



Short Operator Manual

High-speed Bolt Hole Inspection With Elotest B1 V4

Revision 1

DISCLAIMER

This manual is intended to provide the owner with basic information regarding the operation, setup and use of the instrumentation and accessories described.

No warranties are made, explicit or implicit, about the accuracy and completeness of this information. Rohmann GmbH, Rohmann Inc. or any of its affiliates or representatives do not assume any liabilities, direct or indirect, regarding the use of the material herein, nor for any damages, consequential or inconsequential, incurred by the use of either the instrumentation, the manual or any accessories hereto. All eddy current signals, due to their electrical nature, are subject to interpretation. Any and all responsibilities lie with the user of this manual and of the instrumentation described herein.

We do, however, welcome any suggestions on how we can improve this manual and the operation of the equipment described, as well as any corrections of typographic or conceptual nature.

Please make a copy of the response sheet on the next page, fill it out and mail it to your nearest Rohmann subsidiary for updates to this manual and other literature.

Rohmann Inc.

All rights reserved. Reproduction or distribution of any part of this document to third parties without written authorization prohibited. You may copy this document for use within your company only.

File:	OpManual-B1V4-Highspeed-Rotary-2MHz
Equipment:	Elotest B1 V4
Software Version:	n/a
Hardware Versions:	n/a
Revision date:	08/03/2002
Author:	Tom Guettinger, Rohmann Inc.

Customer Response Sheet

Please fill out a copy of the following form and mail or fax it to the nearest address given below.

Your Name	
Company Name	
Mailing Address	
Telephone Number	
Fax Number	
Email Address	
Company Telephone Number	
Company Fax Number	
I wish to receive updates and other information (please circle)	Yes No
Comments or corrections to this manual	
What other material should be included in the next version of this manual	

Contact addresses:

Rohmann Inc.
 114 Perimeter Road
 Nashua, NH 03063
 U.S.A.
 Ph: ++1-603-595-4220
 Fax: ++1-603-595-4221
 Web: www.rohmann.com
 Email: tomg@rohmann.com

INTRODUCTION

The following describes the setup and operation of the Rohmann Elotest B1 V4 (Version 4) eddy current (ET) instrument for inspecting the bolt holes of an aircraft engine disk using the SR1-HF rotor with the Noble Guide fixture. This is not a procedure or replaces any procedure!

Prior to performing any inspection you MUST be familiar with the appropriate NDT procedure. You must also familiarize yourself with the use of the equipment listed below.

EQUIPMENT REQUIRED

1. Elotest B1 V4 UM or UMC with either a power module B1-L1 or battery pack with charger
2. Probe Adapter B1-RS (fits in front of B1 V4; black plug with 8-socket Fischer receptacle)
3. SR1-HF rotor with ARM1 probe adapter (converts 4-pin Cannon to 4-pin Fischer)
4. RK-2-N rotor signal cable or equivalent
5. Appropriate Noble Guide to hold the rotor, with appropriate foot/shoe
6. Appropriate reference standard and rotary probe
7. Any other accessories prescribed by the NDT Procedure.

EQUIPMENT SETUP

- 1) Make sure the B1-RS probe adapter (black square plug with 8 small sockets, Fig. 1) is in the Elotest B1, at the bottom right corner of the front panel. Connect the RK-2-N cable from the rotor to the B1-RS adapter.

