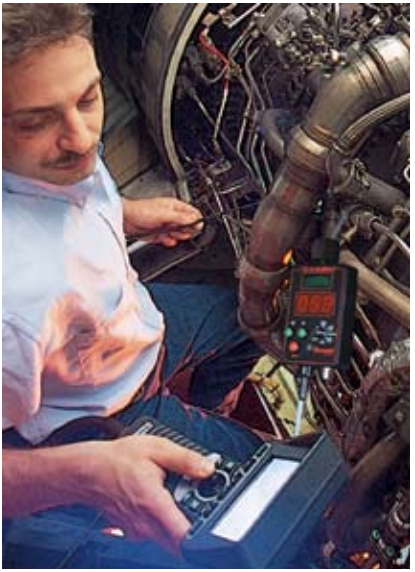
Rhinestahl Corporation

ENGINEERED SOLUTIONS

FutureDrive®

Electronic Turning Tool

Operating Manual



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Description and Introduction

The FutureDrive® Electronic Turning Tool is a fully programmed electronic tool that automates the process of engine rotor shaft positioning during borescope inspections. This positioning automation provides the following benefits:

- One Person Operation (eliminates the need for a second technician to manually turn the shaft)
- Inspection time is reduced
- Inspection accuracy (& thoroughness) is increased
- Damaged blades can be flagged and quickly relocated for re-inspection

The FutureDrive system consists of three components: the main power unit (including case), the drive unit and the controller.

The FutureDrive system was designed with versatility and user simplicity in mind.

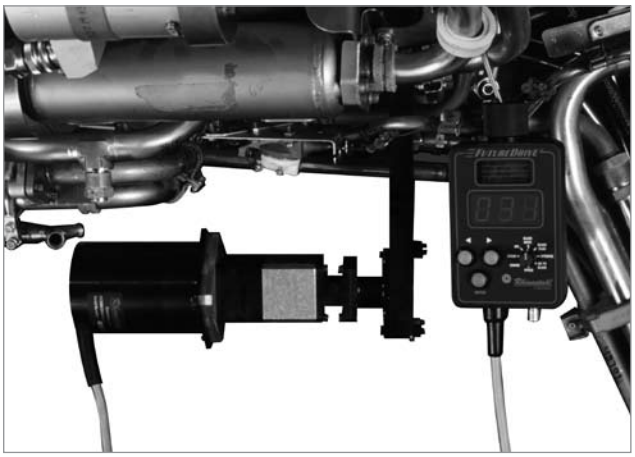

Figure 1

Setup

The following procedure is used to setup the FutureDrive® system:

1. Connect the various components as follows:
   - Attach the particular engine adapter to be used to the Drive Unit.
   - Connect the Drive Unit to the Power Unit via the supplied Drive Cable. Be sure to tighten the connector.
   - Connect the Electronic Hand Control to the Power Unit via the cable attached to the Hand Control. Be sure to tighten the hand screws at the connector.
   - If the Auxiliary Hand Switch or Auxiliary Foot Switch is to be used, connect it to the Hand Control with the supplied Remote Switch cable. This cable is connected by aligning the pin to the slot, pushing the connectors together and then giving the connector a slight clockwise turn.
   - Connect the Power Unit to the appropriate power source via the supplied power cable.
   - **NOTE**: IT IS VERY IMPORTANT FOR PROPER OPERATION TO MAKE SURE THAT ALL OF THE CABLES ARE SECURELY CONNECTED BEFORE TURNING ON THE POWER.

2. Turn ON the FutureDrive system via the switch on the Power Unit.

3. Attach the Drive Unit to the Engine starter/manual turnover pad.

   NOTE: It may be necessary to rotate the adapter drive shaft to align the drive unit mount onto the engine.

Hand Control Layout

Once FutureDrive® is set up, the unit is operated through the Hand Control. The Hand Control's layout is as follows (see figure 2 on page 5 for hand control illustration):

LCD Status Display — consists of four lines:

- Engine displays the engine type selected
- Stage displays the stage selected and at the end of the line the # of blades in that stage
- Mode displays the mode being used
- Status displays status messages on operations and at the end of the line displays an F if the current blade is flagged

Blade # Display

Displays the # of the blade that is presently under the borescope inspection.

Green < and > arrow buttons and red ENTER button

Used to control what happens in the various modes.

