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Eaton **MD**™

MOBILE DIAGNOSTICS

MD-300-V Vehicle Vibration Tool User's Guide

APMT-0350

March 2006



Important

Warnings and Cautions

ONE PERSON CANNOT PERFORM VIBRATION TESTING. A VEHICLE DRIVER AND VIBRATION TEST TECHNICIAN ARE BOTH REQUIRED.

BEFORE INSTALLING OR REMOVING PRODUCTS TO BE TESTED, TURN OFF THE IGNITION, PLACE THE TRANSMISSION IN NEUTRAL, SET THE PARKING BRAKES, AND BLOCK THE WHEELS.

VEHICLE COMPONENTS MAY BE HOT. BE CAUTIOUS DURING INSTALLATION AND REMOVAL OF SENSORS AND HARNESSES.

Always keep personal safety in mind when working on vehicles. Do not ignore common sense.

Use appropriate safety equipment including:

- Safety glasses
- Safety shoes
- Gloves
- Proper transmission jack or lift with safety chains
- Guards and protective devices for presses, pullers, and drivers.
- Wheel chocks

To protect yourself and the vehicle always adhere to the following precautions:

- Always refer to OEM manufacturer's service procedures before removing or replacing any equipment.
- Keep yourself and equipment free from hot or moving parts.
- Always disconnect the battery before replacing any electrical component.
- Always use a properly ventilated area when the engine is running.
- Always have the parking brakes applied, the transmission in neutral, and wheels blocked when working on a vehicle.
- Never leave a vehicle unattended with the engine running.
- Never operate diagnostic equipment while driving the vehicle.

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CLICK-WRAP LICENSE AGREEMENT FOR {Diagnostic Software}

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Introduction

Introduction

The Eaton MD-300-V vibration tool is designed to provide the ability to isolate fundamental vehicle vibrations for quicker diagnostics and repair. By using vehicle speed, this tool pinpoints vibration problems that, in the past, have been difficult to diagnose.

There are two versions of the MD-300-V tool software; Basic and Advanced. The Basic version provides the set-up, testing, data collection, and reporting of information in an easy-to-use format. The Advanced version provides an engineering level view of the gathered data.

The separate MD-300-V Analysis software comes with the MD-300-V Advanced program. The Analysis software allows for in-depth studying using vibration analysis tools on both live and saved data.

If additional support is needed, Vehicle Vibration Reports can be collected and sent to a Vibration Analyst to review for a fee.

Eaton Support Hotline

For further assistance, call the Roadranger Call Center at 1-800-826-HELP (4357). Please have the following information ready:

- A brief explanation of the problem you are having.
- Include the exact wording of any error or warning message you have received.
- Give the sequence of steps you took before the error occurred.
- Describe any changes made to your computer recently, and if the software was running correctly in the past.

Introduction

Kit Contents

The MD-300-V Vehicle Vibration Analysis Kit includes:

#	Name	Qty	Purpose
1	Software CD	1	Contains all necessary PC software
2	PC Card	1	Inserted into the PC to collect the vehicle speeds and vibration data
3	Signal Conditioner	1	Conditions the raw vehicle signal for the PC software
4	Accelerometer (Vibration Sensor)	1	Used to provide vibration input through the seat bracket
5	Tap (3/4" -16NC)	1	To clean threads for threaded speed sensor in flywheel housing or trans- mission speedometer rear bearing cover
6	Speedometer Sensor (Push in)	1	Used for transmission output speed, where necessary
7	Speedometer Pick-up Adapter (SPA) Cables	6	Used to connect the speedometer pick-up to the speed cables
8	Gray Speed Cables	2	Connects the speed inputs to the signal conditioner
9	Data Cable	1	Connects the signal conditioner to the data card
10	Flywheel Sensor	1	Used for transmission input speed

Introduction

Identifying Kit Contents



Installing Software

Diagnostic Software Installation

PC Requirements

In order to successfully run the diagnostic tool, you will need the following components:

A PC should meet the following minimum configuration:

- IBM® PC-compatible computer Pentium III or equivalent (1 GHz or better)
- 256 Mb of RAM minimum (512 recommended)
- Screen resolution
 - Basic 1024 x 768 (XGA)
 - Advanced 1280 x 800 (SXGA)
- CD-ROM drive
- 400 Mb of free space on hard drive
- Microsoft Windows 2000, NT, or XP

Installing Software

How to Install the MD-300-V Software

Use the following procedure to install the software onto your PC.

- 1. Close any applications currently running.
- 2. Insert the software CD in the CD-ROM drive.
- 3. The install program should start automatically. If it does not:
 - a. From the task bar, press the "Start" button and select RUN.
 - b. In the dialogue box, type: d:\setup.exe and click on OK.

Note: "d" is the letter of your CD-ROM drive.

- 4. Read through the Welcome screen and click on NEXT to continue.
- 5. Follow the screen prompts to complete the installation process.

Note: The default path is the recommended installation location.

- 6. Re-start the PC if prompted to do so.
- **Note:** Due to wide variances from computer configurations, the setup program might differ from the procedure just described.

