must be repeated whenever the following is true:

- 1) The electrode is changed to a different type.
- 2) The material, or thickness or the thickness of the coating or lining changes.

3.7 Operation

- 3.7.1 When power is turned on, the circuitry will go into self-test. The Fault Lamp will be lit initially, and the Horn may sound, depending upon the Sensitivity Adjust position. After about 2 seconds the Test Indicator lamp should come on, and the Fault Indicator lamps and Horn should both be off.
- 3.7.2 Once the Model BD-60 is properly adjusted, sweep the electrode over the surface to be tested. The corona generated at the tip the electrode is what seeks out a minute pinhole or crack, breaking down into a spark which penetrates the pinhole and strike the metal or conductive surface below. See the figures above.
- 3.7.3 Understanding the nature of the typical defect encountered is important for proper operation. A very small pinhole with a diameter in microns will require a higher voltage to detect than larger cracks or seam tears, due to the added insulation properties of a minute pinhole, especially if it oblique to the surface.
- 3.7.4 Grounding of the metal object whose coating or lining is being tested may be required for smaller object. If grounding is required, it is recommended that the object be connected directly to the Ground Terminal on the front panel of the Model BD-60, using as short a wire as possible.
- 3.7.5 At settings of the Increase Voltage Adjust above 5, there may be a crackling sound at the electrode tip. This is normal. It is due to corona discharge. If the operator accidentally touches the electrode tip, the Fault Indicator Lamp will come on.
- 3.7.6 The Model BD-60 is designed for continuous operation under normal conditions, but it is recommended that the power be turned off when not in use, or a hazard may occur.
- 3.7.7 If it is used in an atmosphere where chlorinated products are present, or is used in a plating room, or other similar corrosive environment it is advisable to remove the unit when not in use and store it away from these areas. Prolonged exposure can corrode the metal parts inside the instrument, shortening its service life.

3.8 Safety Precautions.



- 3.8.1 Only factory approved electrodes should be used. No other electrodes should be used with this device. Never operate without an electrode.
- 3.8.2 Never touch or come in contact with the high voltage output of this device, nor with any device it is energizing. The Model BD-60 generates a high frequency, high voltage pulse. A spark to the body will not cause harm, but will cause a slight discomfort, similar to the sensation when a static spark jumps from the finger tip to a metal object after walking across a carpet on a dry day. The output of the Model BD-60 is at a very low current. Also, the skin of the body has a very high resistance to the high frequency current, causing any current to flow harmlessly over the skin.

- 3.8.3 Since its output is 500 kHz, it radiates its energy for a short distance. It may interfere with sensitive electronic devices near by. If a user is wearing a pace maker or similar device, their physician should be contacted prior to using this device. The same should be said for women who are pregnant.
- 3.8.4 A small amount of ozone gas is generated as a by-product. Use in a well-ventilated area. Do not use in a confined area where high concentrations of ozone can accumulate.
- 3.8.5 Do not operate around a flammable or explosive environment, as the spark might ignite them. Tanks which contain flammable liquids must be drained, flushed, cleaned, and be completely dry before testing can begin. If used inside a cargo tanker, someone located outside of the tank should always be observing the operator inside.

SECTION 4 - CALIBRATION SERVICE.

- 4.1.1 A certificate of calibration is provided with the Model BD-60. Annual re-calibration is recommended. When sending it back to the factory for re-calibration, request a Return Authorization Number prior to sending it in. Include the handle assembly and any accessory electrode used with the unit. Send it freight prepaid to Electro-Technic Products, Inc., well packed to prevent shipping damage.
- 4.1.2 Specify whether “as received” and “as left” data is required, or only “as left data”. If a unit is received in calibration, then the certificate will so indicate. If the unit require repair to bring the unit into calibration, the “as left” data will be after repair. Our repair department will advise you of the cost prior to any repairs.

SECTION 5 - REPAIR AND TROUBLESHOOTING.

- 5.1.1 There are no user serviceable parts inside the unit. In the event that the unit requires service, send it back to the factory. However, parts are available separately, so an experienced electronics technician can make repairs. The following troubleshooting guide is furnished:



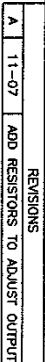
CAUTION. Take precautions not to touch any wires, as power to be unit will have to be applied with the cover removed to perform this operation.