Mode Select Knob

Used to select the "mode" that the FutureDrive is operating in. These modes are as follows:

- Engine is used to select the Engine that is being borescope inspected.
- Stage is used to select the Stage of the engine to be inspected.
- Jog is used to jog the engine back and forth and to set the zero point.
- Blade Move is used to move from blade to blade.
- Blade Flag is used to flag particular blades for re-inspection during the inspection of a particular stage.
- Interval is used to perform an automated blade move with a particular interval between blade moves.
- Go to blade is used to select and move to a particular blade.
- Speed is used to select a speed between 1 and 99.

Hand Control Layout

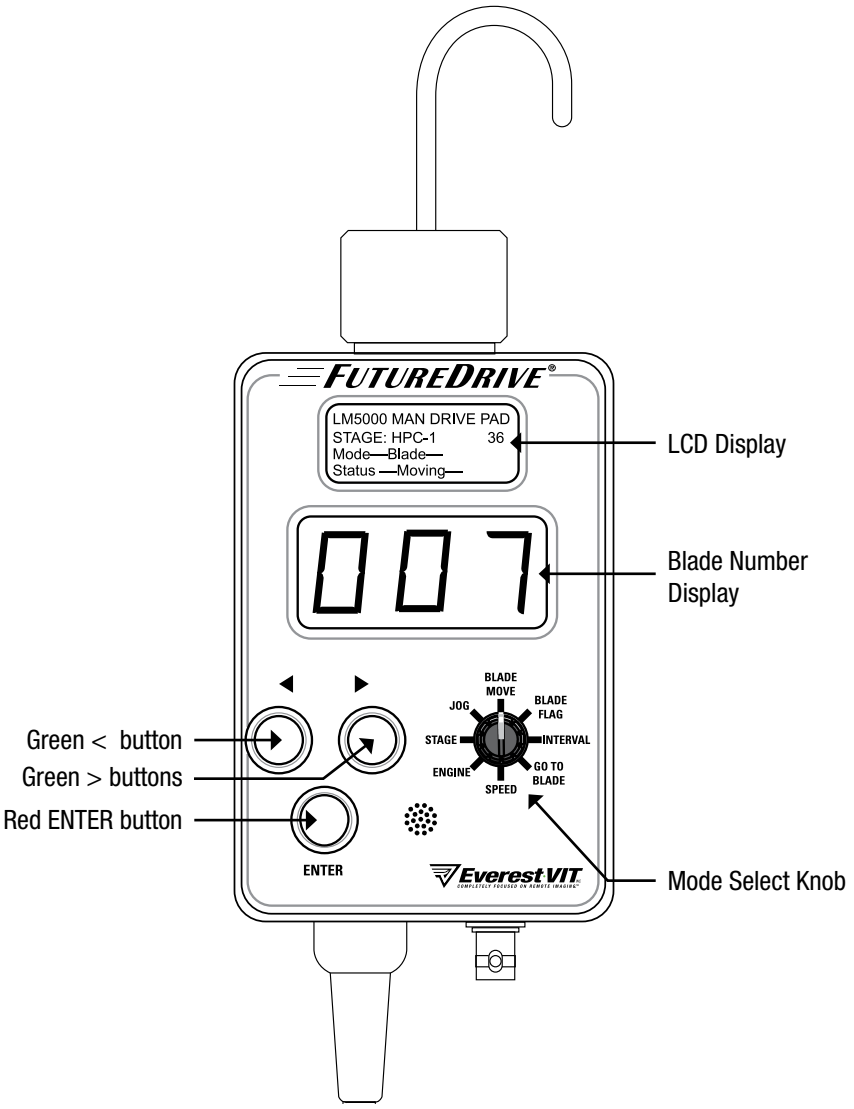

Figure 2

Operation

STANDARD BORESCOPE INSPECTION PROCEDURE

Once set up, the FutureDrive® is used to perform the standard borescope inspection procedure as follows:

NOTE: Certain engines are limited to movement in only one direction. For these engines, backlash is not an issue and references to it below can be ignored. Additionally for these engines, any type of blade move in the opposite direction is accomplished by moving through the entire series of blades (e.g. to move from blade 6 to blade 5, FutureDrive will move from blade 6 to 7 to 8 until it gets all the way back around to blade 5).

