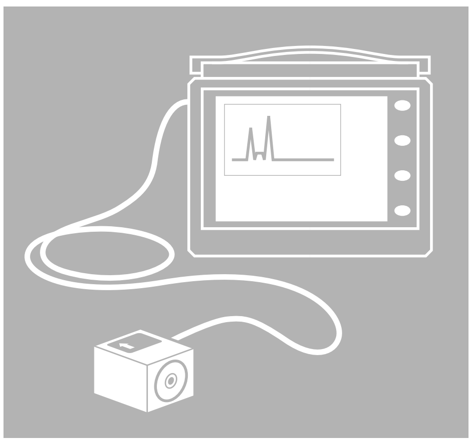
VEHICLE VIBRATION ANALYSIS



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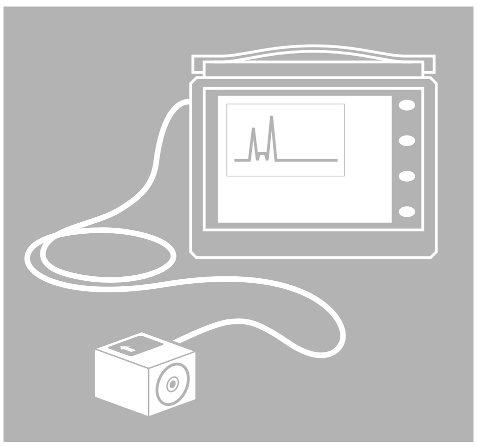
VEHICLE VIBRATION ANALYSIS



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INTRODUCTION

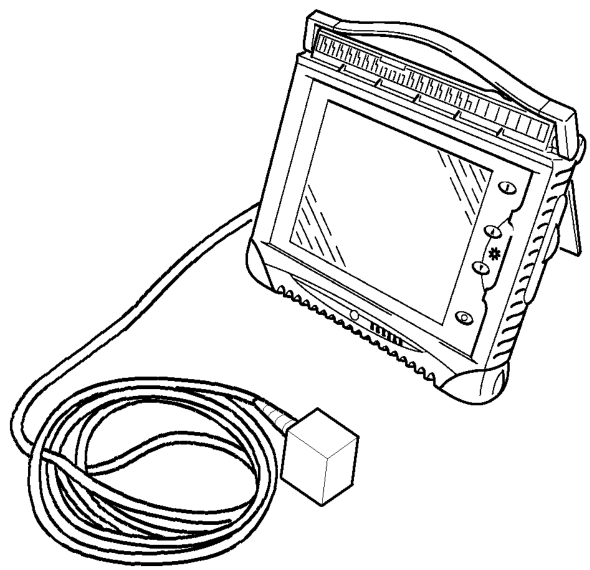
The Vibration Analyzer is a Worldwide Diagnostic System (WDS) based tool designed to locate the source of annoying vibrations in Jaguar vehicles. Vibration data is acquired by a transducer connected to the Portable Test Unit (PTU). The transducer is an accelerometer that converts vibration frequencies into electrical signals.

The acquisition procedures follow the familiar pattern of other PTU guided diagnostic programs complete with on-screen instructions, help information and component location diagrams.

The current WDS software is programmed to analyze vibrations confined mainly to two areas: the driveline, and wheels and tires.

Because the components in these areas rotate at known speeds, and speed is related to frequency, it is possible to determine the source of a vibration by analyzing its frequency.

PTU AND VIBRATION ANALYZER



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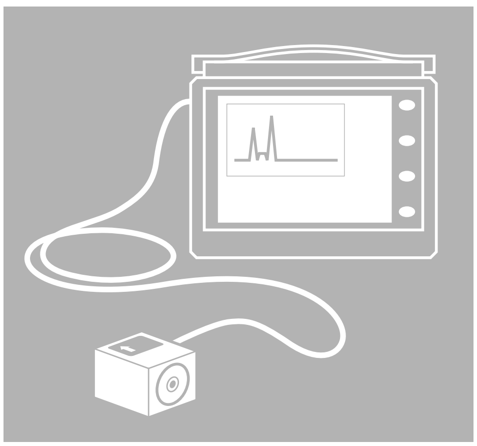
NOTES

VEHICLE VIBRATION ANALYSIS



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INTRODUCTION TO VIBRATION ANALYSIS

The following terms and concepts are explained in this section:

- Noise, Vibration and Harshness
- Vibrating Systems
- Oscillation
- Cycle
- Frequency
- Calculating Component Frequency
- Frequency and Amplitude
- Natural Frequency
- Resonance
- Phasing / Beating
- Modifying Natural Frequency
- Order
- Driveline Vibrations
- Harshness

NOTES

Noise, Vibration and Harshness

Noise, Vibration and Harshness (NVH) are present in every vehicle, but not everyone reacts to them in the same way. A noise or vibration that is unbearable to one person may be unpleasant to another, or even go unnoticed until brought to their attention. It is all a matter of perception. This is not to say that NVH can be ignored, but simply that its causes need to be assessed objectively and systematically.

The vibration analyzer has been introduced to detect the source of annoying vibrations in Jaguar vehicles. It will not detect noise. Before using this tool, you should appreciate the nature of sound and vibration.

Because we use different senses to detect sounds and vibrations, we tend to think of them as entirely separate phenomena. Sounds and vibrations are essentially one and the same thing, however. Sound waves are vibrations in the air. Both are measured in cycles per second or Hertz (Hz).

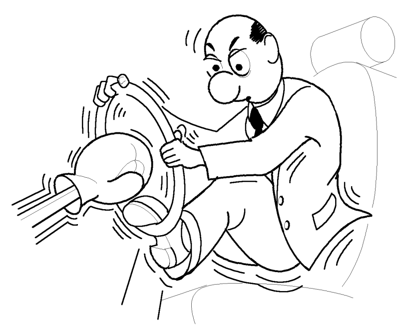
1 cycle per second = 1 Hz.

NOTES

A noise or vibration that is unbearable to one person may go unnoticed by another

VA.02

Vibrations under 200 Hz can be felt



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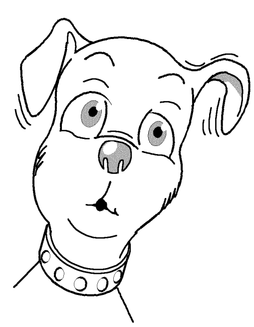
Vibrations between 20 Hz and 20,000 Hz are audible to the human ear

VA.04

Vibrations over 20,000 Hz are ultrasonic, that is to say, outside the range of the human ear



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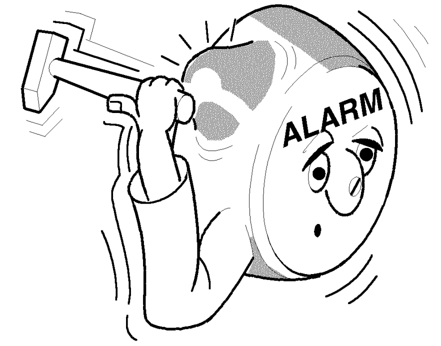
INTRODUCTION TO VIBRATION ANALYSIS

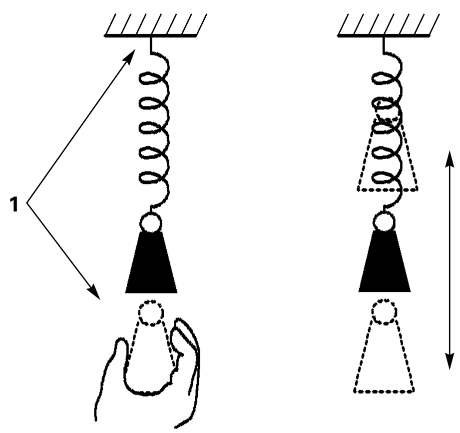
VIBRATING SYSTEM – HAMMER AND BELL



Vibrating Systems

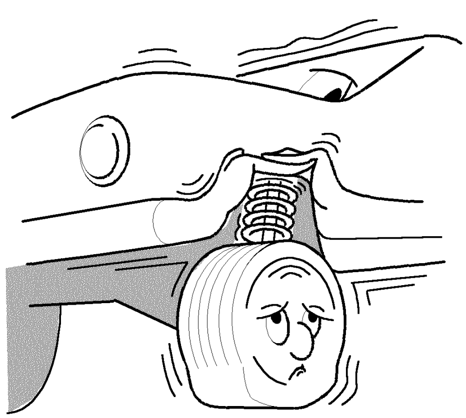
Anything that vibrates, like a bell or a tuning fork is a vibrating system. The hammer that strikes the bell and sets it ringing is the vibrating force.

VIBRATING SYSTEM – SUSPENDED MASS



A mass suspended by a spring is another example of a vibrating system. Pulling down on the mass (1) applies the vibrating force which sets the system vibrating.

VIBRATING SYSTEM – VEHICLE SUSPENSION



A vehicle suspension system is also a vibrating system; bumps and potholes in the road are the vibrating forces.

NOTES

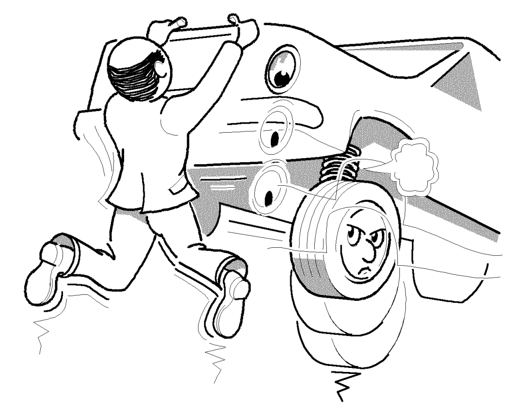
Oscillation, Cycle and Frequency

Oscillation, cycle and frequency are the common terms used to describe vibrations.

Oscillation

An oscillation is the movement of an object around a common point. A vehicle suspension oscillates. If the shock absorbers were removed from a vehicle it would vibrate uncontrollably as soon as a vibrating force was applied. The effectiveness of shock absorbers can be judged by bouncing the fender of a vehicle and seeing how quickly the oscillations are damped out.

OSCILLATION



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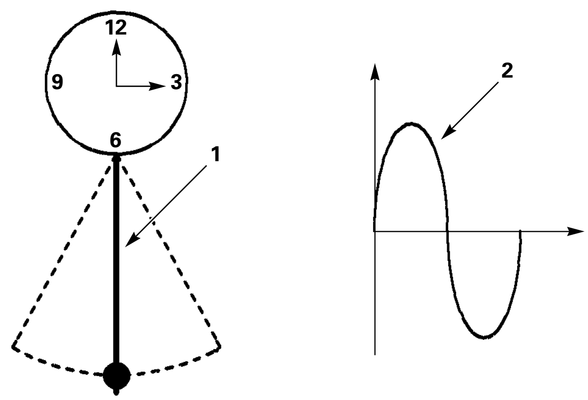
Cycle

When a constant vibration is plotted against time a pattern emerges. This is due to the repetitive vibrating force acting, in this case, on the pendulum (1) and causing it to oscillate. The trace (2) from rest to the extreme point of travel and back again is called a cycle. Cycle is derived from the word circle, and the distance traveled by the pendulum on either side of rest is half a circle. The distance traveled will remain the same as long as the vibrating force remains constant. The vibration will continue until the energy in the system is dissipated and the system is at rest.