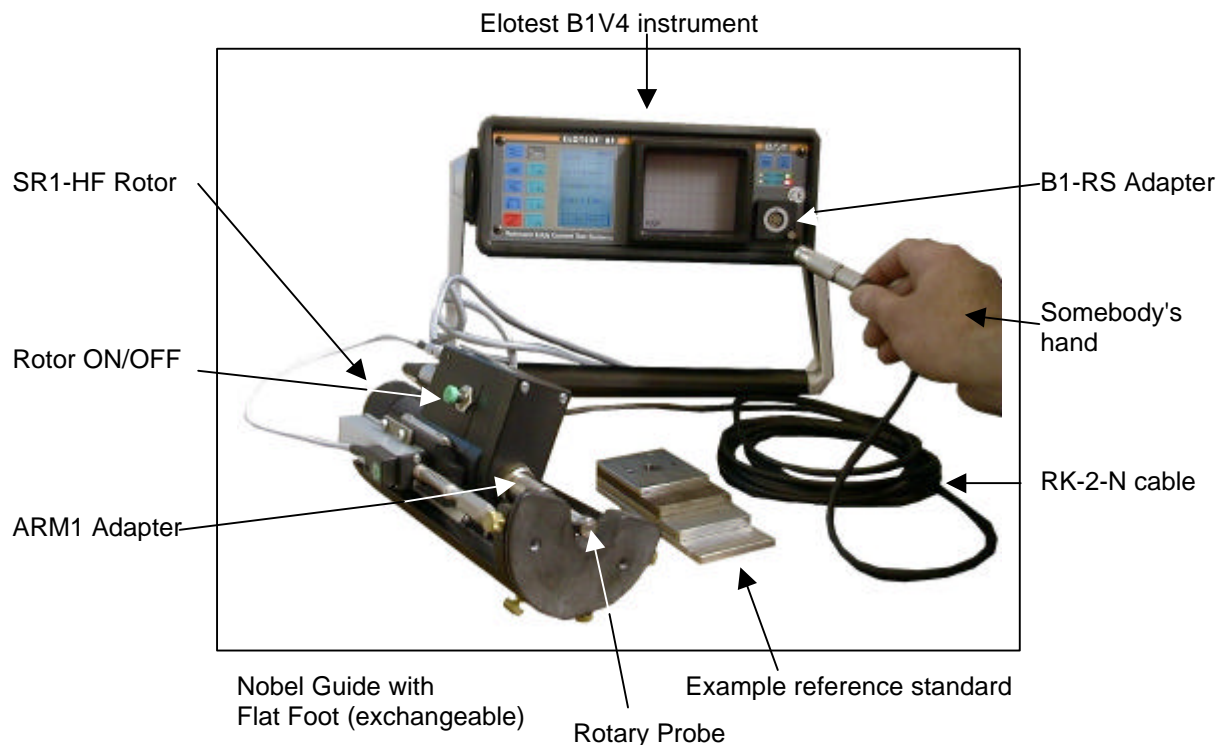


Fig. 1 Setup of ET equipment for bolt hole inspection

- 2) If needed for your specific probe, insert the ARM1 adapter into the front end of the rotor and secure it with the knurled nut. Insert the rotary probe of the appropriate diameter for the bolt holes to be inspected into the rotor or adapter.

The adapter has a 4-socket, in-line Cannon connector at one end that mates to the rotor. At the other end is a 4-socket Fischer receptacle to mate to the probe. Probes usually have an alignment mark that must mate up with the dot on the rotor or ARM1 adapter. Insert the probe carefully. Do **NOT** rotate the probe inside the adapter once you are past the first O-ring or you will bend the pins in the probe and destroy the adapter.

- 3) Align the rotor in the Nobel Guide s e.g. per the "Operators Manual of the Nobel Guide S016602".
- 4) Place Teflon tape over the probe and make sure the tape is split where the probe is split (if you are using a split-shaft plastic probe). Or coat the probe with approved mineral oil (3-in-1 oil or LDP work great). If you use both, tape and oil, the probe will last quite long. If you don't use any, the probe may last only about 40-70 holes on in-service disks!
- 5) Turn on the Elotest B1. Turn off the rotor if it starts spinning. You can turn on the B1 at the start of this procedure and then plug in the rotor etc. later. You can also unplug things with the B1 on; you will not damage anything.

SETTING UP THE ELOTEST B1 V4

Set up the Elotest B1 V4 parameters (frequency, phase, gain, filters etc.) as per your NDT procedure or:

1. Start with the frequency menu (press the ● button). The center-frequency (optimum) for the SR1-HF rotor is 2 MHz. Turn the rotary knob at the left side of the instrument until the value is 2 MHz. Set the BW limit (noise filter) to OFF. Press the F4 key to activate the auto-preamp routine. The instrument will find the optimum value of the Preamplifier (signal booster) automatically.