1. Select the Engine and set the backlash for the particular Engine

a. Turn the Mode Select knob to the ENGINE setting.

b. Use the < and the > keys to choose the type of engine to be inspected.

c. Press the ENTER key to confirm the selection and begin the backlash setting process.

d. Use the < key to turn the engine until the engine is positively engaged (i.e., there is no backlash left in that direction).

e. Use the > key to turn the engine in the other direction until the engine just becomes positively engaged. (It is VERY IMPORTANT to stop this step as soon as the backlash is traveled through to insure proper correction for the backlash).

f. Press the ENTER key to store Backlash setting.

IF YOU ARE NOT SURE THAT STEP E WAS PERFORMED PROPERLY, YOU CAN REDO STEPS D THROUGH F AS MANY TIMES AS IS NECESSARY TO SET THE BACKLASH.

2. Select the Stage to inspect

a. Turn the Mode Select knob to the STAGE setting.

b. Use the < and the > keys to choose the stage to be inspected. The stage name will appear in the top LCD window.

Operation (continued)

3. Jog the engine to zero the blade under the borescope at the desired blade viewing point.

a. Turn the Mode Select knob to the JOG setting.

b. Use the < and > keys to move the blade under the scope to set the desired zero viewing point.

c. Press the ENTER key to zero this setting. This is where each blade will move to as the blades are inspected.

The JOG setting can also be used to manually move the engine back and forth as desired. Only when the ENTER key is hit will it set a new zero.

4. Begin the inspection by moving from Blade to Blade

a. Turn the Mode Select knob to the BLADE MOVE setting.

b. Press the > key to move to the next blade.

c. Press the < key to move to the previous blade (see note on page 6 for engines that move only in 1 direction).

When the entire stage has been inspected, the unit will beep. At this time you can move through each stage of the inspection by performing steps 2 through 4 in succession for each stage.

NOTE: The remote control hand and foot switch are equivalent to the > key. This allows movement of the engine from blade to blade without using the hand control.

Advanced Features

The following Advanced Features are available through the Hand Control:

Blade Flag

The FutureDrive® unit has the ability to mark questionable blades for re-inspection. This is done as follows:

a. Turn the Mode Select knob to the BLADE FLAG setting.

b. Press the ENTER key to either flag a blade or to unflag a blade that has been previously flagged. The status line in the upper LCD readout on the hand control will have an “F” at the end of the status line for any blade that has been flagged. It will be blank for any unflagged blades.

At any point during the inspection of a stage, the operator can move to any flagged blades by performing the following procedure:

a. Select the stage that the flag blade is on with the Stage Mode. Then turn the Mode Select knob to the BLADE FLAG setting.

b. Press the > key to move to the next highest blade that has been flagged. (If there is no blade flagged in the current stage the unit will not turn at all.)

c. Press the < key to move to the previous blade that has been flagged.

NOTE: Blades can also be flagged while in Interval Mode. See Interval Mode for description of this procedure.

Interval

The FutureDrive tool has an interval move feature to allow a fully automatic movement of the blades through the inspection of a stage with an operator specified delay between blade moves. This option is particularly useful during video borescope inspections. This mode is used as follows.

a. Turn the Mode Select knob to the INTERVAL setting.

b. Use the < and the > keys to select the delay in 1/4 seconds between blade moves

c. Press the ENTER key to confirm the interval selected and to begin the interval movement.

d. To stop the interval mode movement press the ENTER key again.

Advanced Features (continued)

Go to Blade

The FutureDrive® tool allows the operator to move to a particular blade at any time. This is done as follows:

a. Turn the Mode Select knob to the GO TO BLADE setting.

b. Use the < and > keys to select the blade to go to. (This blade selection will appear in the upper LCD display in the Status line).

c. Press the ENTER key to move to the selected blade.

Speed

The FutureDrive system allows a wide range of engine turning speeds to be used. The speed is selected as follows:

a. Turn the Mode Select knob to the SPEED setting.

b. Use the < and > keys to select the speed desired. (The possible range of speeds is from 1 to 99 which corresponds to approximately 5° to 360° per minute).

Maintenance and Care

Clean the unit only using a dry soft clean cotton cloth.

Always insure during operation that all ventilation openings are not covered.

This unit is designed for indoor and outdoor use. The user must insure however that the unit is not allowed to get wet or damp due to the nature of the electronics & other sensitive components.