Connecting the MD-300-V to the Vehicle

Your Vehicle Connections

Although every attempt has been made to provide connections to most medium- and heavy-duty vehicles, not all connections can be covered. In most cases, you will be able to tee into the existing speed sensor connections on the vehicle. If not, you may need to place an additional sensor on the vehicle. Additional flywheel and transmission output speed sensors are provided (see "Kit Contents" on page 7). Both engine speed and transmission output speed are required for the test.

A CAUTION

Do not modify vehicle harnesses.

Connecting to the Vehicle

- 1. Remove plug from flywheel sensor hole.
- 2. Run the tap into the hole to make sure threads are clear.
- 3. Install sensor:
 - a. Screw sensor in until it touches the flywheel.
 - b. Back sensor out 1/2 to 3/4 turn.
- 4. Lock sensor in place by tightening jam nut against flywheel housing.



5. Feed gray cable down from cab and connect to sensor.

CAUTION

Tie cables away from all hot and moving parts.



6. Install the output shaft sensor:

Option A: Using Existing Speedometer Sensor

- 1. Remove wiring harness from sensor.
- 2. Connect SPA cable to sensor.
- 3. Connect wiring harness to SPA cable.

Option B: Using Push-in Sensor

- 1. Remove jam nut and plug from sensor hole.
- 2. Push sensor into sensor hole until tight and re-install jam nut. Then connect SPA cable to sensor.
- 3. Tie SPA cables away from all hot and moving parts.



7. Feed gray speed cable down from the cab and connect to the SPA cable.

A CAUTION

Tie cables away from all hot and moving parts.



Tie cables away from all hot and moving parts

- 8. Place accelerometer on driver seat mount:
 - a. Clean mounting area with cloth / rag.
 - b. Point arrow toward front of vehicle.



Route cable so as not to interfere with driving.

9. Connect three cables to signal conditioner.



- 10. Connect data cable to signal conditioner.
- 11. Connect data cable to PC card.
- 12. Verify PC is turned off.
- 13. Install PC card into PCI slot.

Note: Consult the computer manufacturer's installation instructions.

14. Turn on PC.



Starting a New Test

Once the software has been installed and the cables have been connected correctly, the gathering data phase can begin.

- 1. Select the MD-300-V icon on the desktop or go to Start, Programs, and locate the MD-300-V software in your programs list.
- 2. Select "New Test" from the Startup Dialog box.

Heavy Duty Diagnostic Software	×
New Test F1 Browse for Test F2	
Open Last Test F3 Cancel esc	
Help F10	

3. Select the location and file folder name for the test data to be saved under.

Please Name your test then press the "save" button.					<u>? ×</u>	
Save jn:	🔁 Manual 0908	04	*	+ 🗈 💣	•	
Histoy Desktop My Documents My Computer	Nanual.vva					
My NEWOIK P	File name:	Enter new test name.		-] [ОК
	Save as lype:	Custom Pattern (*.vva)		-]	Cancel

4. Select the driveline configuration that matches the vehicle using the up and down arrow keys.



5. Select the desired startup mode. **Note**: This option will not be displayed if only the Basic level is available.

	×
Select Starts	up Mode
Basic	Advanced

6. After verifying the accelerometer is placed correctly, click the "Check Accel" button and follow the on-screen steps to verify the accelerometer is functioning properly. See page 63 to troubleshoot any card errors.



- Fill in the data on the Setup Tab as required on page 23 for the Basic level or on page 30 for the Advanced level.
 Note: When using the software for the first time, or after installing a new accelerometer, you must enter the Accelerometer Setup data.
- 8. Take the vehicle for a test drive with an assistant. Drive the vehicle at the condition where the vibration exists at a steady speed and gear while gathering test data. During the test drive, review and record the data displayed on the Test Tab as indicated on page 25 for the Basic level or on page 36 for the Advanced level.
- 9. Use the "Analysis Software Functions" on page 38 to further identify the vibration, if necessary.
- 10. Follow the "Repair Strategies" on page 54 to assist in vibration corrections.

MD-300-V Basic Program

The Basic Functions screens contain three main areas: the Menu bar across the top, the Setup tab, and the Test tab.

The Menu Bar

The Menu Bar contains the main program functions: File, Advanced, and Help.

File

MD-300V (DVA Test)		
File Advanced Help		
New Test		
Open Test		
Save Test		
Change Driveline		
Page Se <u>t</u> up		
Print Window Ctrl+P	Info	
E <u>x</u> it		
Fleet Name:		

The File menu provides all the functions available with the vibration test files.

New Test	Creates a new test and requires the user to enter a test name. This will create a file folder containing all test infor- mation and data files.
Open Test	Opens an existing test file. This can be useful if the previ- ous test vehicle was similar in setup and only needs a few minor changes, such as VIN number and tire size.
Save Test	Saves the current test file including any changes that have been made.
Change Driveline	Allows changes to the driveline selection if the wrong one has been selected previously.

Page Setup	Changes the report printing options including headers, margins, and printer destinations.
Print Window	Prints the current screen to the desired printer.
Exit	Exits the current test.