The BW is a filter that filters out interference noise e.g. from radios, TV-monitors etc. It is similar to the B1 V3 "Band Width", but can only be turned on or off. I have not yet found an occasion to have BW=on. IF you DO turn it on, the rest of the settings will be affected and you must change them accordingly.

2. Set the phase to anything (Press the ◦ button and change the value with the rotary knob).
3. Press the ●-button and set the Main Gain (the black arrow on the LCD is next to F1) to about 40 dB. Make sure Y-Spread and X-Spread are at 0 dB. Null the instrument.
4. Place the Noble Guide onto the reference standard and plunge the probe into the standard's bolt hole (fig. 2). Observe the OVLD light on the top-right of the instrument. If it comes on, press F2 and reduce the PREAMP until the light goes off. The final value should be larger than 0dB or something is wrong (probe and frequency do not match). [Note: "something is wrong" means call us if you can't determine the cause].
5. Press the filter button ● and set the Low-Pass (LP, press F2) and High-Pass (HP, press F1) Filters. Typical values are HP=800 Hz, LP=1.25 kHz for the SR1 rotor and for probes with diameters 0.2-0.8 inches in diameter. Probes with smaller diameters usually require a lower HP value, probes with larger diameters a higher HP value. Use the values in your NDT procedure if stated. Null the instrument.

If the HP filter is on and set to a value, the HP and LP filters form a Bandpass filter (Pressing F1 in the Filter Menu toggles HP on/off). The older versions of the B1s (B1.2, B1.3 SD) only let you select between LP, BP and HP filters and you could set the value. B1 V3 instruments give you a choice between universal filters (HP and LP separately adjustable) or SD-Mode to be like the older B1.3 instruments). A BP filter on these instruments internally meant that a HP was set at the value of $BP - 1/2BP$ and a LP was set to $BP + 1/2BP$.

I.e. if the BP was set to 800 kHz, the equivalent on the B1 V4 is $HP=400$ Hz and $LP=1.2$ kHz.

The B1 V4 allows you to finely tune the filters by separately setting HP and LP values.

How should you use filters? See below!

6. Place the Noble Guide again on the reference standard, align the probe with the hole and turn on the rotor. Plunge the probe into the hole and locate the maximum signal from the EDM notch. You should get a nice, clean signal as shown in fig. 3. If you do not get this signal but get a large "streak" even away from the EDM notch, slightly reposition the probe horizontally until you get a clean signal. Split-shaft probes, if not centered correctly, will "slap" against the bolt hole wall and cause a "smeared" signal.



Fig. 2 Rotary probe in reference standard

7. Once you have a clean signal, press the \circ button and adjust the phase until the signal points straight up and down. Then press \bullet and adjust the Main Gain until the amplitude meets the required height as per the NDT Procedure.
8. Set the alarm thresholds to the value in the NDT procedure. E.g. if the procedure states that the calibration signal amplitude is 4 major scale-divisions (2 up and 2 down) and the reject level is 4 scale-divisions, set the alarm gate (box mode) at 1.5 scale divisions (error on the save side). Usually I like to set the alarm-threshold to 1/2 the reject level (again, error on the save side).

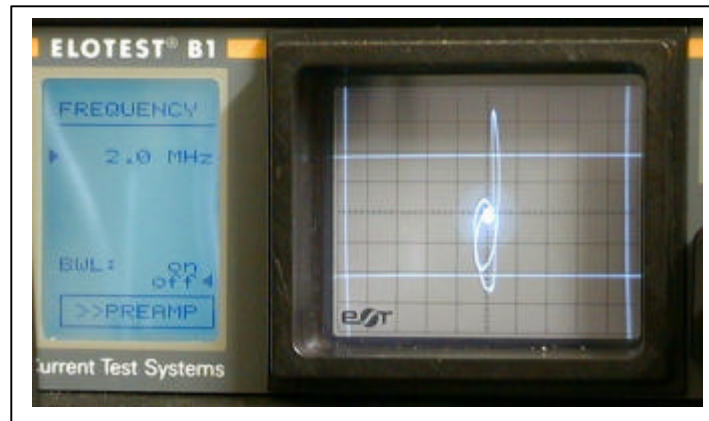


Fig. 3 Eddy current signal in Y/X mode from EDM notch in the reference standard, shown with alarm thresholds.