Only use original FutureDrive® components and adapters with this tool. Use of non-original FutureDrive parts can lead to failure of unit and voiding of warranty.

Troubleshooting

Unit will not operate

If problems are noticed in the operation of FutureDrive®, please make sure that all cables are securely connected.

Improper connection of cables can cause various problems.

LCD Status Display does not work or is not easy to read

The Hand Control for FutureDrive must be connected to the Power Unit before the power is turned on. Connect the Hand Control, turn the power off and then back on again.

Try to adjust the contrast knob in the Power Unit. This knob is near the foam which holds the Hand Control.

Blades do not repeat position in BLADE MOVE mode when moving in one direction

The zero point must be set by pressing ENTER while in JOG mode. If ENTER is not set, the JOG mode only moves the blade position temporarily.

Make sure unit is set to correct stage.

Blades do not repeat position in BLADE MOVE mode when changing direction of movement

The backlash for the particular engine may have been set incorrectly. If the backlash is not set correctly for the particular engine, the unit may over or undercompensate for the amount of backlash and when reversed will not move the blade to the selected zero point. To remedy this situation redo the Engine Select and Backlash setting step in the operation section.

Troubleshooting (continued)

Motor is turning but blades do not

The shear pin on the drive unit may have sheared. Check to see if shear pin is broken and replace with replacement shear pin provided. **Note**: Only use shear pins provided in order to avoid potential damage to unit or engine.

To remove broken shear pin: securely hold the turning tool gearbox (in a vice or clamped to a table) and rotate the 1/2 in. square drive with a wrench until you can see through the center of the pin. BE CAREFUL NOT TO CRUSH THE GEARBOX. The pin is now aligned and can be driven out using a 3/16 in. pin punch and a hammer. After the old pin is removed, replace it with a new pin (supplied in spare parts bag) while the holes are still aligned.

Specifications

Electrical Requirements

Voltage	120V / 240V AC (Autoselecting)
Frequency Range	50-60 Hz.
Current	2A Max.
Fuse Rating	2A (F or T)

Unit complies with EMC and low voltage directive.

Environmental

Operating Temp.	0° C to 50° C
Storage Temp.	-10° C to 70° C
Humidity	0 to 96%

Operation

Speed	Variable from 5° to 360°/minute
Direction	Bi-directional (Uni-directional on some engine models.)
Torque	Limited by shear pin at 120-135 ft-lbs.
Interval Timer	0 to 25 seconds between blade moves in 1/4 second increments.
Blade counter	Up to 999
Engine Types	Preprogrammed for all major engines per customer requirements.
Blade Flagging	Damaged blade locations can be flagged and automatically repositioned.
Control Type	Simple multiplexing one hand control design with emphasis on simple operation without sacrificing full functional versatility. Backlit LCD display provides for maximum visibility in widest variety of operating conditions.
Power Electronics	PC microprocessor based system design insures reliable operation. EPROM's can be easily updated in the field.
Drive Unit	Stepper motor design with encoder feedback for full motion control range with digital accuracy. High torque gearbox insures reliable operation. Variable acceleration design provides for minimal backlash problems during operation.

Warranty and Contact Information

GE Inspection Technologies disclaims all warranties not expressly set forth herein, including any WARRANTY OF MERCHANTABILITY and/or WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. There are no warranties which extend beyond the description on the face hereof.

The parties agree that the buyer's sole and exclusive remedy against the seller shall be for the repair or replacement of defective parts as provided herein. The buyer agrees that no other remedy (including, but not limited to, incidental or consequential damages for lost profits, lost sales, injury to person or property, or any other incidental or consequential loss) shall be available to the buyer.

For a period of 12 months from the date of purchase, GE Inspection Technologies. will provide free warranty service at GE Inspection Technologies' factory, including parts, labor, and UPS ground service back to the customer, for any malfunction of its products. Units out of warranty will be repaired promptly and at reasonable cost. In all cases, the customer must pay for shipping the units to us. If you wish to have the unit shipped back to you other than by UPS ground you must pay for the difference. Freight collect shipments will be refused.

If you have a problem with your unit, a phone call to us or rereading the manual might be able to solve the problem. Some problems might require you to return the unit for repair. To speed return repairs please tell us precisely what the problem is and a person we can contact who is observing the problem.

Returned units should be packed in the original shipping cartons. We are not responsible for damage done in transit. Shipments must be sent freight pre-paid to:

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