Advanced



The Advanced menu provides program customization to best fit user needs.

Add User Transmission	Allows for entering a new transmission configuration or modifying an existing configuration listed in the software. This includes the manufacturer, model, forward speeds, reverse speeds, input torque, output torque, forward gear ratios, and reverse gear ratios. Selecting "Cancel" at the bottom of the screen will discard any changes made.
Preferences	Changes the default directory that files are saved in and the length of the data file saved during testing. Type in the directory name or use the "Browse" button to change the default directory. Use the up and down arrows to modify the standard 30 second time frame (not recommended).



Help

The Help menu provides useful information on the product functions and the version level.

The Setup Tab



The Setup Tab records vehicle information and checks the accelerometer is functioning properly. Not all information is required, but it is suggested to provide the best correlation with shop records. The **number of flywheel teeth** (see 7 above) **and all information in red are required** before starting the test.

1	Vehicle Info	Enter information about the vehicle including: unit number, fleet name, truck manufacturer, truck model, VIN number, vehicle mileage, wheel base, RO number, and the name of the individual conducting the test.
2	Tire Diameters	Enter the steer axle and drive axle tire diameters in inch- es (measured from the ground to the top of the tire).
3	Engine	Select the number of engine cylinders. This is critical to identifying engine related vibrations.

4	Transmission	Select the transmission model by choosing the Produc- tion Status, Transmission Manufacturer, and the Trans- mission model. This is critical to identify gear information and the relationship between engine speed and transmission output shaft speed. If the desired transmission is not displayed, use the "Add User Trans- mission" selection under "Advanced" in the Menu Bar.
5	Axle	Enter the axle ratio as stated on the axle tag. This is crit- ical to isolating axle vibrations.
6	Driveline Configuration	Displays the driveline configuration selected when the test started. If the proper configuration is not displayed, use the "Change Driveline" selection under "File" in the Menu Bar.
7	Engine Flywheel	Enter the number of flywheel teeth OR use the "Find Teeth" button (recommended) and follow the on- screen steps to get an accurate tooth count.
8	Transmission Output	Enter the number of teeth on the tone wheel at the transmission output shaft. (For Eaton Fuller transmissions the number is usually 16.)
9	Accelerometer	The accelerometer check must be performed daily to ensure the accelerometer has not been damaged. Fol- low the on-screen steps to verify each side of the sen- sor is functioning properly. Once completed, the program will advise if the accelerometer is damaged.
10	Vibration Complaint	Enter any vibration complaint notes. These notes will appear on all reports and files recorded during testing.

The Test Tab



The Test Tab is used once the Setup Tab screen is complete. It is an active window during the data collection process.

1	Analyzer Start and Stop Buttons	Used to start and stop the vibration analysis test func- tion. Vehicle must be moving to start test. Note: If the vehicle comes to a stop, the test will need to be restarted.
2	Saved File List	Any data that has been saved during the current test will be displayed in the list.
3	Current Gear Position	Shows the current gear position while the vehicle is in motion during a test.
4	Collect a Vibration	Allows the data to be collected while the vehicle is in mo- tion during a test. (NOTE: The vehicle must be held at a steady speed and gear while gathering test data.) To change the amount of time data is collect for, use the "Preferences" selection under "Advanced" in the Menu Bar. (Not recommended) WARNING: Use caution when driving at slow speeds and obey all traffic laws.

5	Pause Display	Freezes the current screen information in order to review it on screen or use the "Print Window" selection under "File" in the Menu Bar.
6	Vehicle Sensor Information	Provides a view of the vibration sensor inputs to com- pare with vehicle gauges and verify they are functioning properly.
7	Vibration Analysis Table	Indicates the source(s) of the vibration. Red indicates a problem vibration has been detected. Yellow indicates a vibration has been detected, but below levels that need correction. Green indicates the tool has not found a problem vibration.

Test Tab Measurements

Below are charts of how the MD-300-V measures the linear and torsional vibrations.

Linear Vibrations

Measurement	Level
< 70 mg	Green
> 70 mg	Red

Torsional Vibrations

	0 - 300 rad/s ²	300 - 1000 rad/s ²	> 1000 rad/s ²
< 0.3º	Green	Green	Green
0.3 - 1º	Green	Yellow	Red
> 10	Green	Red	Red

MD-300-V Advanced Program

Note: Advanced Functions are only found in the engineering version of the vibration analysis software.

The Advanced functions provide a user, skilled in vibration analysis, the ability to review actual sensor information by utilizing vibration analysis graphs. The program also allows for live FFT (Fast Fourier Transform) analysis of linear and torsional vibration information.

While viewing torsional information, the user can review vibration orders using acceleration or displacement on the Y-axis. The ability to review vibration frequency and order plotted against acceleration is also available. In addition, there are more speed sensor and vibration input options.

The Advanced Functions screens contain six main areas: the Menu bar across the top, the four sections of the Setup tab: Vehicle Information, Transmission Ratios, Speed Sensor Setup, Accelerometer Setup, and the Test tab.