This principle applies to all cycles. A driveshaft completes a cycle when it rotates through 360°. Consequently, a plot of driveshaft rotation against time is similar in all respects to the plot of a pendulum.

OSCILLATION CYCLE



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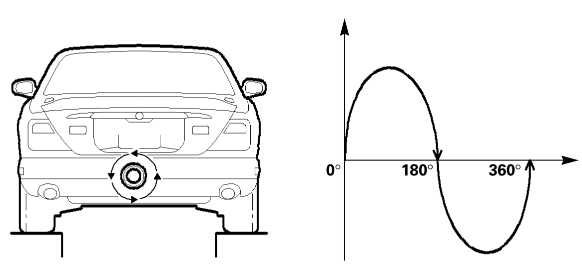
DRIVESHAFT PLOT



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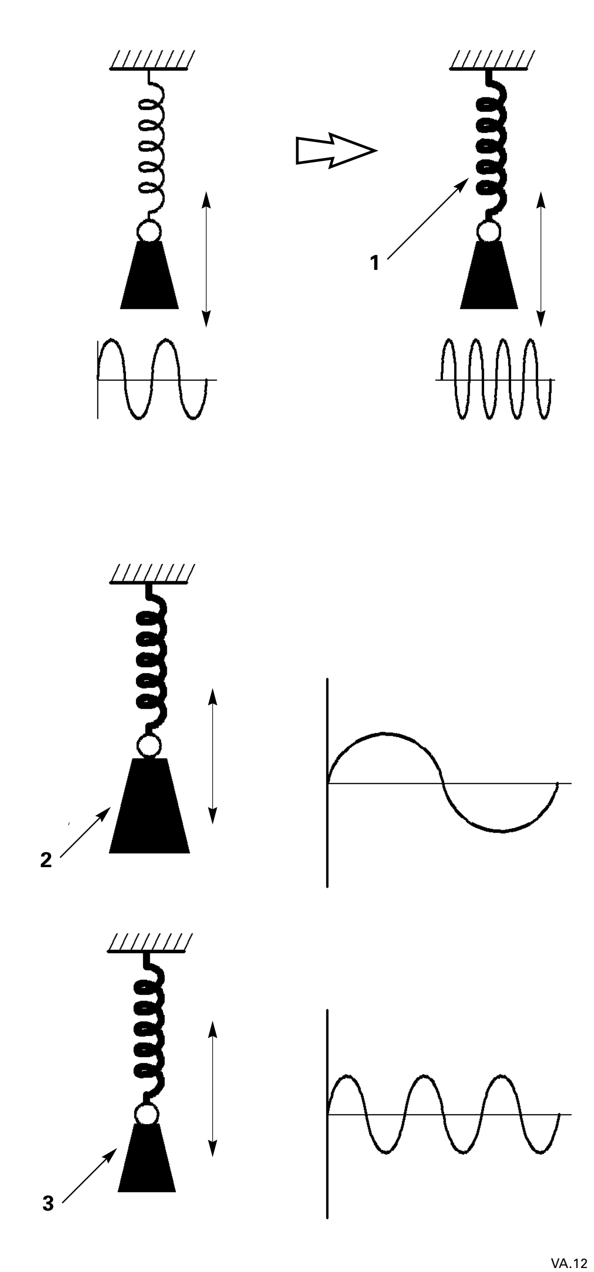
NOTES

INTRODUCTION TO VIBRATION ANALYSIS

Oscillation, Cycle and Frequency (continued)

CHANGING VIBRATION FREQUENCY



Frequency

The number of times a vibration occurs in a given time span is called the 'frequency'.

The factors that determine the frequency of vibration are:

1. The mass of the vehicle
2. The size of the suspension springs
3. The amount of vibrating force needed to set up the vibration.

Changing Vibration Frequency

Frequency can be changed by making changes to the vibrating system.

If the strength of the suspension spring or the size of the suspended mass is changed, the frequency also changes.

Change in spring strength
The suspended mass moves faster – frequency increases – if the strength of the spring is increased (1). Conversely, the suspended mass moves more slowly – frequency decreases – if the strength of the spring is decreased.

Change in mass size
A larger mass (2) moves slower – frequency decreases; a smaller mass (3) moves faster – frequency increases.

NOTES

Calculating Component Frequency

Frequency can be expressed in revolutions per minute (rpm) as well as cycles per second or Hz. The speed of rotating components is commonly measured in 'rpm'.

There is a direct mathematical relationship between the two values:

	rpm ÷ 60 = Hz	and	**Hz x 60 = rpm**
Thus:	**3000 rpm ÷ 60 = 50 Hz**	and	**50 Hz x 60 = 3000 rpm**

This simple formula may be used to calculate the rpm of a component when vibration occurs.

Worked Examples

A To calculate driveline vibration frequency, first divide the engine rpm by the gear ratio to determine the driveshaft speed (rpm), then divide the driveshaft speed by 60.

For example, if engine rpm is 3000 and gear ratio (4th) is 1:0.73,

engine @ **3000 rpm** ÷ gear ratio of **0.73** = **4109.5 rpm** driveshaft speed and

driveshaft @ **4109.5 rpm** ÷ **60** = **68.49 Hz** driveline vibration frequency

B To calculate wheel vibration frequency, first divide the driveshaft speed (rpm) by the differential gear ratio to determine the wheel speed (rpm), then divide the wheel speed by 60.

For example, if driveshaft speed is 4109.5 rpm and differential gear ratio is 4.2,

driveshaft @ **4109.5 rpm** ÷ gear ratio of **4.2** = **978.45 rpm** wheel speed and

wheel speed @ **978.45 rpm** ÷ **60** = **16.30 Hz** wheel vibration frequency

The calculations shown in examples A and B are automatically performed by WDS using the data entered on the Vehicle Features Screen.

NOTES

INTRODUCTION TO VIBRATION ANALYSIS

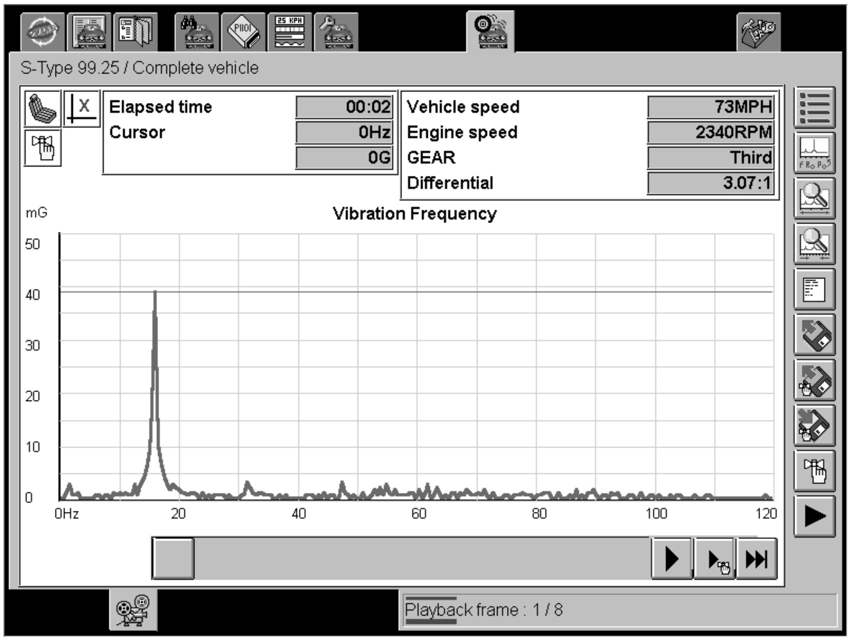
First Order Frequency Modes

XJ Series Sedan: P6000 Tires – 225/60					
Speed		Axle Ratio 3.06		Axle Ratio 3.27	
MPH	KPH	Wheel	Driveshaft	Wheel	Driveshaft
30	48.3	6.5	20.0	6.5	21.4
35	56.3	7.6	23.3	7.6	24.9
40	64.4	8.7	26.7	8.7	28.5
45	72.4	9.8	30.0	9.8	32.0
50	80.5	10.9	33.3	10.9	35.6
55	88.5	12.0	36.7	12.0	39.2
60	96.5	13.1	40.0	13.1	42.7
65	104.6	14.2	43.3	14.2	46.3
70	112.6	15.2	46.6	15.2	49.8
75	120.7	16.3	50.0	16.3	53.4
80	128.7	17.4	53.3	17.4	57.0
85	136.8	18.5	56.6	18.5	60.5
90	144.8	19.6	60.0	19.6	64.1
95	152.9	20.7	63.3	20.7	67.7
100	160.9	21.8	66.6	21.8	71.2
105	168.9	22.9	70.0	22.9	74.8
110	177.0	24.0	73.3	24.0	78.3
115	185.0	25.0	76.6	25.0	81.9
120	193.1	26.1	80.0	26.1	85.5
125	201.1	27.2	83.3	27.2	89.0
130	209.2	28.3	86.6	28.3	92.6
135	217.2	29.4	90.0	29.4	96.1
140	225.3	30.5	93.3	30.5	99.7
145	233.3	31.6	96.6	31.6	103.3
150	241.4	32.7	100.0	32.7	106.8
155	249.4	33.8	103.3	33.8	110.4
160	257.4	34.8	106.6	34.8	113.9
165	265.5	35.9	110.0	35.9	117.5

NOTES

Vibration Frequency and Wheel Harmonic Orders Traces

SAMPLE TRACE – S-TYPE VIBRATION FREQUENCY



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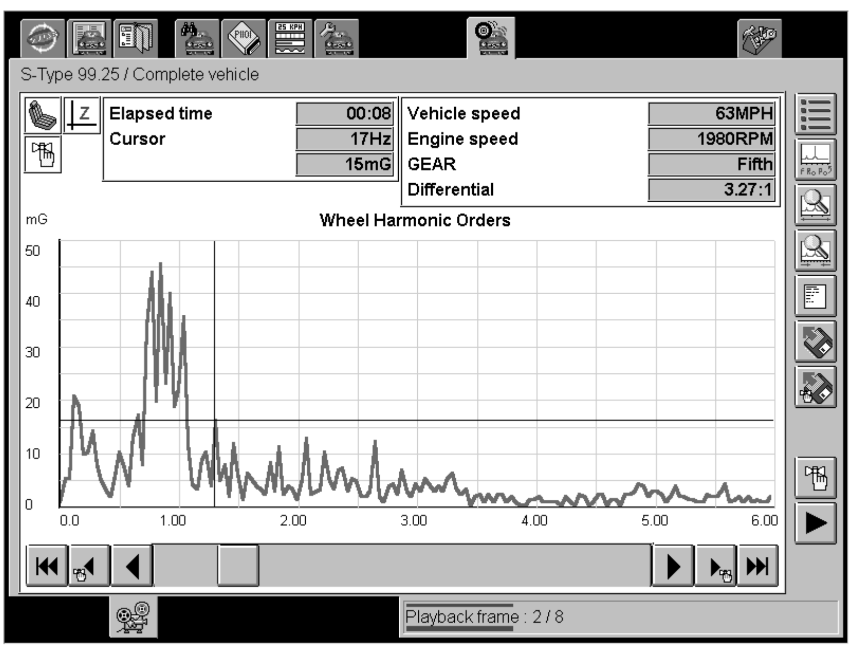
SAMPLE TRACE – S-TYPE WHEEL HARMONIC ORDERS