To set the alarm gates press the MENU button until the top line of the LCD display reads "PARAMETERS". Press F1 to display the "THRESHOLD" Menu. Press F1 to turn the alarm gates on. Press F4 to change between Box and Cross gates. The alarm gates are ALWAYS active, even if invisible.

Set the X-LEV to maximum by pressing F2 and adjusting the value to 255. Press F3 and use the rotary knob to adjust the Y-LEV (Y-Gate). Press the MENU button to go up one level.

9. Turn the acoustic alarm on or off as you desire by pressing F2 opposite to ALARM in the "PARAMETER" Menu. Press F1 to set BEEP: on. Leave MODE:trig and LOG:norm. I prefer BEEP:ON so that I can concentrate on the bolt hole inspection until the alarm goes off.
10. If you wish, you can now fine-tune the filters. Press the filter button •. Toggle to time-base display (Y/t). On the screen you will see the vertical component of the eddy current signal displayed as a function of time. The B1 is synchronized with the rotor to show exactly one revolution of the probe. You will see the spike from the EDM notch in the reference standard and a base-line signal from the rest of the bolt hole wall (Fig. 4).

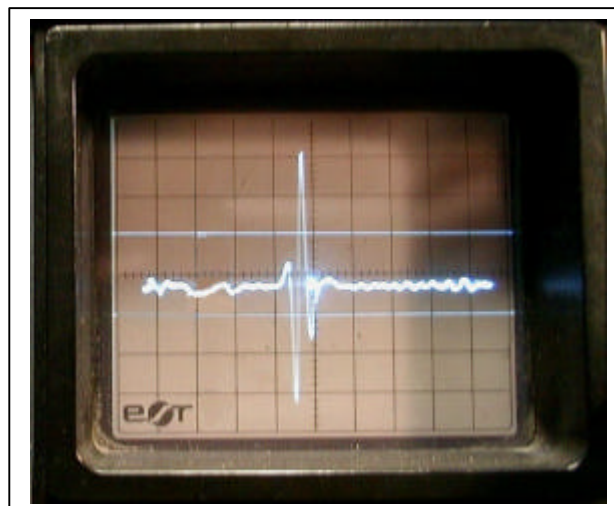


Fig. 4 Eddy current signal in Y/t mode from EDM notch in the reference standard, shown with alarm thresholds.

Adjust the Low-Pass and High-Pass filters so that you get an optimum signal-to-noise ratio, i.e. as clean a base-line as possible while still retaining a large notch signal amplitude. Normally the signal-to-noise ratio should be at least 3:1 or better. You can work at 2:1 but must be severely careful when interpreting signals. When done, adjust the Main Gain again until the correct amplitude is reached.

Take a paperclip or other narrow metal object, remove the probe from the standard and hold the clip next to the probe element. Note the location of the spike signal on the screen. Since the rotor is synchronized, you can correlate a signal location on the screen with a physical location relative to the rotor, e.g. make a 12 o'clock mark on the rotor corresponding to the center of the screen. This allows you later on to determine the position/orientation of a flaw in a bolt hole.

Switch back to Y/X display mode by pressing F4. I usually prefer to perform inspections in Y/X (impedance plane) mode since flaw signals tend to change phase as a function of the size of the flaw causing them. Once I detect a flaw, the phase can tell me whether it is a crack-like indication, corrosion etc. I then switch to Y/t mode to determine the number of flaws present, as well as their orientation.