The Menu Bar

The Menu Bar contains the main program functions (identical to that of the Basic Functions Menu Bar): File, Advanced, and Help.

File

MD-300V (DVA Test)	
<u>File A</u> dvanced <u>H</u> elp	
New Test Open Test Save Test	
Change Driveline	
Page Setup Print Window Ctrl+P	Info
E <u>x</u> it	
Fleet Name:	

The File menu provides all the functions available with the vibration test files.

New Test	Creates a new test and requires the user to enter a test name. This will create a file folder containing all test infor- mation and data files.
Open Test	Opens an existing test file. This can be useful if the previ- ous test vehicle was similar in setup and only needs a few minor changes, such as VIN number and tire size.
Save Test	Saves the current test file including any changes that have been made.
Change Driveline	Allows changes to the driveline selection if the wrong one has been selected previously.
Page Setup	Changes the report printing options including headers, margins, and printer destinations.
Print Window	Prints the current screen to the desired printer.
Exit	Exits the current test.

Advanced



The Advanced menu provides program customization to best fit user needs.

Add User Transmission	Allows for entering a new transmission configuration or modifying an existing configuration listed in the software. This includes the manufacturer, model, forward speeds, reverse speeds, input torque, output torque, forward gear ratios, and reverse gear ratios. Selecting "Cancel" at the bottom of the screen will discard any changes made.
Preferences	Type a default directory for files to be saved in or use the "Browse" button. Use the up and down arrows to modify the number of pre-trigger and post-trigger seconds. Pre- tigger seconds sets the number of seconds data is gath- ered before the "Collect a Vibration" button is depressed on the Test Tab. The post-trigger seconds sets the num- ber of seconds data is gathered after data collection is stopped.
Spectrum Setup	Changes the technical setup of the program. These set- tings should not be changed without advice from a vibra- tion analyst.

Help

The Help menu provides useful information on the product functions and the version level.

The Setup Tab

The Setup Tab is broken into four sections: Vehicle Information, Transmission Ratios, Speed Sensor Setup, and Accelerometer Setup.

Vehicle Information

The Vehicle Information Tab records vehicle information. Not all information is required, but it is suggested to provide the best correlation with shop records. All **information in red is required** before starting the test.



1	Vehicle Info	Enter information about the vehicle including: Unit num- ber, fleet name, fleet account number, truck manufactur- er, truck model, VIN number, vehicle mileage, vehicle build date, RO number, transmission serial number, wheel base, and the name of the individual conducting the test.
2	Vibration Complaint	Enter any vibration complaint notes. These notes will appear on all reports and files recorded during testing.

3	Driveline Configuration	Displays the driveline configuration selected when the test started. If the proper configuration is not displayed, use the "Change Driveline" selection under "File" in the Menu Bar.
4	Engine	Select the engine make, model, and number of cylinders. This is critical to identifying engine related vibrations.
5	Axle	Enter the axle ratio as stated on the axle tag. This is crit- ical to isolating axle vibrations.
6	Tire Diameters	Enter the steer axle and drive axle tire diameters in inches (measured from the ground to the top of the tire).

Transmission Ratios

The Transmission Ratios Tab allows for vehicle transmission selection and review of ratios and speeds.



1	Transmission Selection	Select the transmission model by choosing the Produc- tion Status, Transmission Manufacturer, and the Trans- mission Model. This is critical to identify gear information and the relationship between engine speed and transmis- sion output shaft speed. If the desired transmission is not displayed, use the "Add User Transmission" selection un- der "Advanced" in the Menu Bar.
2	Gear Ratio Setup	Displays all information specific to the transmission se- lected including gear ratios and the number of forward and reverse speeds.

Speed Sensor Setup

The Speed Sensor Setup Tab provides options for placing the speed sensors at different locations along the driveline. It also displays the number of gear teeth identified by the speed sensor pickups. The user can also identify where test files will be saved.



1	Speed Sensor Locations	Select different speed sensor locations using the drop down box and corresponding pictures to best isolate the vehicle vi- bration. The selections include: - Trans Flywheel RPM (ch1) & Trans Output RPM (ch2) - Trans Input RPM (ch1) & Trans Output RPM (ch2) - Trans PTO RPM (ch1) & Trans Output RPM (ch2)
2	Number of Teeth	Enter the number of teeth for both sensor locations OR use the "Find Teeth" button and follow the on-screen steps to get an accurate tooth count. The number of flywheel teeth must be accurate for the system to make vibration calculations. Note: The channel information is color coded to match the speed sensor location arrows in the pictures.
3	Data File Setup	Enter the desired location and name for saving test files.
Accelerometer Setup

The Accelerometer Setup Tab displays the sensor calibration data. It is important for vibration measurement accuracy and should be input when the program is installed or the sensor is changed.



1	Main Accelerometer Information	Displays the main accelerometer sensor calibration data and allows for input of the mounting location de- scription and accelerometer serial number. Adjust- ments to the sensitivity and offset can be made using the up and down arrows. Note: This information is required when using the program for the first time or when an accelerometer is replaced.
2	Check Accelerometer	The accelerometer check must be performed daily to ensure the accelerometer has not been damaged. Fol- low the on-screen steps to verify each side of the sen- sor is functioning properly. Once completed, the program will advise if the accelerometer is damaged.

