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BRT-320A
OPERATION MANUAL

January 1994

P/N: MAN-BRT-320.2AN

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SAFETY INFORMATION

Power Sources

The BRT-320A is designed to operate from internal rechargeable NiCd batteries, disposable 9-VDC alkaline batteries, or an external AC/DC power adapter. Avoid exposure of batteries to intense heat. Use only the power adapter that is specified for the BRT-320A.

Light Source Radiation

Your BRT-320A unit is configured with dual built-in laser sources. Lasers which are used are semiconductor diode lasers classified as 21 CFR class 1 laser products. The product complies with 21 CFR 1040.10 and 1040.11.

Laser Safety

Laser radiation may be encountered at the fiber connection port. The level of exposure is below that known to cause eye injury through accidental short-term exposure. Avoid prolonged exposure to the fiber and do not stare into an unterminated end.

Caution

Use of controls or adjustements or performance of procedures other than those specified herein may result in hazardous radiation exposure.

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Section 1. INTRODUCTION

1.1 Description

The BRT-320A is a portable and rugged back reflection test set. It is configured with 1300/1550 nm dual wavelength thermo-electrically cooled lasers. It allows you to make direct and isolated back reflection measurements of a specific device or fiber span. The BRT-320A has ultra fast stabilization circuitry; a warm-up period is not required before use. Back reflection readings can be stored; up to 300 memories are available. Powering of the unit is 3-Way; NiCd rechargeable batteries, back-up alkaline batteries, and AC power are all standard. The BRT-320A is supplied with a PVC protective covering, strap and carrying case.

1.2 Conventions

To maintain consistency between the key labels in the text and the key labels on the instrument, the following conventions have been adopted.

Command printed on a key ...lowercase italics

COMMAND PRINTED ABOVE A KEY
... UPPERCASE ITALICS

LED INDICATORS
... BOLD CHARACTERS

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1.3 Unpacking and Inspection

The BRT-320A Test Set package contains the following items:

o BRT-320A equipped with built-in low back reflection connector.

o Built-in NiCd battery and replaceable alkaline battery.

o AC/DC power adapter.

o Mandrel tool.

o Operation manual and certificate of calibration.

o Carrying case.

If the contents are incomplete, contact your EXFO representative. If any damage has resulted from shipping notify EXFO immediately. Your unit has been inspected thoroughly before shipment.

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EXFO US: 1-800-663-3936
EXFO Europe: 011-33-1-39-53-98-30

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Section 2. OPERATION

2.1 Theory of Operation

A back reflection test set is an instrument used to measure back reflection of connectors, components, or section of fiber for example. Reflections occur as a result of two different effects: Rayleigh scattering and Fresnel reflections. Rayleigh scattering causes reflections as a result of refractive index fluctuations in the fiber itself while Fresnel reflections occur at refractive index discontinuities such as at an air gap between connectors.

Optical return loss is the ratio of the total reflected power to the incident power at the input end. The unit operates by launching constant power light into the fiber. It simultaneously measures the reflected power using a 1 mm InGaAs detector, internal to the unit.