- 5.1.2 No user serviceable components are located in the Generator Handle.
- 5.1.2 To remove the cover for servicing, disconnect the power cord line from its power source, and remove the two ¼ in. hex hand screws located on either side of the front panel. Lay the unit down and carefully lift the front panel away from the chassis. Take care not to damage any of the wires, or their connections, while removing or re-installing this panel.

- 5.1.3 Check all connections for loose or broken wires. If the pilot light does not come on, check for shorts and for input voltage at the fuse. If fuse is blown, replace it with a ½ A Slo-Blo fuse.
- 5.1.4 If the fuse is Okay, check the power cord for shorts, and replace if necessary. Test the ON/OFF Switch.
- 5.1.5 If the pilot light comes on, check the transformer for 115 V between the secondary leads. If you have an extra generator handle, exchange handles.
- 5.1.6 If you should have any further questions, contact Electro-Technic Products, Inc. for additional technical assistance.

SECTION 6 - REPAIR AND REPLACEMENT PARTS.

Part Number	Description
12101	Electrode Tip, Standard
12201	Electrode Tip, Spring, Low Voltage
12461	Electrode Shorting Block
002-0005-1	Nut, 10-32, Hex, for Electrode Socket
010-0003-1	Isolation Transformer, 115 V
010-0007-3	Choke
010-0012-1	Step Down Transformer, 230 to 115 V
011-0019-1	Handle Assembly (High Voltage), with Cord
020-0032-1	Potentiometer, Sensitivity / Voltage
020-2001-3	Resistor, 250 ohm, Porcelain
021-0017-1	Capacitor, 17.5 uF, 330 VDC
021-0043-3	Capacitor, 0.022 uF, 630 VDC
022-0011-6	SCR, High Voltage
025-2509-1	Printed Circuit Board Assembly
026-0051-3	Banana Plug, Black
026-0052-3	Banana Plug, Red
026-0053-3	Banana Jacks, Black and Red
027-0001-1	Relay, 24 VDC
027-0020-1	Signal Horn
028-0002-1	Pilot Light
029-0002-1	Fuse Holder
029-0024-3	Fuse, 1/2 A, 3 AG, Slow-Blow
044-0011-3	Adjusting Knob
045-0003-1	Electrode Socket
049-0001-1	Cabinet Handle Assembly
059-0040-1	Switch, Toggle, SPST, w/leads attached
060-0002-1	Line Cord Set, 3 Conductor, 115 V
060-000X-1	Line Cord Set, 3 Conductor, 230 V, Specify Type



		ELECTRO-TECHNIC PRODUCTS, INC.	
		CHICAGO, ILLINOIS 60640-4510	
SCALE:		DRAWN BY:	GR
DATE:	06-09-2002	REVISED:	11-09--
DESCRIPTION:	BD-60 SCHEMATIC		
MATERIAL:		PART NUMBER	

Special Note Regarding CE Marking. The Model BD-60 generates a high voltage corona of approximately 500 kHz. However by the very nature of its design, it will produce electromagnetic interference (EMI) as a result of its operation. Electric arc welders, for example, are another product that by its very nature and mode of operation produces EMI.

As a result, the Model BD-60 cannot meet the European Union Electromagnetic Compatibility (EMC) Directive 89/336/EEC, and cannot be CE marked.

It does, however, meet EN61010-1:1993 Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, following the provisions of the Low Voltage Directive 73/23/EEC, as amended by 93/68/EEC

Because of the risk of EMI, a risk assessment should be carried out prior to use of this equipment.

The power output of the Model BD-60 is limited. The effective range of EMI is less than about 1 meter on so in all directions. Metal objects nearby may bend or deflect this radiation. Therefore, there is some risk that it might interfere with electronic equipment 1 meter or so from this apparatus. This might include telephones, computers, cell phones, for example. Operators who wear pacemakers may also wish to consult with a physician prior to using this equipment.

If interference with equipment is detected, move the Model BD-60 further away, or schedule its operation when the affected equipment is not in operation. Consult plant safety personnel regarding its use.

If you should have any further questions, contact Electro-Technic Products, Inc. for additional technical assistance.