TRUE BALANCE IS DYNAMIC

Hundreds of muscles constantly adjust to keep the human body balanced. XACTBalance™ acts in much the same way. Inside each flexible thermoplastic cartridge, media moves freely, targeting the precise location of imbalance and correcting it. No more ugly lead weights. No more massive inventories. Just a clean look and a smooth, environmentally safe ride.

WELCOME TO A NEW DYNAMIC IN WHEEL BALANCING

XACTBalance is protected under U.S. patent 6,979,060. Other U.S. and International patents pending.

INTERNATIONAL MARKETING, INC.
1-800-233-7086
www.xactbalance.com
A Better Way To Get You There™
Resource Guide
January 2006

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XACTBalance Award Winning Performance
XACTBalance, the first lead-free, active wheel weight made for all types and sizes of wheels, is designed to adapt to changing tire and driving conditions. The heart of XACTBalance lies in the thousands of tiny steel beads housed within its flexible thermoplastic shell. These beads move and adjust to changing conditions as the tire rotates, targeting the exact location of the imbalance and correcting it. The result is a more precise and longer-lasting balance.

XACTBalance is an adhesive wheel weight, which means it can be installed without scratching or damaging wheels. Its positioning on the inside of the wheel also offers a cleaner look and secure placement.

'XACTLY ON TARGET: XACTBalance® HONORED WITH SEMA INTERNATIONAL NEW PRODUCT AWARDS
Over 15 years of technical development pays off with patent and latest recognition

January 25, 2006 - IMI’s newest automotive product, XACTBalance®, was recently granted a patent for its unique design and was recognized at the 2005 SEMA Show in the show’s first-ever International New Product Awards.

SEMA - the Specialty Equipment Market Association - represents the $31 billion style, performance, comfort, and convenience automotive product industry. Winners of the SEMA International New Product Awards were selected by a panel of international journalists who reviewed over 1,000 new automotive products introduced at what is considered the automotive industry’s largest specialty equipment trade show. Each journalist chose ten products based on style, performance, and other factors, which were then recognized as award winners.

XACTBalance® WINS “INNOVATION AWARD” AT REIFEN TIRE EXPO
Environmental performance, safety, innovation among award criteria

June 22, 2006 - The accolades for IMI’s newest automotive product keep coming, this time at the Reifen (Tire) Expo 2006 in Essen, Germany. XACTBalance won the Expo’s Innovation Award in the category of Technical/Products. Nominees for the award were chosen by an independent jury on the basis of innovative content, benefit to user, economic efficiency, safety, sustainability, environmental performance and potential for winning and retaining customers.

Reifen is billed by many as the world’s largest international tire expo. This year’s event, held May 23-26, included 473 suppliers from 42 countries and set attendance records with more than 17,000 tire industry participants from 80 countries.

International Marketing, Inc. (IMI), founded in 1973 in Chambersburg, Pa., develops and markets automotive and trucking maintenance products and equipment worldwide. For more information about IMI or XACTBalance, call 1-800-233-7086 or visit www.imiproducts.com.
ABSTRACT
A series of highway and laboratory experiments were performed with XACTBalance, a vibration-reducing tire/wheel product. The purpose of these experiments was to observe how the product behaves dynamically on a wheel, and to explain how it functions to reduce tire/wheel vibration. Videos were created with a wireless camera filming the product at speed on a rotating tire/wheel. The images obtained aided in understanding the mechanism by which tire vibration is reduced. Based on the experimental and video observations, we present a technical explanation of the vibration reduction behavior.

INTRODUCTION
Advances in vehicle design over the last twenty years have been accompanied by reductions in the weight of automotive chassis and suspension systems. The resulting increase in vibration transmission has led to increased complaints about ride harshness and vibration. Reductions in bodywork vibration and interior noise have made passengers more sensitive to road input and chassis vibration [i]. Some vehicle trends have also contributed including: strut suspensions and rack and pinion steering systems that transmit vibration more directly to the passengers, tires with lower aspect ratios, increased sensitivity to road forces, and higher customer expectations about ride quality [ii].

At the same time, advancements in the tire industry have significantly increased the uniformity and repeatability of tire manufacture, reducing the amount of tire/wheel imbalance. This has decreased the importance of vibrations induced by tire/wheel assembly imbalance relative to vibrations induced by other sources such as uneven road surfaces and radial force variation. Historically, lead weight balancing has been the primary means for reducing tire vibrations. Discrete masses are added to the inside and outside rim to balance the offset mass and locate the wheel/tire center of gravity at the center of the axle. However, lead weight balancing does not account for sources of vibration other than mass imbalance. Radial force variation is caused in part by mass imbalance, but also by a host of other factors: tread pattern, radial ply overlap, material stiffness inconsistency, tread and belt splices, component placement, etc [iii]. In this study, we experimentally investigated the effectiveness of XACTBalance in reducing vibrations caused by mass imbalance and these other factors. Transient and periodic tire/wheel vibration has been the subject of intense study [iv] and many dynamic simulations [v,vi,viiviii]. While the focus of this paper is experiments and video observations to understand the mechanism of vibration reduction, the behavior may be simulated with dynamic tire models in future research.

The tire/wheel vibration reducer studied in this experiment is XACTBalance, a product designed to reduce the vibration level of a loaded pneumatic tire in the dynamic or static mode. A quantity of particles is placed inside an extruded plastic cartridge which is located on the wheel in a static or dual plane mode.