The BRT-320A is illustrated in Figure 2.1

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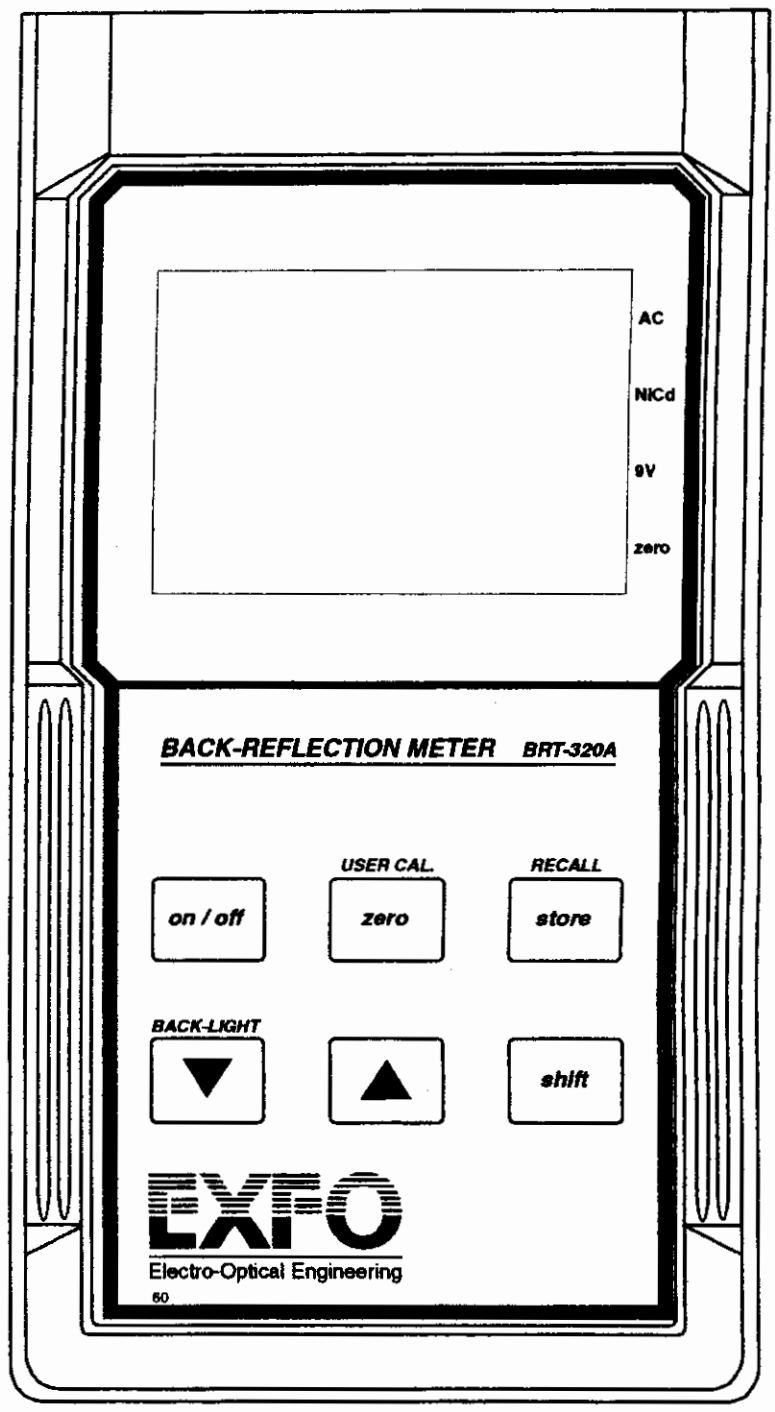


Figure 2.1 BRT-320A

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2.2 Keypad Description and Functions

The following describes the primary function keys.

on/off — Turns instrument on and off. Unit enters the offset calibration mode for a period of 1 minute. Back reflection measurement is displayed.

zero — Zeros out background reflection; mandrel at end of section to zero out. (Note that the instrument sensitivity may have changed depending upon the magnitude of the background reflection).

o Decrements memory location register number for access to memory in the data storage, recall and erase modes.
o Toggles between measurement wavelengths (1300, 1550 nm) in the back reflection measurement mode.

o Increments memory location register number for access to memory in the data storage, recall and erase modes.
o Toggles between measurement wavelengths (1300, 1550 nm) in the back reflection measurement mode.

store — Stores back reflection reading in memory. Press key a second time to confirm storage in the displayed memory location. Storage capacity: 300 readings.

The secondary functions are located above the main function keys in yellow and are described below. The *shift* key must be pressed first to access these functions.

shift
o Accesses secondary functions.
o Acts as an escape key to any mode.

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USER CAL. To enter known calibrated reference reflection value. Compensates for attenuation for indirect isolated measurements. In the UCAL mode, the measurement flashes; use up and down arrow keys to set reference reflection. Press the *USER CAL.* main key to store this reference. To exit the user calibration mode and continue using the standard reading mode, press *shift, USER CAL.* again.