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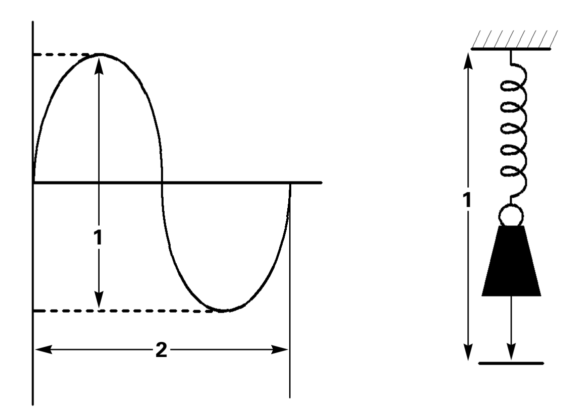
INTRODUCTION TO VIBRATION ANALYSIS

FREQUENCY AND AMPLITUDE



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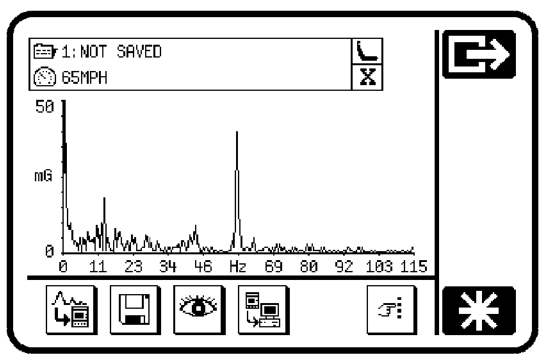
WAVEFORM



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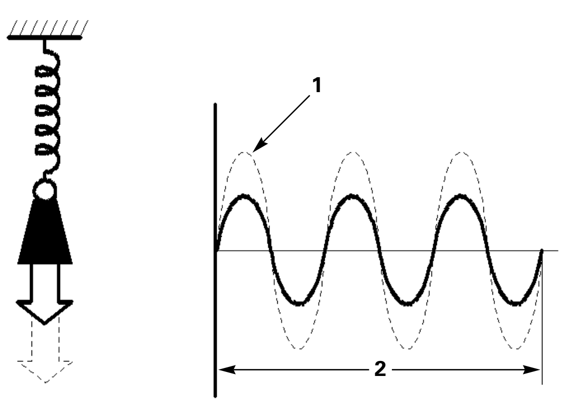
NATURAL FREQUENCY



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Frequency and Amplitude

Frequency (2) tells us how often an object vibrates in a second, while amplitude (1) tells us by how much it moves. Frequency is a function of system design and amplitude indicates the amount of energy induced into the system by a vibrating force.

In practice, the frequency of vibration indicates its source. This is because we know the speed of rotation of certain components in the vehicle, and speed of rotation, as we discovered earlier, is related to frequency. Amplitude, or energy, indicates the level of vibration felt by the driver.

The frequency (Hz) and amplitude (mG) (mill-gravity, thousandth of a 'G') of vibrations detected by the transducer are displayed on the PTU screen.

Natural Frequency

All vibrating systems have a unique vibrating frequency, called the natural frequency (2). If any of the characteristics of the vibrating system change then the natural frequency changes. If the vibrating force acting on a vibrating system changes then the amplitude (1) changes but the natural frequency stays the same.

NOTES

Resonance

Resonance occurs when the frequency of the vibrating force coincides with the natural frequency of a vibrating system

The frequency remains constant but the amplitude – the force felt by the driver – increases greatly.

Resonance Example

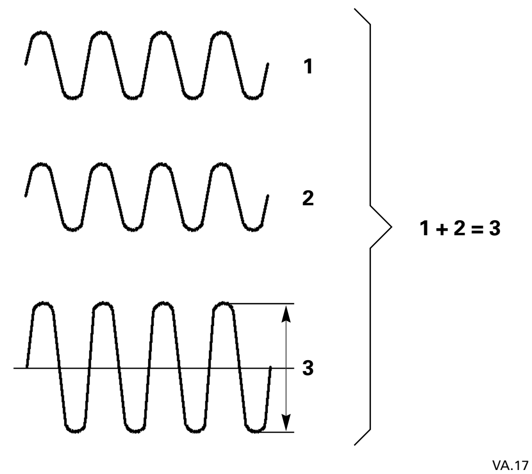
Resonance may occur when an unbalanced tire reacts with a suspension system. In this case, the vibration level is likely to become more noticeable at a specific speed. The point where the vibrating force (unbalanced tire) and the natural frequency of the suspension system resonates is the Resonance Point.

The driver feels a strong vibration when this occurs due to the significant increase in amplitude.

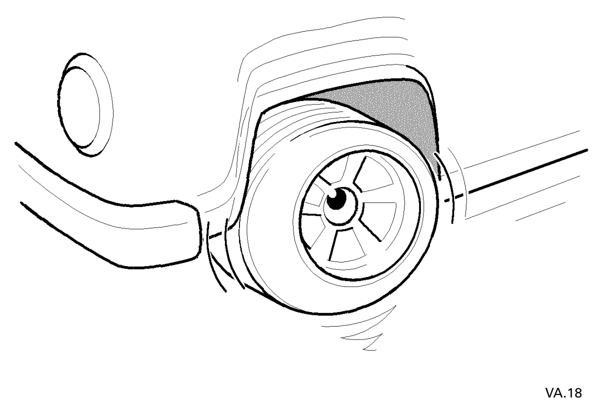
Balancing the tire will restore its natural frequency and so move the resonance point out of the operating range. The result is that the driver will no longer feel the vibration.

NOTES

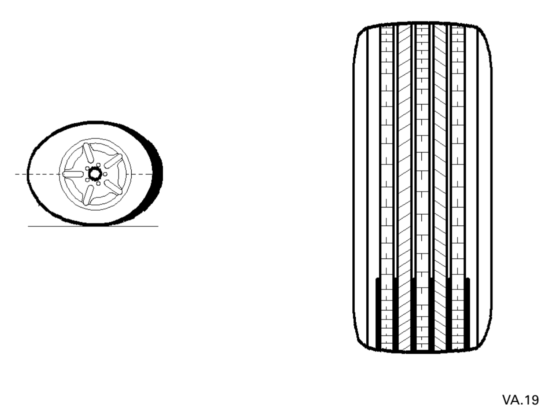
RESONANCE



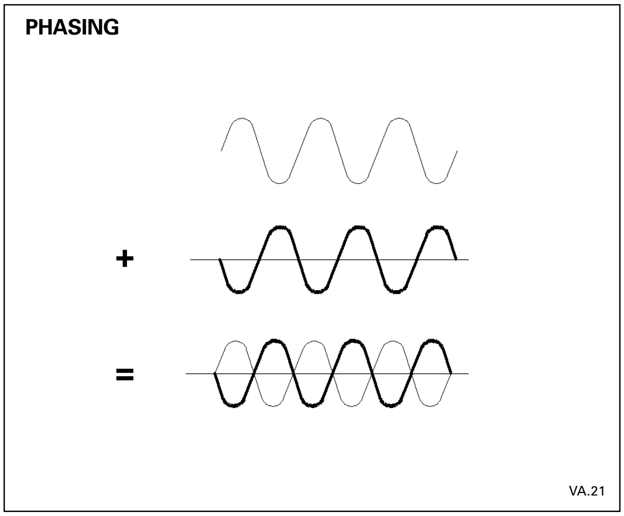
RESONANCE



BALANCE



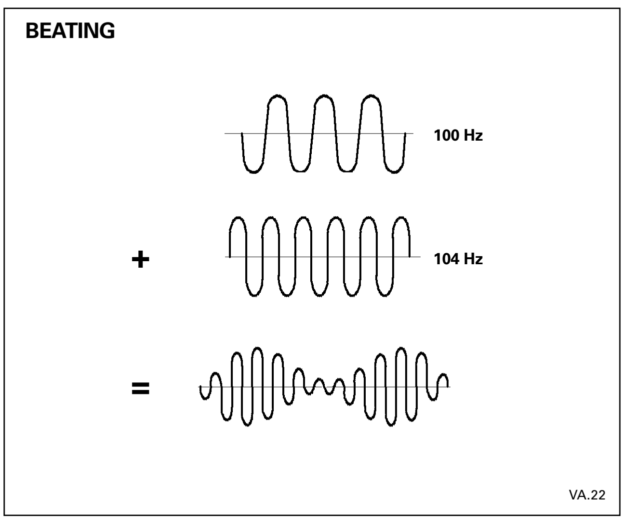
INTRODUCTION TO VIBRATION ANALYSIS



Phasing / Beating

Phasing

Phasing is the lateral shift of one waveform in relation to another. For phasing to have an impact on vibrations, there must be two vibrations of the same frequency. The lateral shift determines how the high and low peaks of the waveforms line up.



Beating

Beating occurs when two vibrations with slightly different frequencies repeatedly overlap at high and low frequencies. It is often noticeable when more than one tire is out of balance.

Over approximately 40 seconds, the vibrations will alternately add and subtract from one another. The net vibration will feel worse when the vibrations are added together.

NOTES

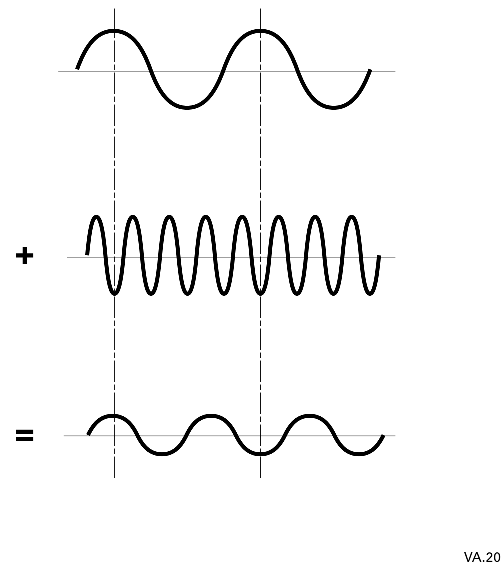
Modifying Natural Frequency

Moving the frequency of the vibrating force either side of the resonance point lowers the amplitude.

If the frequency of the vibrating force cannot be changed, then the amplitude can be lowered by changing the natural frequency of the vibrating system.

Reducing the vibrating force will also reduce the amplitude of the vibration. An example of how this might be accomplished is by balancing the wheels and tires.