11. The instrument is now set-up. Store the parameters in a "setting", i.e. storage-"mail-box" in the B1 V4. Press the MENU button until you see the "SETTINGS" Menu. If there are little key-symbols next to STORE and DELETE you must unlock the Settings.

To unlock settings: Press the MENU key until you get to the "FUNCTIONS" menu. Press F3 for SERVICE, press F3 for SETUP2, press F3 to toggle the lock for the SETTINGS.

Now return to the SETTING Menu with the MENU key, press F2 for STORE. With the rotary knob select a "mail box number". Then press F4 to START storing. A black field appears under JOB and the word POS is displayed. Press F1 to switch between POS and CHR. When POS is displayed, the rotary knob will move the cursor, when CHR is displayed, the rotary knob allows you to select letters, numbers and symbols. This way you can enter a JOB Description, e.g. procedure name. When done, press F4 NEXT.

Proceed similarly with the Probe name PRB and the name for the Reference Standard REF. When you press NEXT lastly, the B1 will respond with DONE! and then again with START at the F4 line. Press the MENU key to get out. The setting values are now stored. If you desire you can lock the Settings the same way as we unlocked them above.

You are now ready for performing inspections.

PERFORMING AN INSPECTION

1. Set up the hardware as above. Make sure you have the correct probe and reference standard for the inspection. Mark the holes on the disk to be inspected with tick/marks and number the holes (to help you in keeping track of inspected holes).
2. Turn on the Elotest B1 V4. Make sure the rotor is off. The B1 "wakes" up with the last settings. If these match the settings required by the NDT procedure, continue. Else load the appropriate setting.
3. Check that the probe fits into the reference standard and cover it with Teflon tape or coat it with mineral oil or both.
4. Place the guide fixture over the reference standard hole and center the probe, wedge the probe if necessary (split-shaft probes) to fit the hole diameter. With the probe in air, null the instrument.

5. Turn on the rotor and plunge the probe slowly into the standard. Once you observe the maximum eddy current signal on the CRT, fine-adjust the gain and phase to meet the requirements of the NDT procedure. This is called "Pre-Cal".
6. Retract the probe and place the guide fixture on the disk to be inspected. Inspect each hole as per the NDT procedure (fig. 5).

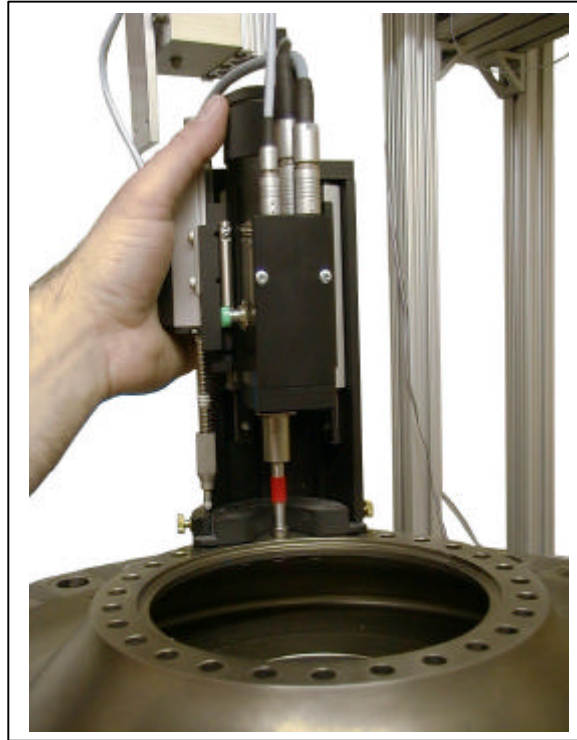


Fig. 5 Eddy current inspection of bolt holes

7. When done, perform a "Post-Cal": Insert the probe into the standard and observe the maximum signal on the CRT. **DO NOT ADJUST ANYTHING ON THE INSTRUMENT!** If the signal does not meet the requirements of the procedure you will have to recalibrate the system and re-inspect the disk!
8. Follow the requirements of the procedure on how to proceed next.