RECALL Recalls back reflection readings from memory. Use up and down arrow keys to display readings located in the memory locations.

BACK-LIGHT Activates the back-light of the display. The display remains lit for a period of 10 minutes if no other key is pressed. If another key is pressed after the time out period, the back-light will be reactivated.

2.3 Display Description

An illustration showing the LCD display with all segments activated is seen in Figure 2.2.

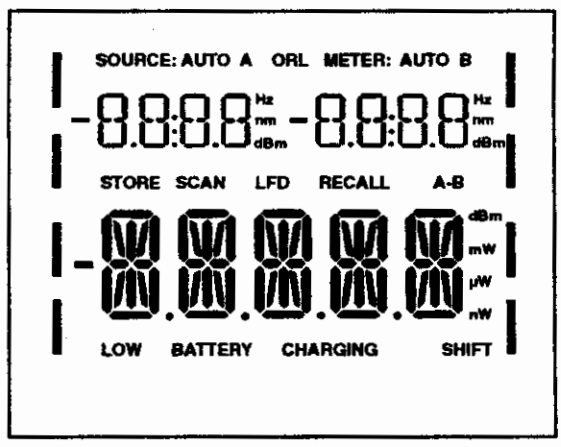


Figure 2.2 Display Summary

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Segment...	Description...
main digits	back reflection reading, status messages.
upper left 4 digits	minimum detectable back reflection (normal and UCAL modes), memory location register number.
upper right 4 digits	wavelength of operation
STORE	indicates data storage mode.
RECALL	indicates data recall mode.
LOW BATTERY	low battery warning indicator for the NiCd batteries.
BATTERY CHARGING	indicates AC adapter is plugged in and NiCd batteries are being recharged.
SHIFT	indicates the *shift* has been pressed to access a secondary function.
AC marker	indicates AC voltage is being used to power the unit.
NiCd marker	indicates NiCd batteries are being used to power the unit.
9-V marker	indicates 9-V alkaline batteries are being used to power the unit.
zero marker	indicates zero function activation.

2.4 Other Controls

The following controls are located on the top end face of the instrument.

AC/DC input	The power adapter is used to power the unit externally and recharge the NiCd batteries.

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Section 3. OPERATOR PROCEDURE

3.1 Power-On

Upon power-on of the BRT-320A , the unit goes into the auto-calibrate mode where electrical offsets are nulled; the LCD displays CAL and the operating wavelength in the upper right (offsets are nulled for both operating wavelengths). This step lasts approximately 60 seconds. The unit is then set to measure backreflection. The main part of the display indicates the backreflection level; ------ dB indicates a back reflection reading below the unit's sensitivity. Wavelength is always indicated in the upper right portion of the display; the minimum sensitivity appears in the upper left. Operating wavelengths are selected by either of the arrow keys; press either key to toggle between wavelengths. (Note that the minimum sensitivity is a function of the background reflection setting and changes if a fiber section has been zeroed. Refer to section 3.2).

3.2 Background Reflection Cancellation

Background reflection cancellation is performed in order to isolate the reflections created by the device under test from extraneous reflections created between the test set and point of measurement. It is therefore necessary to terminate the fiber at a point before the measurement. (Refer to section 3.3 Fiber Termination). With the fiber terminated at an appropriate point, press the *zero* key. Release the termination in order to proceed to the measurement step.

Note that the minimum sensitivity of the unit is displayed in the upper left. The sensitivity is -70 dB prior to performing the *zero* function. The cancellation of background reflection may reduce the sensitivity as a function of the magnitude of the reflection; a new minimum sensitivity level appears in the upper left.