3 Opti Acc Cha	onal elerometer nnels	Used to provide two additional single channel acceler- ometer inputs. Press the "Off" button to activate the ac- celerometer and then input sensor information. As with the main accelerometer, the accelerometer check must be performed daily to ensure the accelerometer has not been damaged. Follow the on-screen steps to verify each side of the sensor is functioning properly. Once completed, the program will advise if the accelerometer is damaged.
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The Test Tab



The Test Tab is used once the Setup Tab screen is complete. It is an active window during the data collection process.

1	Analyzer Start and Stop Buttons	Used to start and stop the vibration analysis test func- tion. Note: If the vehicle comes to a stop, the test will need to be restarted.
2	Saved File List	Any data that has been saved during the current test will be displayed in the list.
3	Display Type	Used to switch between the Basic Function Test screen and the Advanced Function Test screen.
4	Current Gear Position	Shows the current gear position while the vehicle is in motion during a test.

5	Collect a Vibration	Allows the data to be collected while the vehicle is in mo- tion during a test. (NOTE: The vehicle must be held at a steady speed and gear while gathering test data.) To change the amount of time data is collect for, use the "Preferences" selection under "Advanced" in the Menu Bar. WARNING: Use caution when driving at slow speeds and obey all traffic laws
6	Pause Display	Freezes the current screen information in order to review it on screen or use the "Print Window" selection under "File" in the Menu Bar.
7	Vehicle Sensor Information	Provides the option to activate or deactivate the graph- ing of sensor information. Press the squares to the right of each input to toggle them on (green) or off (red).
8	Vibration Display Channel	Provides a list of the vibration sensor inputs and select which will be displayed in the bottom graph for analysis. Depending upon the sensor input selected, either the X- or Y-axis information options will be displayed. X-axis information can show either frequency (in Hz) or order of the vibration in relation to accelerometer signals (ver- tical, lateral, fore-aft). When speeds are used, Y-axis in- formation can show either angular acceleration (rad/ sec ²) or angular displacement (degrees) of torsional ac- tivity in the driveline.
9	Cursor Information	Several color-coded cursors are listed to assist in find- ing vibration relationships by level and the vibration or- der or frequency (in Hz).

Analysis Software Functions

The separate MD-300-V Analysis software comes with the MD-300-V Advanced program. The Analysis software allows for in-depth studying using vibration analysis tools on both live and saved data.

The Analysis functions provide a user, skilled in vibration analysis, the ability to import vibration analysis information saved from the MD-300-V (Basic or Advanced) program. The data files can also be sent to a Vibration Analysis Technician if additional assistance is needed.

The Analysis Functions screens contain five main areas: the Menu bar across the top, the Linear Analysis tab, the Torsional Analysis tab, the Order Tracking tab, and the Spectral Maps tab.

The Menu Bar

The Menu Bar contains the main program functions: File, Edit, and Help.

File



The File menu provides all the functions available with the vibration test files.

Select Files	Opens data that will be used for analysis including the lo- cation of the Current Path files on the computer, a list of the Current Files, a list of the Selected Files, and File Con- trol Keys that allow files to be selected or deselected.
Page Setup	Changes the report printing options including headers, margins, and selecting a printer destination.
Print	Creates a print report which can be exported to a printer or as an image file.
Exit	Closes the program.

Edit



The Advanced menu provides basic editing functions.

Spectrum Setup	Changes the technical setup of the program. These set-
	tings should not be changed without advice from a vibra-
	tion analyst.

Help

The Help menu provides useful information on the product functions and the version level.

The Linear Analysis Tab

The Linear Analysis Tab allows the review of accelerometer data.







1	File Selection	Choose the file to be analyzed.
2	File Info and Vibration Info	The File Info tab displays the vehicle information col- lected during the vibration test including comments. The Vibration Info tab displays color-coded cursors corresponding to the graph to determine the proper source of the vibration peaks.
3	File Data and Graph Control	Displays the data as it was collected from the vehicle during testing.
3a	Input View Controls	Press the squares to the right of each input to turn them on (green) or off (red).
3b	Graph Pallet Controls	Provides zooming and panning of the graph for a better view. Selecting the magnifying glass provides several zoom in options. Selecting the hand allows for easy movement of the data in the viewing window.
3c	Plot Scaling Controls	Modifies the scaling and view of the graph. The X or Y axis information can be locked or unlocked. Once unlocked, the number format can be changed to decimal, scientific, or engineering. Decimal precision can also be modified from 0-6 decimal places. The mapping mode alters the graph to linear or logarithmic scales. The viewing of the graph scale and labels can be toggled on or off. Grid colors can also be changed.
4	Analysis and Graph Control	Choose the way the vibration data is displayed.
4a	Frame Number	The MD-300-V collects data in frame segments. As the data is analyzed it can be displayed one frame at a time (a frame is indicated by the blue lines on the graph) using the up and down arrows.