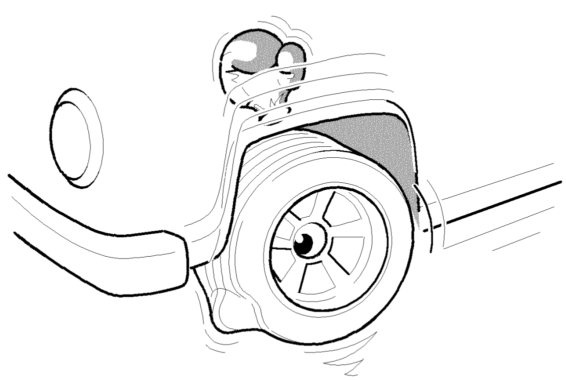
RESONANCE MODIFIED BY ALTERING FREQUENCY



NOTES

INTRODUCTION TO VIBRATION ANALYSIS

ORDER



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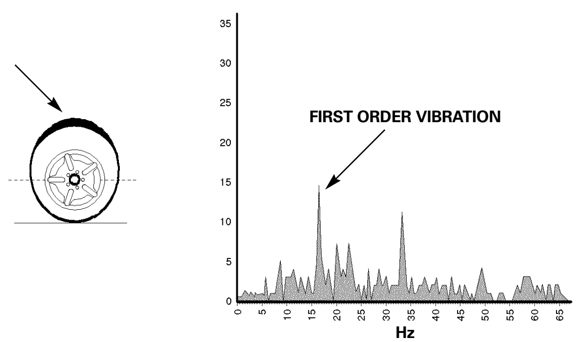
Order

An out of balance tire may generate more than one vibration. As a tire rotates, any raised spot on its surface will strike the road and lift the suspension. This up and down action induces vibrations into the suspension and steering system which are felt by the driver.

FIRST ORDER VIBRATION



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First Order Vibration

The vibration caused by a single raised spot on the tire is called a First Order vibration because it occurs once per revolution.

A first order vibration can have the largest amplitude of all vibrations.

NOTES

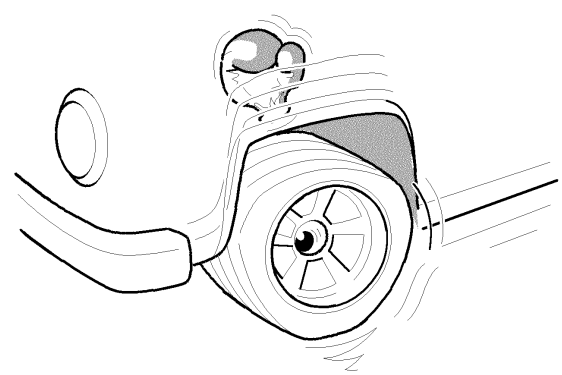
Multiple Distortions

An out of balance tire can also develop multiple vibrations due to the distortion of the tire as it rotates.

If the tire has sufficient out of balance mass, as the wheel rotates faster the amount of distortion increases.

The tire becomes less round and more oval. With two raised areas, the tire vibrates twice every revolution. This is Second Order vibration.

MULTIPLE DISTORTIONS



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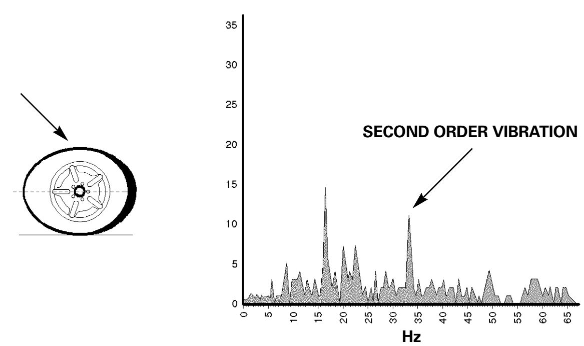
Second Order Vibration

Second order vibration is caused by a second bump in the tire when it changes shape. The amplitude is usually smaller than first order vibration, but its frequency is doubled because there are two vibrations in every rotation.

SECOND ORDER VIBRATION



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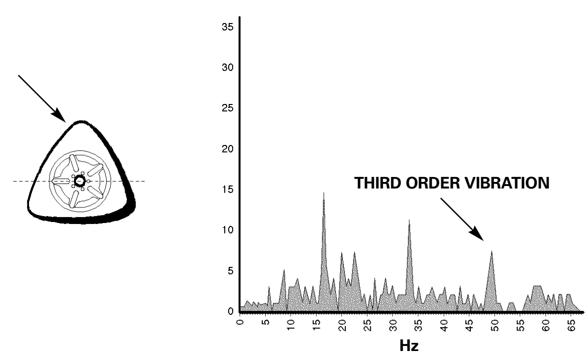
Third Order Vibration

Third order vibration arises when a third bump appears on the tire as it changes shape. The amplitude is generally smaller than second order vibration but has three times its frequency.

THIRD ORDER VIBRATION



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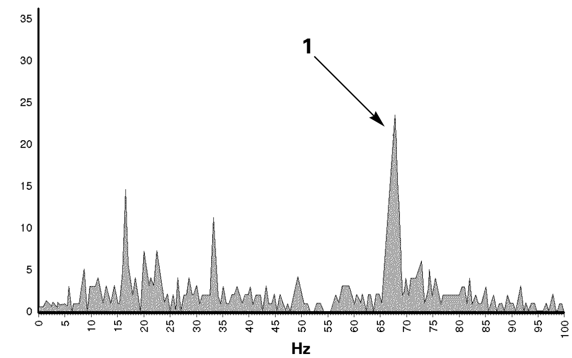
NOTES

INTRODUCTION TO VIBRATION ANALYSIS

DRIVELINE VIBRATIONS



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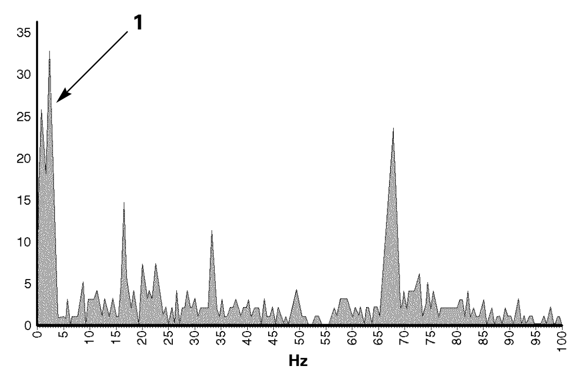
Driveline Vibrations

Driveline vibrations are caused by: imbalance, lateral runout or faulty universal joints. The force resulting from an imbalance or lateral runout usually causes a first order vibration because it occurs once per shaft revolution (1).

HARSHNESS



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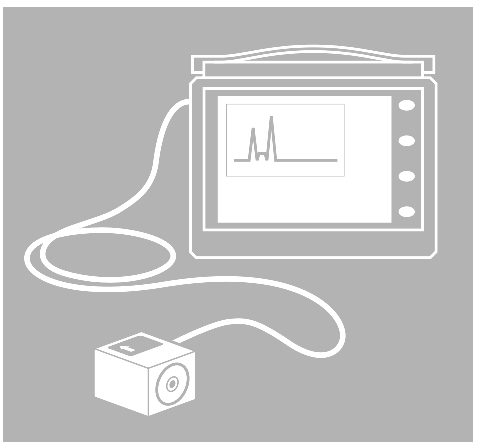
Harshness

Harshness is the condition produced when a tire hits an irregular road surface, such as a pothole or speed bump (1). The degree of impact felt by the driver will depend upon the vehicle suspension. A sports car suspension, is likely to impart a harsher sensation than a luxury sedan. Because harshness is momentary and difficult to isolate, the use of the vibration analyzer for diagnosis is inappropriate. In any case, the source of harshness is usually known. Visual inspection of the location where the symptom originates will usually reveal the faulty component.

NOTES

VEHICLE VIBRATION ANALYSIS



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VIBRATION ANALYZER

Introduction

The Vibration Analyzer locates the cause of vibrations in a vehicle. A transducer mounted on the vehicle and connected to the PTU is used to acquire vibration data during a road test.

Vibrations that occur are normally confined to two areas of the vehicle: the driveline, and wheels and tires. Components in these areas rotate at known speeds, and because speed is related to frequency, it is possible to determine the source of a vibration by analyzing its frequency. This is analysis is performed automatically by the Vibration Analyzer.

Briefly, the Vibration Analyzer calculates the dominant frequencies of the vibration and divides these by engine and/or road speed to obtain a harmonic number for each driveline component. A look-up table of engine and/or road speed, versus the rotational frequency for each driveline component, allows comparison with the harmonic number. When this comparison matches a component, the Vibration Analyzer reveals this as the cause of the vibration.

This technique is commonly used to evaluate Noise Vibration and Harshness (NVH) in vehicles.

NOTES

Transducer

The source of vibrations is located using the PTU and a piezo-electric transducer. The transducer senses vibrations and generates a signal whose voltage is proportional to the vibration.

The transducer has a magnetic base and is designed to be mounted in three axes. During vehicle testing the transducer must be located at the point where the driver experiences the worst vibration. In practice, this means mounting the transducer on the seat rail or the underside of the steering column. In XK8 convertibles, the transducer may also be mounted on the header rail.

Position and Orientation

The transducer must be positioned and oriented where the vibrations are most apparent. Sometimes it will have to be reoriented. Vibrations felt through the driver's seat require the transducer to be first positioned on the seat rail in the longitudinal (fore and aft) axis. If no significant vibrations are detected, new measurements must made with the transducer in the vertical axis. Then, if the new measurements prove to be unsatisfactory, the transducer must be re-oriented to the lateral (sideways) axis and further measurements taken.

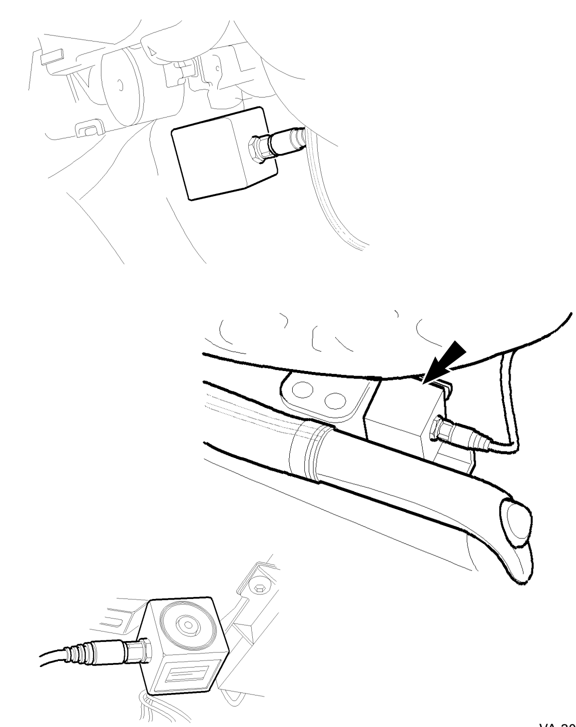
NOTES:

The transducer must be firmly mounted during testing. Failure to observe this precaution will result in the acquisition of corrupt data.