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3.3 Fiber Termination

Fiber termination refers to the attenuation of the reflected light signal. The fiber may be terminated by one of two ways:

o **Fiber mandrel:** Wrap fiber multiple times (5 or 6) around a small diameter mandrel having an approximate diameter of 1 cm. A mandrel tool is provided for this purpose. The fiber is sufficiently mandrelled when the back reflection reading no longer changes. The mandrelling process serves to attenuate the light to such a degree that generated back reflections are negligible. The fiber is then unmandrelled.

o **Index matching gel:** If access to a fiber end is available, it may be treated with index matching gel to suppress reflections.

3.4 Optical Return Loss Measurements

When making measurements, the back reflection of a connection, component or specific section of fiber is sought. To obtain the desired measurement, the reflection generator must be isolated. To do this terminate the fiber before the point of measurement and zero background reflections (refer to sections 3.2 and 3.3). The fiber is then terminated just past the point of measurement. A back reflection reading is taken while the fiber is terminated.
Note that the backreflection measurement obtained is the true value only if the measurement has taken place directly. This refers to a point immediately after the connection to the unit. If there are multiple connectors, for example between the unit and the device under test, the attenuation of the signal due to the connectors must also be taken into account. (This should not be confused with the procedure to cancel background reflection.) The measurement made should be identical to one made if direct access to the device under test were possible. In order to compensate, for attenuation incurred before the point of measurement subtract twice the total loss from the displayed readings. For example refer to Figure 3.1 Let the device under test be B' and let A' be a connector with 1 dB loss, then:

$$B.R._{actual} = BR_{display} - 2\ (-1\ dB)$$
Let $BR_{display}$ read -30 dB,
$$BR_{actual} = -30 + 2 = -28\ dB$$

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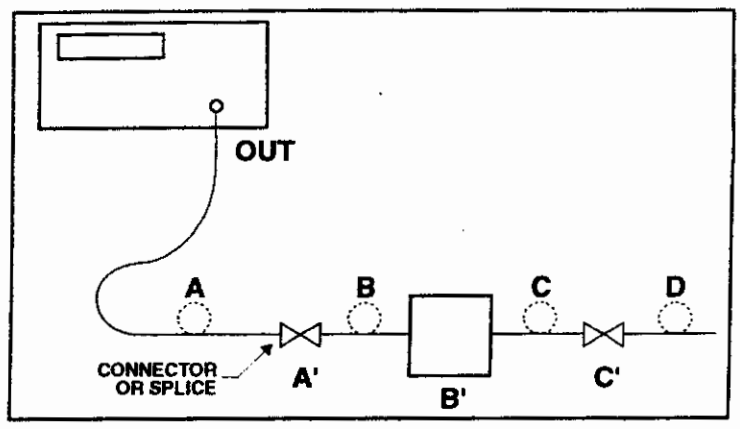


Figure 3.1 Back Reflection measurement.

In comparing $BR_{display}$, -30 dB to BR_{actual}, -28 dB, we see the actual value is a stronger back reflection. This is the reading which would have been obtained if direct access to the device were available.

Therefore:

$$BR_{actual} = BR_{display} - 2 (L_1 + L_2 + L_3 + ... + L_n)$$

where L = loss, N = 1, 2, 3 ....

Another method which can be used to obtain the actual back reflection is the *USER CAL.* (user calibration) method.

3.5 User Calibration

User calibration is used when a known reflector can be used as a reference in order to compensate for losses occurring up to the reference point. The reference may be a jumper whose end connection is flat polished; the glass/air interface theoretically gives a reflection of -14.6 for a glass refractive index of 1.46. To proceed, disconnect the system before the point of measurement and replace it by the known reference reflector. To set the back reflection to this value, press *shift, USER CAL.* The back reflection measurement now flashes. Use the up and down arrows keys to set the back reflection value of the reference reflector. Press the *USER CAL.* main key again to store this reference.

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To indicate that you have set a user calibration level, the upper left portion of the display alternates between UCAL and the minimum sensitivity. Now reconnect the device under test to the "user calibrated" meter; the back reflection reading is now accurate. To exit the user calibration measuring mode, press *shift, USER CAL.*

3.6 Data Storage/Recall/Erase

The BRT-320A has the capability of storing 300 readings. The storage locations referred to as registers are labelled 000 through to 299. To store a reading, press the *store* key; **STORE** appears on the LCD as well as the next available register number in which the reading is to be stored. If you wish to store the reading in a different location, the up and down arrow keys are used to arrive at that location. To enter the reading, press *store*.