4b	Spectrum Setup	The Analog FFT Settings allow alterations to the block size (512 to 16,384 data points), averaging (select be- tween 3 and 6 blocks to analyze), and percent overlap (25% - 90% overlap of block data). The window type control selects the type of vibration analysis to be used. The X and Y axis scaling allows the X-axis to be viewed by order or frequency and the Y-axis to be viewed by voltage peak, RMS, peak squared, RMS squared, or g's peak. G's peak is the default setting and should not be changed without advice from a vibration analyst. Note : Torsional FFT Settings do not apply to acceler- ometer information
4c	Auto Play	Displays the data from beginning to end as it was gath- ered to watch specific spectrum values change through time.
4d	Gear Position	Shows the transmission gear position for the data cur- rently displayed on screen.
4e	Graph Palette Controls	Provides zooming and panning of the graph for a better view. Selecting the magnifying glass provides several zoom in options. Selecting the hand allows for easy movement of the data in the viewing window.
4f	Plot Scaling Controls	Modifies the scaling and view of the graph. The X and Y axis information can be locked or unlocked. Once un- locked, the number format can be changed to decimal, scientific, or engineering. Decimal precision can also be modified from 0-6 decimal places. The mapping mode alters the graph to linear or logarithmic scales. The viewing of the graph scale and labels can be tog- gled on or off. Grid colors can also be changed.

4g	Cursor Controls	The left button on the cursor bar allows the cursor pad at the bottom of the screen to be toggled on or off. The center button changes the cursor color, style, and line width. The right button locks the cursor grid line, snaps to data points, or allows for a free floating cursor. The harmonics button can display 1, 2, or 3 harmonics simultaneously. The cursor control diamond allows the cursor to move one data point at a time.
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The Torsional Analysis Tab

The Torsional Analysis Tab allows the review of angular acceleration (rad/s²) and angular displacement (degrees) for each tach channel.







1	File Selection	Choose the file to be analyzed.
2	File Info and Vibration Info	The File Info tab displays the vehicle information col- lected during the vibration test including comments. The Vibration Info tab indicates the plot cursors dis- played, Y-axis scaling viewed by displacement or accel- eration, and color-coded flywheel and output cursors corresponding to the graph to determine the proper source of the vibration peaks.
3	File Data and Graph Control	Displays the data as it was collected from the vehicle during testing.
3a	Input View Controls	Press the squares to the right of each input to turn them on (green) or off (red).
3b	Graph Pallet Controls	Provides zooming and panning of the graph for a better view. Selecting the magnifying glass provides several zoom in options. Selecting the hand allows for easy movement of the data in the viewing window.
3с	Plot Scaling Controls	Modifies the scaling and view of the graph. The X or Y axis information can be locked or unlocked. Once unlocked, the number format can be changed to decimal, scientific, or engineering. Decimal precision can also be modified from 0-6 decimal places. The mapping mode alters the graph to linear or logarithmic scales. The viewing of the graph scale and labels can be tog-gled on or off. Grid colors can also be changed.
4	Analysis and Graph Control	Choose the way the vibration data is displayed.
4a	Frame Number	The MD-300-V collects data in frame segments. As the data is analyzed it can be displayed one frame at a time (a frame is indicated by the blue lines on the graph) using the up and down arrows.

4b	Spectrum Setup	The Torsional FFT Settings allow alterations to the block size (1/12 to 1/96 of order resolution) and per- cent overlap (none, 25%, 50%, 75%, or 90% overlap of block data). The window type control selects the type of vibration analysis to be used. The X and Y axis scaling allows the X-axis to be viewed by order or frequency and the Y-axis to be viewed by displacement or acceleration. Note : Analog FFT Settings do not apply to linear vibration information.
4c	Auto Play	Displays the data from beginning to end as it was gath- ered to watch specific spectrum values change through time.
4d	Gear Position	Shows the transmission gear position for the data cur- rently displayed on screen.
4e	Graph Palette Controls	Provides zooming and panning of the graph for a better view. Selecting the magnifying glass provides several zoom in options. Selecting the hand allows for easy movement of the data in the viewing window.
4f	Plot Scaling Controls	Modifies the scaling and view of the graph. The X and Y axis information can be locked or unlocked. Once un- locked, the number format can be changed to decimal, scientific, or engineering. Decimal precision can also be modified from 0-6 decimal places. The mapping mode alters the graph to linear or logarithmic scales. The viewing of the graph scale and labels can be tog- gled on or off. Grid colors can also be changed.
4g	Cursor Controls	The left button on the cursor bar allows the cursor pad at the bottom of the screen to be toggled on or off. The center button changes the cursor color, style, and line width. The right button locks the cursor grid line, snaps to data points, or allows for a free floating cursor. The harmonics button can display 1, 2, or 3 harmonics simultaneously. The cursor control diamond allows the cursor to move one data point at a time.

The Order Tracking Tab

The Order Tracking Tab allows specific orders to be extracted from the vibration data for a given reference speed.