The position and orientation of the transducer must be input to the PTU before any measurements are made.

NOTES

TRANSDUCER MOUNTING LOCATIONS



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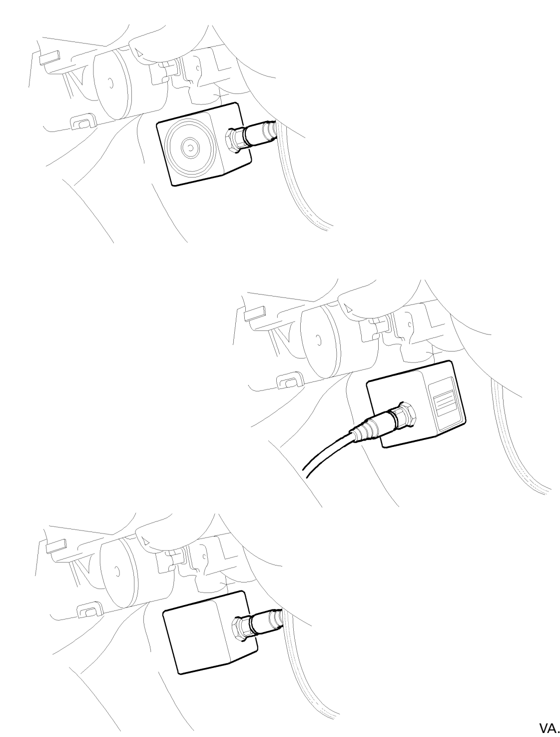
TRANSDUCER ORIENTATION



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VIBRATION ANALYZER

Operating Modes

Driver Only

The main display screen is blanked out for the duration of the test and will not respond to touch until it is safe to do so. The Vibration Analyzer determines when it is safe by checking the gearbox selector lever and handbrake signals.

Driver and Assistant

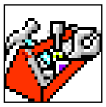
In this mode the Assistant operates the Vibration Analyzer.

Training Mode

Training mode allows you to familiarize yourself with the tool before using it in the service bay or road test environment. Simulated values are used to emulate normal Vibration Analyzer operations without having to connect the PTU to the vehicle.

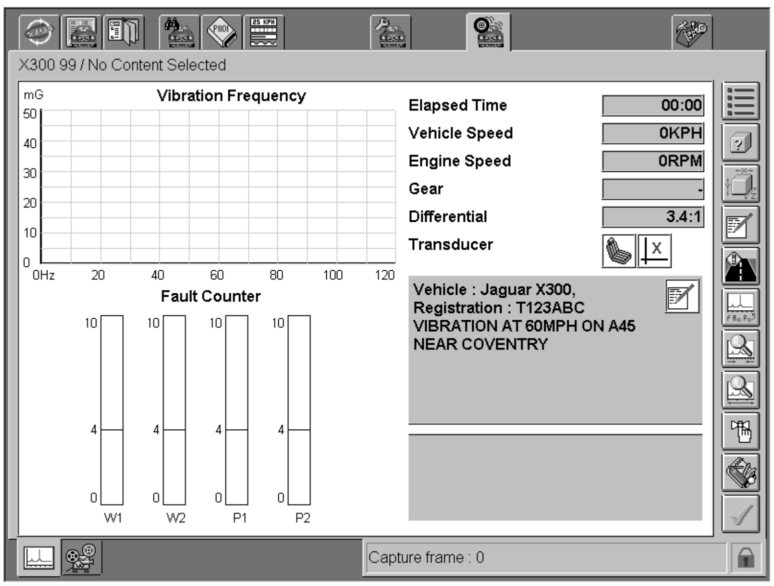
NOTES

Using the Vibration Analyzer



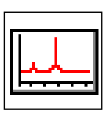
Toolbox Tab
The Vibration Analyzer may be invoked from the Toolbox Menu once the vehicle under test has been identified.

Vibration Analyzer Tab
The Vibration Analyzer tab appears at the top of the screen when you select Vibration Analyzer from the Toolbox menu. Until this tab is selected, the Vibration Analyzer screen will remain blank.

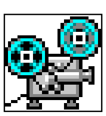


Vibration Analyzer Screen VA.32

The Vibration Analyzer has two sub-tabs:



Live Display sub-tab
The vibration analysis capture and live display sub-tab is always visible.



Playback sub-tab
The vibration analysis playback sub-tab is only visible when stored data is available. Once analysis is started, stored data is cleared and the playback sub-tab is hidden until the analysis screen is exited.

NOTES

VIBRATION ANALYZER

Preparation

When the Vibration Analyzer tab is pressed, you will be presented with a series of screens instructing you on how to connect the PTU to the vehicle and mount the transducer. You will also be presented with vehicle configuration screens and a menu for selecting Driver and Driver and Assistant operation. You must pay particular attention to the warnings which accompany these screens. If there is a Previous Session data file or tagged data files present, the playback sub-tab will appear.

Transducer

Following the guidelines on page 3.3, place the transducer in one of three areas: Steering column, Seat rail or Header rail. Orient the transducer to measure vibrations in the following directions: fore and aft, up and down, left and right.

Vehicle Content

The Vibration Analyzer is automatically configured for the vehicle identified by its VIN number and content. Any changes made to the identified vehicle, will result in the application being shut-down automatically, then re-starting with the new vehicle specification. The previous Vibration Analyzer analysis will then be available for playback.

Road Test

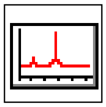
Road test the vehicle under the appropriate conditions. During the test, the Vibration Analyzer continually monitors and captures road speed and vibration data which is processed and presented on the Live Display screen.

WARNING: THE ROAD TEST MUST CONDUCTED BY TWO COMPETENT PERSONS – ONE TO DRIVE THE VEHICLE AND THE OTHER TO OPERATE THE PTU.

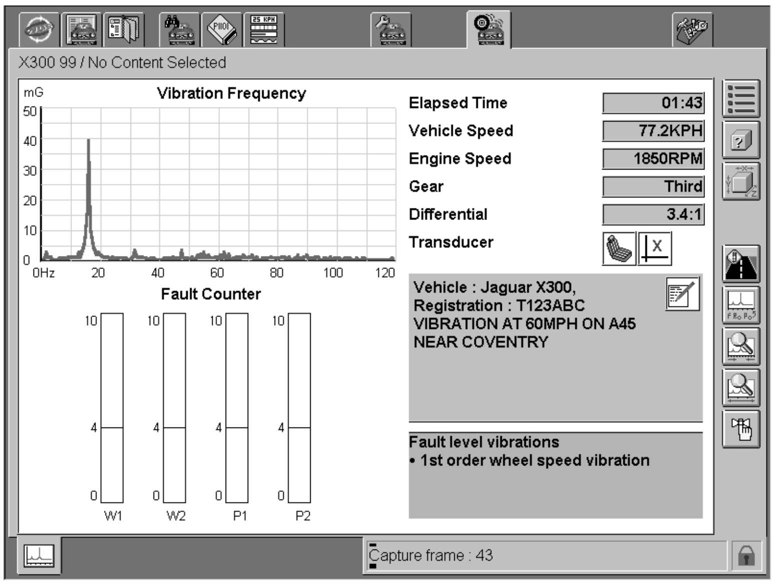
NOTES

Live Display Screen

NOTE: The Live Display screen is only visible in Driver and Assistant mode.



You can view the captured data immediately by pressing the Live Display sub-tab.



Live Display Screen VA.33

Vibration Frequency

The magnitude and frequency of the vibration are displayed in the top left hand quarter of the screen. This is updated every time a new capture is processed (approximately every 2 seconds).

The frequency range may be adjusted to show higher order frequencies, or the axis changed to show wheel speed order or driveshaft order.

Fault Counters

The vertical bar graphs display the number of successive fault conditions detected and indicate the current fault status.

Driveline Information

The driveline information panel in the top right hand quarter of the screen presents the relevant road test driving conditions, such as vehicle speed.

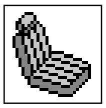
NOTES

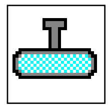
VIBRATION ANALYZER

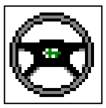
Live Display Screen (continued)

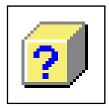
Transducer Location

The location of the transducer is displayed on the screen for the purposes of information. This may change during the course of a test to reflect any change of location.


Seat rail

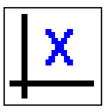

Header rail


Steering column

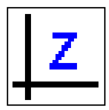


Other

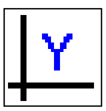
The orientation of the transducer is indicated by X, Y and Z symbols:



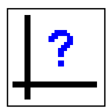
X (fore and aft)



Z (up and down)



Y (left and right)



Other

Vehicle Information

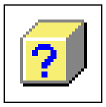
Vehicle information and notes entered by the technician are shown here. Once the Vibration Analyzer has identified the warning condition or fault, a suitable message to this effect is displayed in the results panel.

> **NOTE:** Because “warning condition” is of a lower level of vibration than a “fault” it may be overwritten by a fault message if the vibration increases in severity during the course of the test.

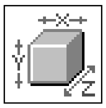
All components that have a fault or warning condition are listed separately.

NOTES

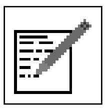
System Buttons



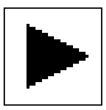
Change Vibration Transducer Location
The selection of this button has no effect on analysis and can be toggled at any time during the road test.



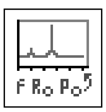
Change Vibration Transducer Orientation
The selection of this button has no effect on analysis and can be toggled at any time during the road test.



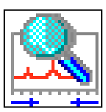
Add/Edit
Select this button to append additional notes and comments relevant to the road test.



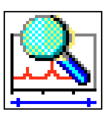
Play
No measurements are taken until this button is pressed. When the button is pressed in Driver Only mode, the screen blanks out as soon as the vehicle starts to move and does not become visible again until the vehicle is stationary. Pressing the button a second time brings measurement and analysis to an end.



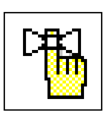
Change Frequency Axis
Press this button to toggle the axis of the trace between frequency and harmonic order. The button only operates in Driver and Assistant mode.



Zoom In
This button magnifies the X-axis of the vibration frequency scale.



Zoom Out
This button decreases magnification of the X-axis of the vibration frequency scale to display a greater frequency range.

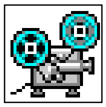


Tag Frame
This button is used to tag a frame so that it may be rapidly recalled for viewing on the Playback screen.