To recall readings stored in memory, press *shift, RECALL.* Access storage registers by using the up and down arrow keys. Exit the recall mode by using the *shift* key.

The memory of the BRT-320A can be completely erased. To erase the memory, enter the storage mode by pressing *store*. Locate the register between 000 and 299; **ERASE** appears across the main part of the display. Press *store* again to enter the erase command. The unit returns to its normal measurement mode after a period of approximately 20 seconds.

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Section 4. BATTERY/POWER INFORMATION

4.1 Introduction

The BRT-320A has 3-Way powering; its three standard power sources are:

o a rechargeable built-in NiCd battery.
o a disposable 9 volt alkaline battery.
o an external AC/DC power adapter which also recharges the NiCd battery.

Note that the unit's primary power source is the NiCd battery. Once the NiCd battery runs low, the 9V battery continues to power the unit. The operation of the unit is uninterrupted by this transfer.

4.2 Replacing the Alkaline Battery (non-rechargeable)

To replace the alkaline battery:

o Turn off the BRT-320A unit.
o Open the battery compartment door on the lower back of the unit.
o Replace the 9-Volt alkaline battery, close door.

4.3 Recharging the NiCd Battery

To recharge the NiCd batteries, plug the AC/DC power adapter into the jack on the top end face of the unit. Recharging time is approximately 15 hours if the unit is not in operation. The unit may be recharged while operational at a slower rate. To conserve battery life, use the adapter when line voltage is available.

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Section 5. Specifications, General Information

5.1 Specifications

Optical Specifications

Model:	BRT-320A-23BLC
Source:	Lasers, thermo-electrically cooled
Wavelength:	1300 ±15 / 1550 ± 15 nm
Spectral Width:	5/5 nm
Range:	-8 to -70 dB
Resolution:	±.05 dB
Power Output:	-6/-6 dBm
Source Stability[1]:	±.01/±.01 dB
Temperature Stability[2]:	±.03/±.03 dB

General Specifications

Size:	22 X 10 X 5 cm	8 3/4 X 4 1/2 X 2 in.
Weight Unit:	.7 kg	1.5 lb
Shipping:	2.5 kg	5 lb
Power;	built-in NiCd batteries, 9-V battery back-up supply, AC adapter.	
Environment:	Operation: -10 to +40°C Storage: -30 to +60°C	
Standard Accessories:	Field carrying case, AC adapter, NiCd batteries, 9-V batteries, mandrel tool, operation manual, certificate of calibration.	

1. At 23°C ±2° after 1 minute warm-up period over 1 hour.
2. For a temperature variation from -10 to +40°C.

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5.2 Inspection and Maintenance

The optical port is mounted on an interface plate for easy access to cleaning. To remove the interface plate, use an Allen wrench on the four outer screws. Lift the interface plate and disconnect the pigtail from the bulkhead connector. Clean the fiber using a lint free swab dipped in alcohol. Dry using clean compressed air. Connect the fiber to the connector and adjust the screws in the interface plate.

5.3 Service and Repair

Warranty

EXFO E.O. Engineering warrants products manufactured by it to be free from defects in material and workmanship and to meet the applicable specifications under normal use and service for a period of 12 months from the date of original shipment. EXFO E.O. Engineering's obligation under this warranty is limited to the repair or replacement of such products which, after having been returned to the factory or a designated location, shall be examined and, in the opinion of EXFO E.O. Engineering, found defective and that such defect was not induced by causes external to the product. This warranty does not cover recalibration for instruments whose calibration is specified on the calibration certificate to be less than one year.

Alternatively, EXFO E.O. Engineering may elect to issue credit for any defective product. Products to be repaired or replaced shall be returned prepaid to the designated place of repair in accordance with authorization, packing and shipping instructions issued by EXFO E.O. Engineering. Return shall not be made until such authorization and instructions are issued.