1	File Selection	Choose the file to be analyzed.
2	Channel to Track	Select the desired data channel to be reviewed from the pull down list.
3	Reference Speed	Select the flywheel or output speed source.
4	Plot Type	Select if the level will be plotted against RPM or speed.
5	Vibration to Track	Select the desired vibration source to be reviewed from the pull down list.
6	Extract Order and Copy Data	Once the "Channel to Track" and "Vibration to Track" options are selected, Extract Order will create a revised vibration graph. Copy Data duplicates the current infor- mation which can then be imported into a spreadsheet for further analysis.
7	File Data and Graph Control	Displays the data as it was collected from the vehicle during testing.
7a	Input View Controls	Press the squares to the right of each input to turn them on (green) or off (red).
7b	Graph Pallet Controls	Provides zooming and panning of the graph for a better view. Selecting the magnifying glass provides several zoom in options. Selecting the hand allows for easy movement of the data in the viewing window.
7c	Plot Scaling Controls	Modifies the scaling and view of the graph. The X or Y axis information can be locked or unlocked. Once unlocked, the number format can be changed to decimal, scientific, or engineering. Decimal precision can also be modified from 0-6 decimal places. The mapping mode alters the graph to linear or logarithmic scales. The viewing of the graph scale and labels can be tog-gled on or off. Grid colors can also be changed.

7d	Cursor Controls	The left button on the cursor bar allows the cursor pad at the bottom of the screen to be toggled on or off. The center button changes the cursor color, style, and line width. The cursor control diamond allows the cursor to move one data point at a time.
8	Order Graph Control	Allow for movement and cursor control configuration.
8a	Graph Identifier	Shows which order is currently displayed on the graph.
8b	Graph Palette Controls	Provides zooming and panning of the graph for a better view. Selecting the magnifying glass provides several zoom in options. Selecting the hand allows for easy movement of the data in the viewing window.
8c	Plot Scaling Controls	Modifies the scaling and view of the graph. The X and Y axis information can be locked or unlocked. Once un- locked, the number format can be changed to decimal, scientific, or engineering. Decimal precision can also be modified from 0-6 decimal places. The mapping mode alters the graph to linear or logarithmic scales. The viewing of the graph scale and labels can be tog- gled on or off. Grid colors can also be changed.
8d	Cursor Controls	Within the order graph, there are two cursors that can be placed on any of the information points for review. The left button on the cursor bar allows the cursor pad at the bottom of the screen to be toggled on or off. The center button changes the cursor color, style, and line width. The right button locks the cursor grid line, snaps to data points, or allows for a free floating cursor. The cursor control diamond allows the cursor to move one data point at a time.

The Spectral Maps Tab

The Spectral Maps Tab allows the review of the entire data file at once to get an overall picture of vibration trends.





1	File Selection	Choose the file to be analyzed.
2	Process Bar	Indicates the progress of the extraction when the "Ex- tract Order" button (5) is pressed.
3	Channel to Track	Select the desired data to be reviewed from the pull down list.
4	Vibration to Track	Select the desired vibration to be reviewed from the pull down lists. These selections include: - Plot Type: Choose order or frequency vs. time or RPM. - Graph Type: Choose Waterfall or Spectral Map. If Waterfall is selected you can then choose vertical or orthogonal display.
5	Extract Order	Once the "Channel to Track" and "Vibration to Track" options are selected, this will create a revised vibration graph.
6	File Data and Graph Control	Displays the data as it was collected from the vehicle during testing.
6a	Input View Controls	Press the squares to the right of each input to turn them on (green) or off (red).
6b	Graph Pallet Controls	Provides zooming and panning of the graph for a better view. Selecting the magnifying glass provides several zoom in options. Selecting the hand allows for easy movement of the data in the viewing window.
6c	Plot Scaling Controls	Modifies the scaling and view of the graph. The X or Y axis information can be locked or unlocked. Once unlocked, the number format can be changed to decimal, scientific, or engineering. Decimal precision can also be modified from 0-6 decimal places. The mapping mode alters the graph to linear or logarithmic scales. The viewing of the graph scale and labels can be toggled on or off. Grid colors can also be changed.

6d	Cursor Controls	The left button on the cursor bar allows the cursor pad at the bottom of the screen to be toggled on or off. The center button changes the cursor color, style, and line width. The cursor control diamond allows the cursor to move one data point at a time.
7	Order Graph	Once the "Channel to Track" and "Vibration to Track" options are selected and the Extract Order button is pressed this displays a revised vibration graph.

Now that vibration data has been gathered and analyzed, it is time to implement driveline changes to eliminate the vibrations. Areas identified as needing correction are colored red on screen. Use the following flowcharts to correct the vibration by matching the identified source with the flowchart name.

NOTE: If more than one area is colored red, each one must be corrected.

















Troubleshooting

Troubleshooting the MD-300-V

Speed input is not displayed

If the Tach Ch 1 or Tach Ch 2 power lights are not illuminated green, verify the following:

- Cable has been correctly inserted into the signal conditioner.
- Speed sensor has been inserted the proper depth from the gear.
- All cable connections are fully inserted.
- Cable is fully functional by swapping it with the other speed cable.