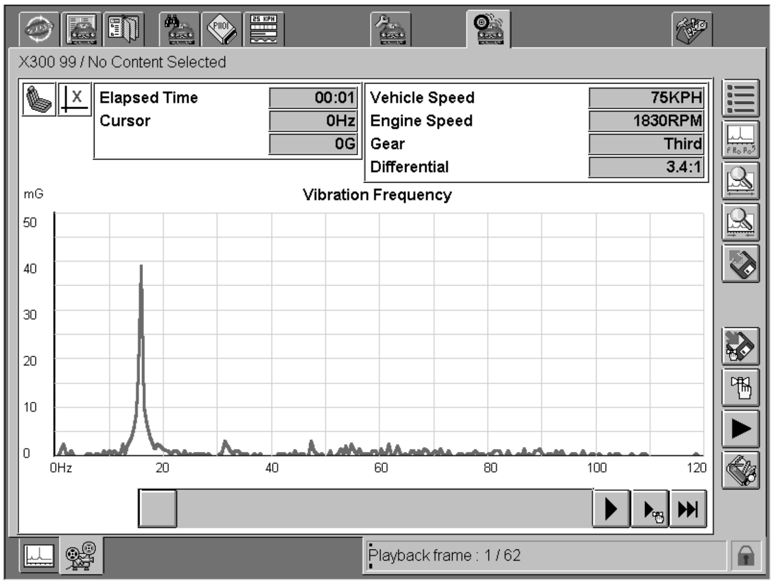
NOTES

VIBRATION ANALYZER

Playback Screen



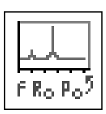
Once a road test is completed, the entire session may be reviewed on the Playback screen.



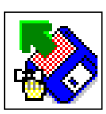
Playback Screen VA.34

If the Vibration Analyzer failed to detect a fault you may scan through capture session frame by frame in order to locate those that appear to indicate the presence of a fault.

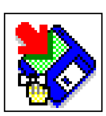
Playback Buttons



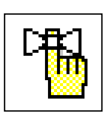
Change Frequency Axis
This performs the same function as the button on the Live Display screen.



Load Tag File
Press this button to load Tagged frames from file.



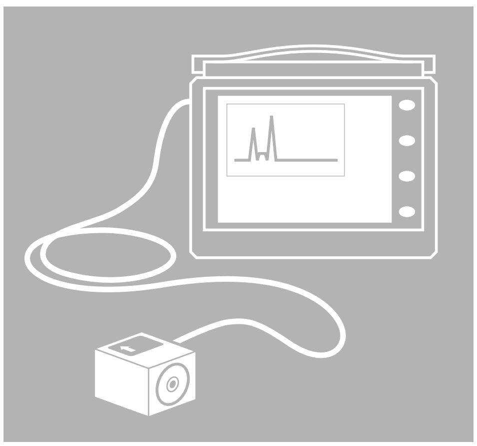
Save Tag File
Press this button save Tagged frames to file.



Tag
Press this button to tag or untag a 2-second Capture frame for export.

NOTES

VEHICLE VIBRATION ANALYSIS



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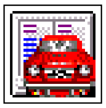
Service Training Course VVA

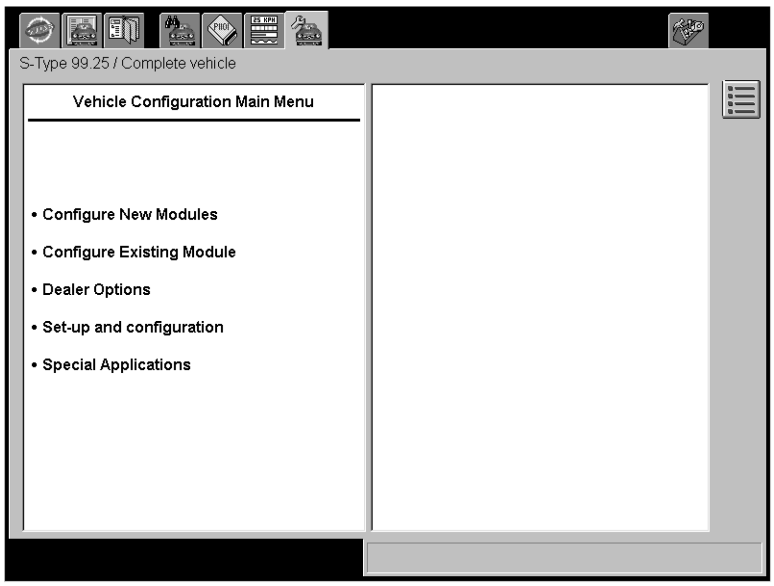
DRIVESHAFT BALANCER

Driveshaft Balancer is configured to suit a named vehicle and is only available after the VIN number has been entered. Balance is achieved by analyzing data acquired simultaneously from vibration and optical sensors mounted on the vehicle. The amount of imbalance is calculated from capturing up to 2000 sample vibrations over a short period of time, typically 800mS.

> **NOTE:** Because the comprehensive help text is deemed sufficient to guide both inexperienced and experienced technicians, no interactive training mode is provided for this application.



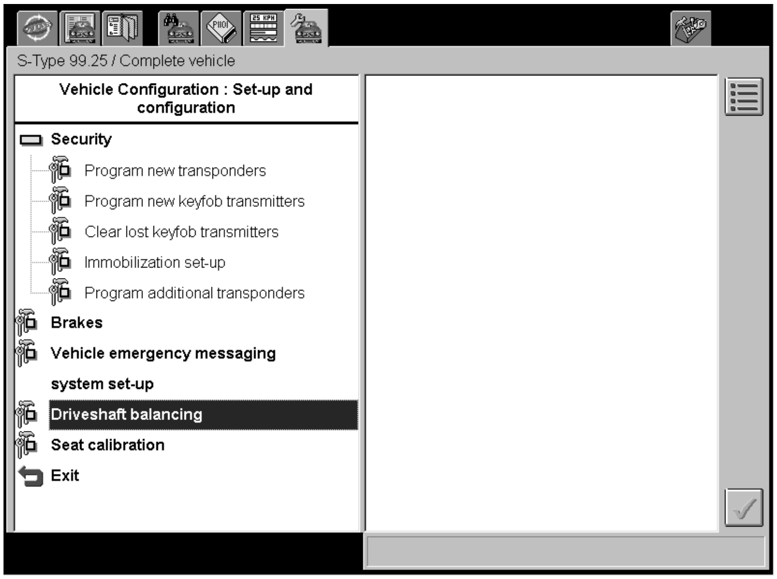
Driveshaft Balancer is launched from the Vehicle Configuration application.



Vibration Configuration Main Menu VA.35

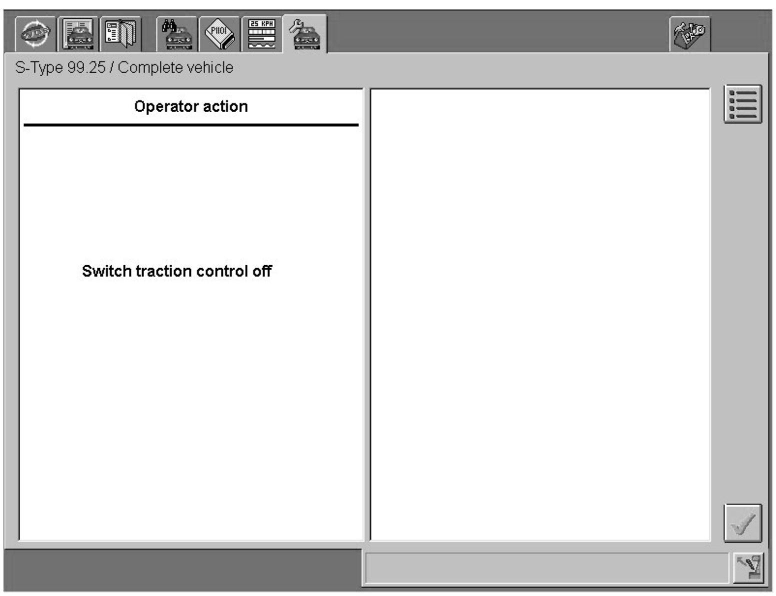
Select Set up and Configuration from the menu.

NOTES



Set Up and Configuration Screen VA.36

Select Driveshaft Balancing and press the tick button. A series of screens instructs you to connect the PTU to the vehicle and mount the vibration transducer and optical transducer. You will also instructed to remove the wheels and raise the vehicle on a ramp.



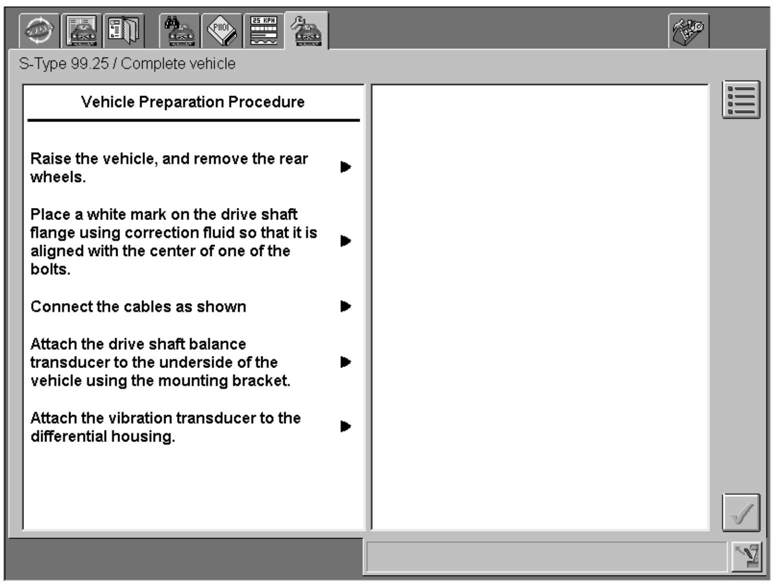
Deactivate Traction Control Screen VA.37

Once preparation is completed, start the engine and inhibit Traction Control. This screen appears only if Traction Control is fitted and activated. The PTU determines this from the vehicle configuration data and by communicating with the vehicle. When you deactivate traction control the PTU verifies the deactivation. If Traction Control is still active, a fault report is displayed and you will be advised to run a traction control switch test. Press the tick button and view the Capture Screen.