Each returned product shall be accompanied by a statement or report fully stating the claimed defects and any other pertinent information concerning the failure.

EXFO E.O. Engineering's responsibility under this warranty does not apply to any products which have been repaired, worked upon or altered by persons not authorized so as to in EXFO E.O. Engineering's sole judgement injure the stability or reliability of such product, or which have been subject to misuse, negligence or accident, or where applicable, the serial number has been altered, erased or removed.

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CAUTION ! **Under no circumstances** should anyone, besides EXFO's trained personnel, open the case of an instrument since permanent damage to the unit could occur. The opening of a unit's case immediately **VOIDS** all warranties on EXFO E.O. Engineering's behalf. Removal of the warranty sticker across the seam of the case will **NULLIFY** EXFO E.O. Engineering's warranty. Furthermore, removal of the case screws will also **VOID** the unit's warranty.

EXFO E.O. Engineering shall not be liable for damages resulting from the use of the purchased product, nor shall be responsible for any failure in the performance of other items to which the purchased product is connected or the functioning of an entire system of parts of any system of which the purchased product may be a part.

EXFO E.O. Engineering reserves the right to make changes in the design or construction of any of its products at any time without incurring any obligation to make changes whatever on units purchased. Accessories, including but not limited to fuses, pilot lamps and batteries used with EXFO E.O. Engineering's products are not covered by this warranty. A test set-up charge will apply to any returned instrument which, after test, is found to meet the applicable specifications.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS OF A PARTICULAR PURPOSE. IN NO EVENT SHALL EXFO E.O. ENGINEERING BE LIABLE FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES.

Service and Repair

Instruments and accessories manufactured by EXFO Electro-Optical Engineering are designed, inspected, and tested to ensure product reliability and performance.

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If you are having trouble with an instrument or an accessory manufactured by EXFO Electro-Optical Engineering, we suggest that you first refer to the appropriate section of this manual. If more information is necessary to determine the instrument's problem, call our service department for assistance. Our service personnel can usually solve the problem over the phone or decide whether service or repairs are required.

Repair Under Warranty

Please feel free to call our service department for any suspected problem. If the instrument cannot be repaired by telephone assistance, our service personnel will provide you with a Return Authorization Number to return your instrument to EXFO E.O. Engineering for service or repair. Instrument freight charges must be prepaid to EXFO Electro-Optical Engineering. All repairs carried out under warranty are returned prepaid to the customer.

EXFO Electro-Optical Engineering will not be responsible for any product returned without a Return Authorization Number (R.A.N.).

If you have any questions concerning our policy, do not hesitate to contact our service department. It is also your responsibility to insure the instrument during shipment.

Repairs Out of Warranty

Out-of-warranty repairs are also provided on all of EXFO Electro-Optical Engineering's fiber optic instruments. This service is billable to the customer for both parts and labour.
All instrument freight charges must be prepaid returned by the customer and an evaluation of costs involved will be provided on request.

All products manufactured by EXFO Electro-Optical Engineering, under warranty or out of warranty, are to be returned according to EXFO's return procedure. For any return, please contact our service department at:

Attention: Service Department
Tel: (418) 683-0211
Fax: (418) 683-2170

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When you do, you will receive a Return Authorization number along with all the necessary information on the return procedure.