Transmission gear is not displayed

If gear information is not recognized, verify the following:

- Return to the Setup screen and verify speed sensor information has been correctly identified. See page 23 for the Basic level or on page 33 for the Advanced level.
- Verify the correct transmission has been selected.

Software displays a card error

If the software does not recognize the card is connected to the PC, verify the following:

- Card has been correctly inserted into the properly into the PC.
- Card has been inserted into the correct slot in the PC.
- Cable has been correctly connected to the card.
- · Cable has been correctly connected to the signal conditioner
- Card is fully functional by conducting the following test:
 - 1. Start National Instruments Measurement and Automation software.
 - 2. Selected "Devices and Interfaces".
 - 3. Select "Traditional NI-DAQ Devices".
 - 4. Select the "DAQCard 6024E".
 - 5. Click on "Properties" at the top of the screen.
 - 6. Click on "Test Resources" and verify the tests passed.
 - 7. If the tests did not pass, try another card slot.

Troubleshooting

No vibration input

If vibration input is not recognized, the accelerometer has not been connected properly. Verify the following:

- Cable has been correctly inserted into the proper port of the signal conditioner.
- Cable has been correctly inserted into the signal conditioner.
- All cable connections are fully inserted.
- Accelerometer is fully functional. See the Accelerometer Check on page 23 for the Basic level or on page 34 for the Advanced level.
- Cable is fully functional.

Appendix

Removing the Diagnostic Software

In the event that the diagnostic tool program has to be deleted, use the Add/ Remove Program utility in the Control Panel program group. This will safely remove the software program from your computer.

Instructions

To uninstall the software:

- 1. Click on the 'START' button on the Task Bar. From the menu, select 'SETTINGS' and then 'CONTROL PANEL'.
- 2. Click on the <u>ADD/REMOVE PROGRAMS</u> icon. The following screen will be displayed:
- 3. Highlight diagnostic tool from the text box, then click on the <u>CHANGE/REMOVE</u> button.
- 4. The following screen should be displayed:
- Click on NEXT to remove the diagnostic software from your computer.
- Note: If a dialog box appears asking you to remove shared files, click the 'NO TO ALL' button.
 - 5. When the uninstall is complete, click on the 'OK' button.
 - 6. Finally, click on the 'OK' button on the '<u>ADD/REMOVE</u> Programs Property' dialog box.

Appendix

Slip Member Check



To check a Spicer Life slip member for <u>broken back (movement perpendicular</u> to shaft axis) the shaft should remain installed with the vehicle resting on its wheels.

- 1. Arrange dial indicator with magnetic base one-quarter inch (1/4") from the driveshaft's tube weld. Dial indicator should be firmly mounted on the tube so that no movement of the dial indicator base is allowed.
- Extended dial indicator arm from the base, across the slip member boot, allowing the dial indicator to contact the yoke shaft tube onequarter inch (1/4") off the opposite side of the boot from where the magnetic base is mounted. Dial indicator's arm should be running parallel to the driveshaft. (See Figure A)
- 3. Apply effort perpendicular to shaft axis making note of total indicator travel. (See Figure B) Allowable indicator travel is .000 .012 inches.

Appendix

Measure Yoke Runout

To check a Spicer Life end yoke for <u>excessive runout</u> (greater than .005") the transmission output yoke and drive axle input and output yokes must be measured.

Note: If measuring SPL or Half-Round Yoke styles, go to Step 2.

1. Remove the universal joint end caps so the measurement can be made on the machined yoke surface. (See below)



2. Rotate the yoke being measured to the 12 o'clock position. Place the protractor on the yoke and rotate the yoke so the protractor reads "0".







Full-Round Yokes

Appendix

3. Place the dial indicator base on the transmission case or the axle housing being measured.





SPL and Half-Round Yokes

Full-Round Yokes

4. Move the dial indicator probe so that it contacts the machined surface. Adjust the dial indicator so the dial reads "0".





SPL and Half-Round Yokes

Full-Round Yokes

- 5. Pull the dial indicator probe upward, rotate the yoke 1/2 turn or 180 degrees and release the probe. Be sure only the probe moves upward and not the dial indicator so the reference measurement made in Step 4 is not compromised. Record measurement.
- 6. Compare the measurement made in Step 4, which was "0", to the second measurement taken in Step 5. If the difference is greater than .005" the yoke must be replaced.

Appendix

Checking and Correcting Tire Runout



Use a tire runout gauge, or dial indicator, to check lateral and radial runout. Lateral runout should be checked on a smooth surface along the tire's mid-sidewall. Radial runout should be checked on a smooth rib in the center of the tread, if possible.

Record the minimum and maximum radial and lateral runout measurements. The maximum tire runout shouldnot exceed .125". If necessary contact the appropriate Tire Manufacturer for runout limits.
Appendix

Change Control Log

Last Revised Date	Description of Clarifications and Updates
23 Mar 2006	Updated Wheel End section Added "Checking and Correcting Tire Runout" Updated warning and caution symbols

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APMT-0350 Printed in USA

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