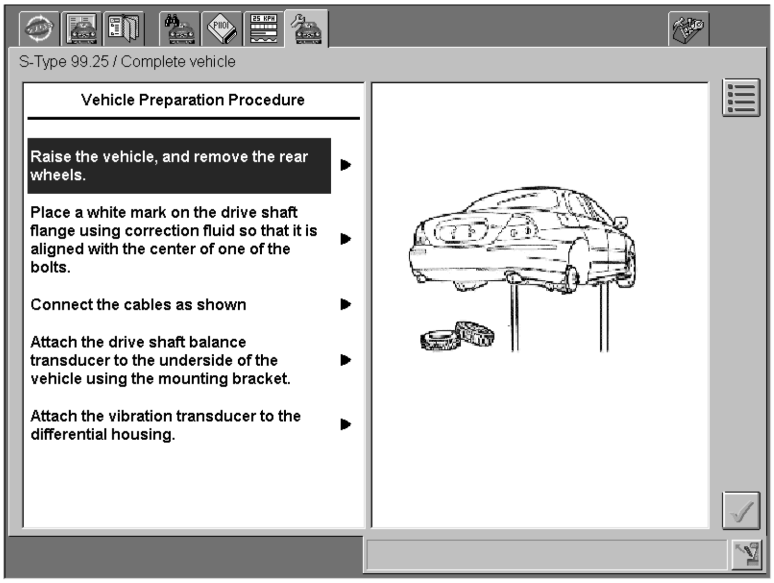
DRIVESHAFT BALANCER

Driveshaft Balancing Procedure: Step-by-Step Guide (S-Type example shown)

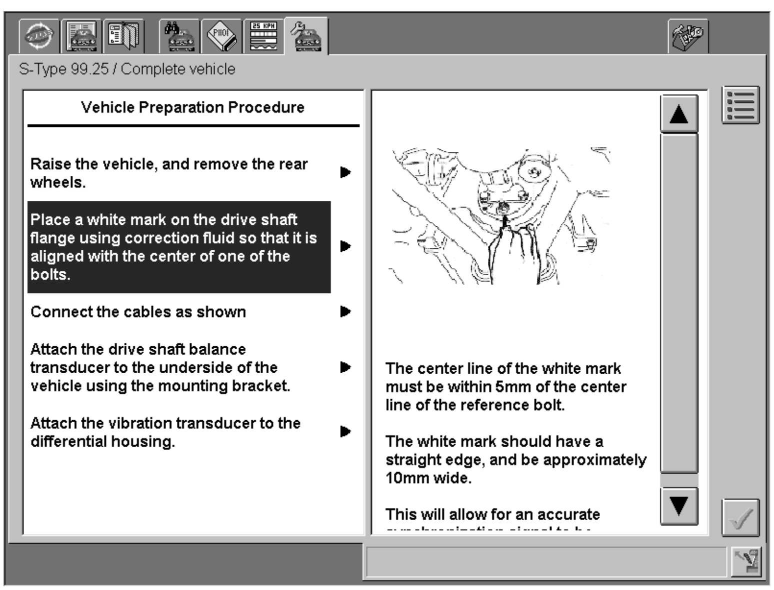
1. Input the VIN and read the data from the vehicle.
2. Select the Vehicle Configuration tab and then select Set Up and Configuration from the Main menu.
3. Select Engine Type (i.e V8).
4. Select Driveshaft Balancing from the Set Up and Configuration menu.
5. Read the Vehicle Preparation Procedure menu.



Vehicle Preparation Procedure Screen VA.38



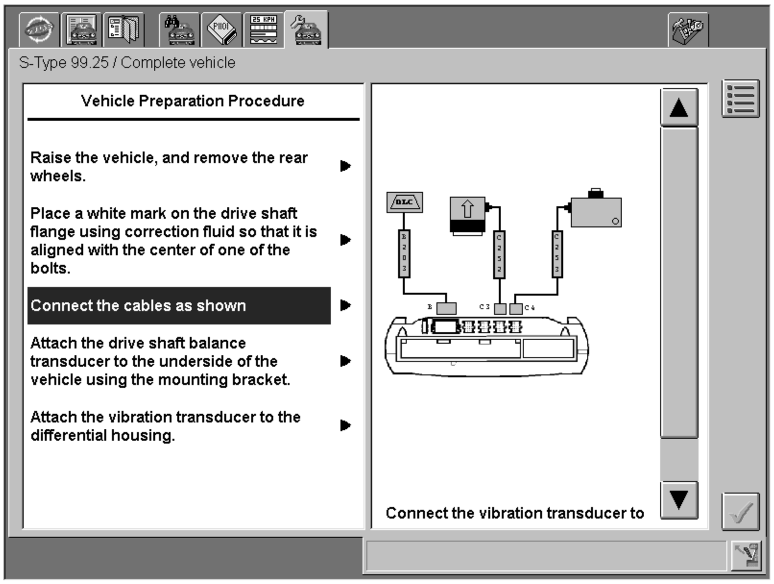
Vehicle Preparation Procedure Screen VA.39



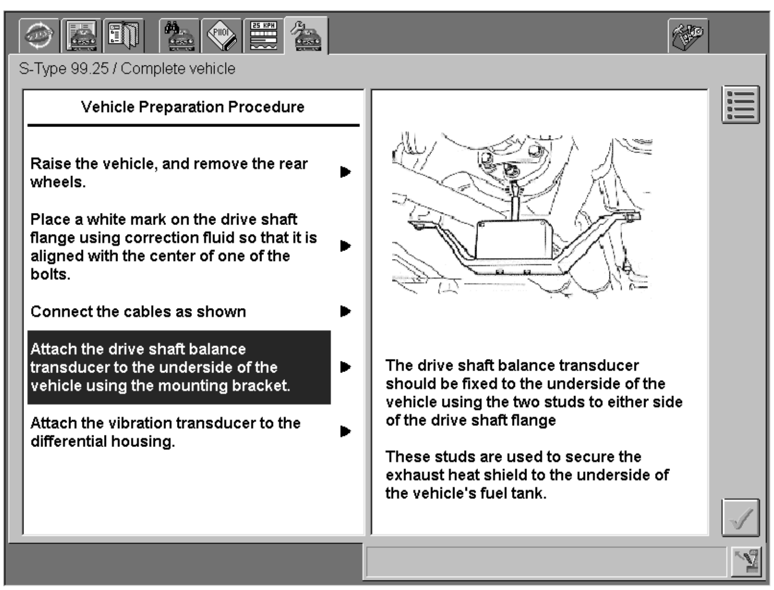
Vehicle Preparation Procedure Screen VA.40

DRIVESHAFT BALANCER

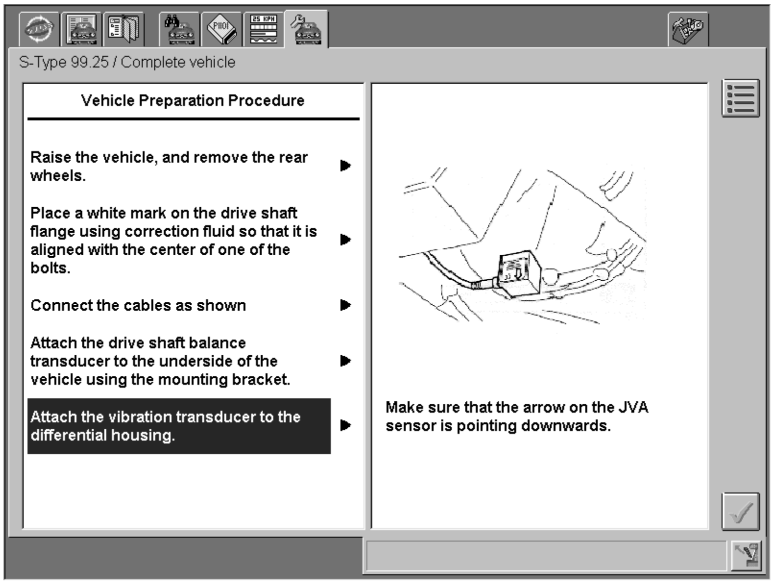
Driveshaft Balancing Procedure: Step-by-Step Guide (S-Type example shown)



Vehicle Preparation Procedure Screen VA.41



Vehicle Preparation Procedure Screen VA.42



Vehicle Preparation Procedure Screen VA.43

DRIVESHAFT BALANCER

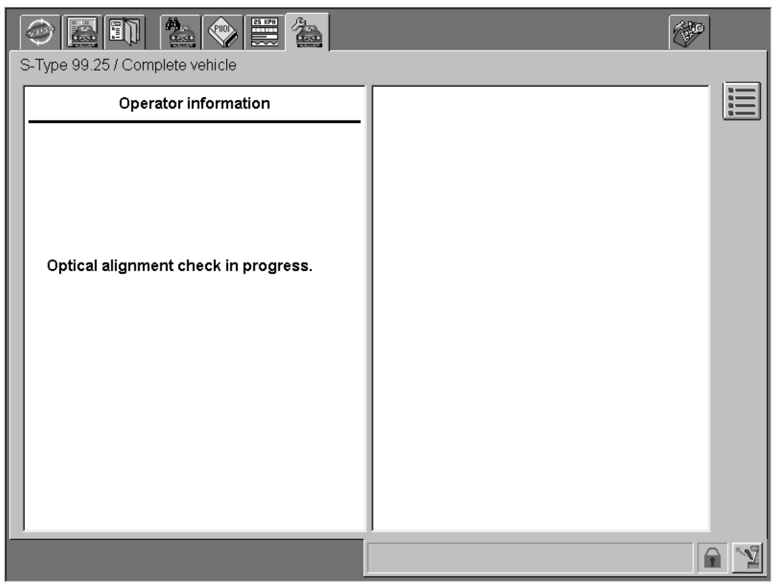
Driveshaft Balancing Procedure: Step-by-Step Guide (S-Type example shown)

6. Follow instructions to start the engine.

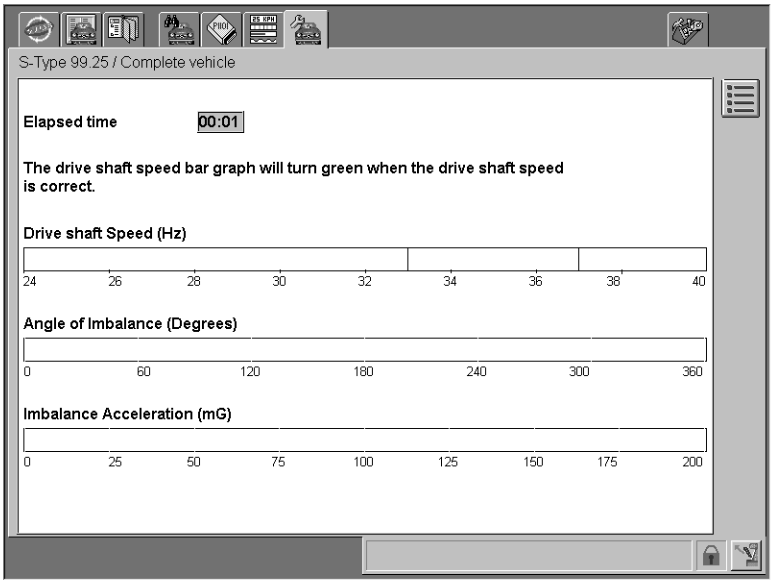
7. Follow instructions to switch off Traction Control.

8. Select Drive
NOTE: Remember to take your foot off the brake pedal.

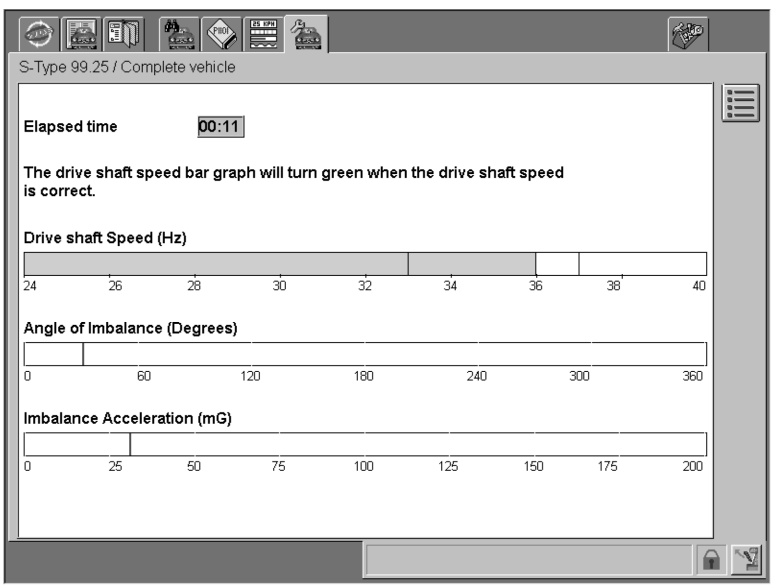
9. Follow instructions.