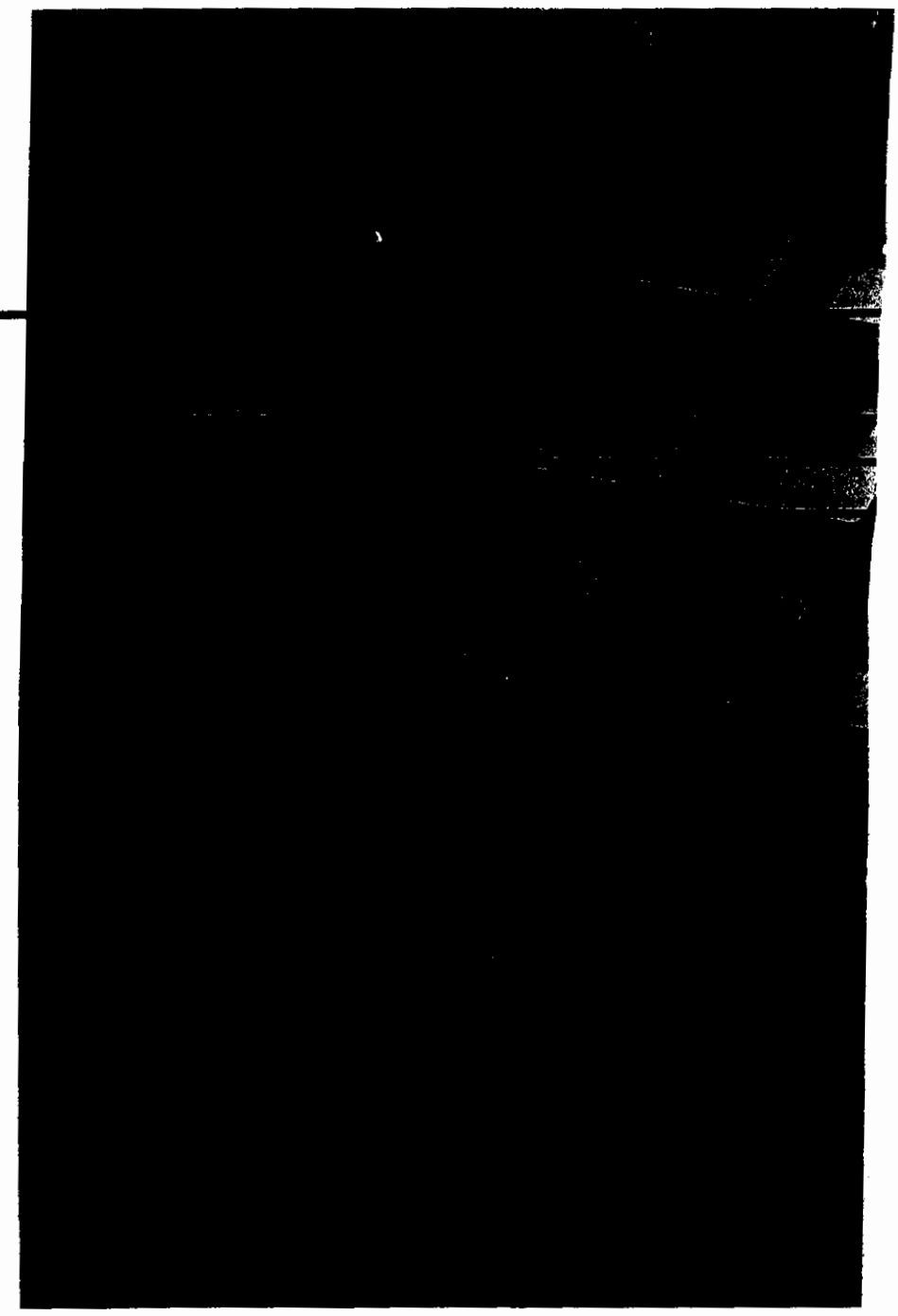
Note: The return of any instrument to EXFO has to be made according to EXFO's procedures. Any instrument sent back to EXFO not according to the standard company procedures will be refused and returned to sender.

Transportation and Storage

Although your fiber optic test instrument is designed to be rugged and field portable, transportation damage can occur from improper handling. Therefore, we recommend that the following steps be taken to minimize the possibility of damage.

Use the supplied shock-proof carrying case when transporting your instrument in the field. If the instrument is to be shipped, repack it in the original packing material for best protection. When not in use, store instrument at room temperature in a clean and dry area. Avoid areas of high humidity and large temperature fluctuations. Keep the instrument away from direct sunlight and avoid unnecessary mechanical shocks.

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