Operator Information Screen VA.44



Driveshaft Speed Bar Graph Screen VA.45



Driveshaft Speed Bar Graph Screen VA.46

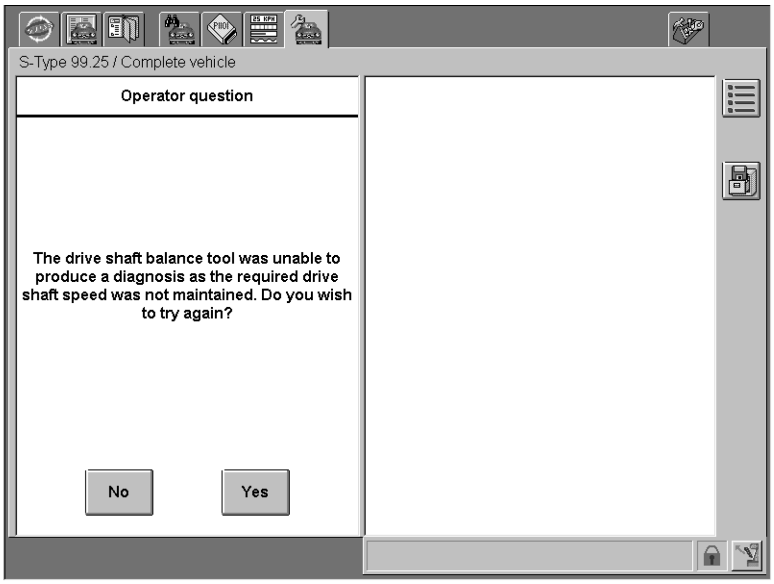
Engine speed equates to capture frequency and must be constant while data is captured. Capture frequency is specific to a vehicle model. On S-Type vehicles the capture frequency of 35Hz is obtained by maintaining the engine speed at 1600 rpm. On other vehicle models the engine may have to run at a different speed to achieve its capture frequency. In all instances, the necessary instructions are given by the PTU. The angle of imbalance and amplitude are displayed as histograms and updated continuously while the engine speed / capture frequency is maintained.

The growing number of captures made during a session is indicated by a bar graph on the status bar. Once sufficient vibration data is acquired it is analyzed and a fault diagnosis is displayed on PTU. The capture screen may be terminated by pressing the tick button.

DRIVESHAFT BALANCER

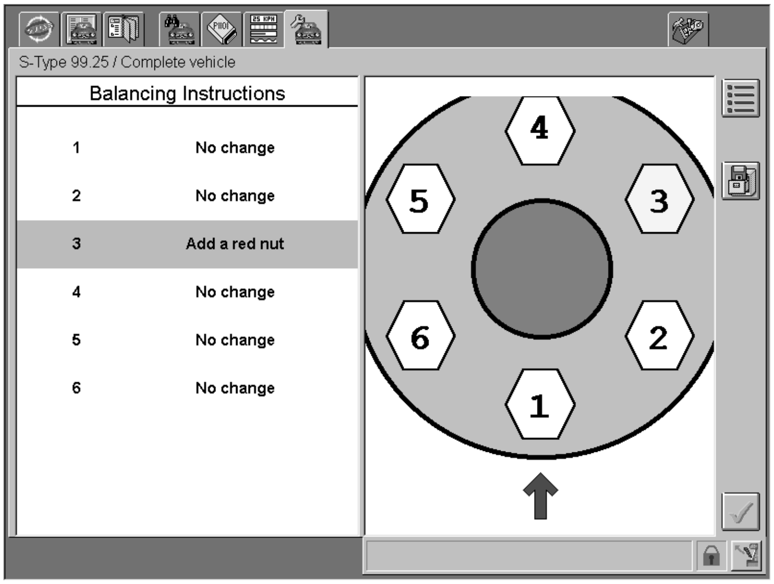
Driveshaft Balancing Procedure: Step-by-Step Guide (S-Type example shown)

10. NOTE: If testing 'times out' (after 60 seconds) the following screen will appear. Select Yes to start the test again.



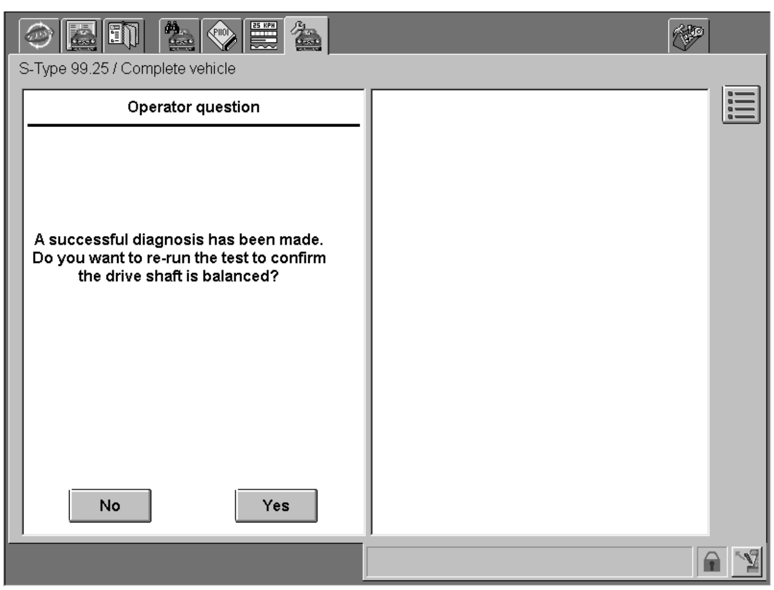
Operator Question Screen VA.47

11. At the end of the test, the following screen will appear.



Balancing Instructions Screen VA.48

At the conclusion of a successful capture session the PTU displays a comprehensive diagnostic report. Fit the appropriate weighted nut to the bolt as instructed to correct the imbalance, then carry out a second capture event to verify the imbalance has reduced or disappeared.



Operator Question Screen VA.49

DRIVESHAFT BALANCER

Warnings, Cautions and Operator Messages

There are a number of error messages which may be communicated via the PTU screen during a session.

Connect Sensor
The PTU performs an identity check on both sensors. If either sensor is disconnected you will be warned which sensor requires connecting.

Traction Control
During the vehicle set-up a check is performed by the PTU to ensure that Traction Control (TC) is inhibited. You find it is virtually impossible to maintain the required capture speed unless this system is switched off. If a problem is encountered in deactivating TC the PTU will instruct you to run a TC switch test.

Optical Sensor Misalignment
The PTU performs an optical sensor alignment check after vehicle set-up. If it fails to receive a signal from the sensor an optical sensor misalignment message is displayed.

Vibration Sensor Saturation
The sensor is designed to detect small vibrations that cause imbalance. If it becomes swamped by excessive vibration 'noise' during a capture session, the PTU will issue a warning message.

Optical Sensor Failure
This message is displayed on the PTU screen if a complete sensor failure occurs during a capture.

Erratic Optical Sensor Signal
This message is displayed if the PTU receives an erratic signal during a capture session.

Failed to Capture
This a 'time-out' message and is displayed if a successful capture and diagnosis is not accomplished within 60 seconds from the start of a session.

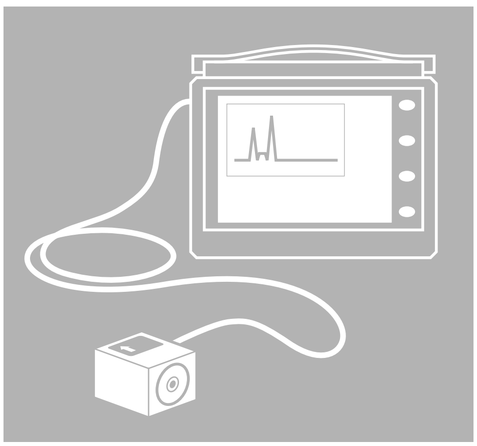
Driveshaft Speed
A fault message is displayed if you fail to maintain engine speed at 1600 rpm while data is being captured.

Check Driveshaft Alignment
The message is displayed if the amplitude of captured samples exceeds the accepted range.

Session Log
All instructions and configuration information together with a summary of the results are logged during a session.

NOTES

VEHICLE VIBRATION ANALYSIS



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Service Training Course VVA

TASK SHEET 1 – WORKSHOP

VIBRATION ANALYZER TRAINING MODE

Complete this Task Sheet to familiarize yourself with the Vibration Analyzer feature of the WDS PTU.

1. Activate the PTU Training Mode.

2. What symbol appears on the PTU screen when Training Mode is activated?

   ____

3. What must first be entered into the PTU in order to launch the Vibration Analyzer program?

   ____

4. Launch the Vibration Analyzer program from Toolbox and follow the onscreen instructions. Answer the next two questions while reading the instructions.

5. What cable is used to link PTU to the DLC? (NOTE: Actual cables are not needed when using Vibration Analyzer in Training Mode.)

   ____

6. Can the PDU JVA transducer yellow cable be used with WDS?

   ____

7. When the configuration screen is displayed, select Two-Man Operation.

8. Select seat rail, fore/aft, 3:07 differential.

9. Select Capture Screen (middle Sub-Tab), then press the Play button to initiate the simulated Vibration Analysis.

10. Highlight one of the four Fault Counter vertical bar graph displays. What are the limits displayed on the waveform display screen?

    ____

    ____

    ____

11. What are the four classifications of vibration represented by the Fault Counters?

    ____

    ____

    ____

    ____

12. When a Fault Counter has registered four ‘red faults’, what ‘Fault Report’ is displayed?

    ____

    ____

    ____

TASK SHEET 2 – WORKSHOP

DRIVESHAFT BALANCER

Complete this Task Sheet during Driveshaft Balancing.

1. Prior to performing Driveshaft Balancing, you must determine that the vibration is in the driveline area. What frequency reading (in Hz) from WDS would indicate that the vibration is in the driveline?

   ____

2. Can Driveshaft Balancer be accessed through Toolbox?

   ____

3. Which Tab is used to access Driveshaft Balancer?

   ____

4. Can the VVA cable C252 be used with Driveshaft Balancer?

   ____

5. Where should the white reference mark be placed?

   ____

   ____

   ____

6. How wide should the white reference mark be?

   ____

7. On S-TYPE vehicles, what should the capture frequency be?

   ____

8. What happens if 60 seconds go by and capture frequency has not been reached?

   ____

   ____

9. Where, other than PTU, can you find information about Driveshaft Balancer?

   ____

10. How many weighted colored nuts are there?

    ____

11. What are the weights of the colored nuts?

    ____

    ____

    ____