The extruded plastic cartridge utilized for this test was produced with a clear resin which allows visibility of the XACTBalance media and its movement during speed changes.
VIDEO EXPERIMENTS AND XACTBALANCE DYNAMIC OBSERVATIONS

To gain further insight into the behavior of XACTBalance on a rotating/vibrating tire/wheel, a wireless camera test fixture was attached to a standard wheel. The wireless camera was mounted opposite the XACTBalance extrusion (Figure 1), and the entire fixture was mass-balanced with the existing wheel balance. With this, the tire/wheel, camera test hardware and XACTBalance resulted in an evenly balanced wheel assembly.

The camera signal was received with an antenna held on a boom outside the right rear cab window of the vehicle (2005 Chevrolet Silverado, see Figure 2). The wheels were 17-inch steel wheel with P265/70R17 tires. The experiment was performed on the right rear wheel position.

The experiments were performed in darkness to achieve continuous resolution between the XACTBalance extrusion and the background. Lights and rechargeable batteries were mounted on the test fixture to illuminate the extrusion chamber (Figure 3).

When the vehicle was stopped, the XACTBalance material was at rest in a position determined by the roll of the tire when it came to a stop (Figure 4). Next, the vehicle was accelerated up to 65 MPH and held at constant speed. The wireless camera recorded the XACTBalance behavior during the acceleration and at constant speed. The material was observed to move freely within the extrusion chamber when the vehicle started to accelerate.
When a certain speed was reached, the XACTBalance material came to equilibrium at a steady-state position and remained there as the vehicle held a constant speed of 65MPH (Figure 5).
Additional videos were taken of the XACTBalance behavior at changing speeds. The vehicle was accelerated up to 65 MPH and held at constant speed. The XACTBalance material assumed an equilibrium position similar to the previous constant speed test (Figure 6). Then, the vehicle was accelerated to 72 MPH and held at constant speed. The observation was somewhat limited by resolution of the dynamic video, but the XACTBalance material shifted slightly to the left. This indicates that the material was shifting to a new “dynamically balanced” equilibrium position after the speed change. The shift in equilibrium position would be required by a change in radial force variation, and could not be achieved with a standard lead weight balance.

Figure 6 XACTBalance behavior at 65MPH (top) and 72MPH (bottom)


Comparative Test Data
XACTBalance improves ride performance and is a replacement for lead wheel weights as a method for balancing all types of vehicle wheel assemblies. XACTBalance provides true dynamic balancing because of the media inside which is dimensionally controlled. The media is able to adapt to speed, air pressure and temperature changes; whereas a lead weight, or any solid mass, cannot respond or adapt to these changes in the tire footprint.

On A Balancer

Points A, B and C represent the tire footprint while the lines in the upward direction represent vibration force vector frequencies that travel through the tire/wheel assembly in the direction illustrated. The lead weight is addressing only one of these vector frequencies.

On The Highway

Tire is balanced in a free-rolling state. Addresses imbalance at point B.

With XACTBalance, these vibration vector frequencies are more adequately addressed due to its dimensions and the dynamic media within it.

The acrylic adhesive tape used on XACTBalance meets specifications by several major OEMs and is rated for temperatures from -30° to 200° F and is a proven vibration damper.

IMI guarantees XACTBalance Dynamic Wheel Weights to be fit and in form for the purpose intended as outlined and described within the XACTBalance brochure.

XACTBalance is an average of twice the length of conventional lead weights. As the above diagrams illustrate, it can compensate for tire/wheel imbalance over a broader area on the wheel.
COMPARATIVE DATA TESTING

<table>
<thead>
<tr>
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<tr>
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XACTBalance comparative dynamometer testing at speeds of 65 and 75 mph recorded vibration measurements with a lead weight dual plane balance and the same wheel assembly was run at the same two speeds with XACTBalance in a single plane mode balance.

The above listed vertical vibration measurements (in Newtons) show that XACTBalance significantly reduced vibration levels of the tire/wheel assembly in comparison to a dual plane lead weight balance.

“A New Dynamic in Wheel Balancing.”
U. S. patent # 6,979,060. Other U. S. and international patents pending.

INTERNATIONAL MARKETING, INC.
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Toll Free: 800-233-7086 •
E-mail: imi@imiproducts.net • Web Site: www.imiproducts.com
SUMMARY RESULTS

SINGLE-PLANE ACTIVE BALANCING EXTRUSIONS

April 15-16, 2004

Dynamometer Fixed-Axle Testing
and
On-Vehicle Dynamometer Testing

Tire: LT 225/75R16 Firestone Steeltex Radial R4S
and
Tire: P215/70R15 General Ameri GS60

Report Prepared by KCF Technologies, Inc. (State College, PA)
A road test was performed to document the ability of XACTBalance Weights to perform tire/wheel balancing and to compensate for simulated imbalance on a tire/wheel assembly. These tests were performed on the fixed-axle dynamometer load axle at Bridgestone/Firestone’s Akron Technical Center in Akron, OH. A summary of the results, with numeric tables and graphical representation, is contained. The data tables and charts are contained in the supplementary files “2004 04 05 TEST RESULTS….xls”. Specific information about the experimental set-up and test situations are included in the files titled “Test Description (date).xls”. This includes information about the accelerometers and the data acquisition system, including the frequency range, frequency resolution, window, etc.

**General Experiment Description**

A Kistler bi-directional load cell, mounted on a fixed-axle with variable load was used to acquire force vibration data induced by the rolling tire at various speeds and loads. A series of balance methods were applied to the tire/wheel, and each set-up was tested at speeds of 65 and 75 MPH, and loads of 1000 and 1500 lbs. The vibration of interest was measured at the tire/wheel rotation frequency (fundamental) and its multiples. The peak frequencies analyzed at 65 MPH were:

- 13.0 Hz Fundamental (1/rev) tire/wheel induced vibration
- 26.0 Hz 2X Harmonic
- 39.0 Hz 3X Harmonic
- 52.0 Hz 4X Harmonic
- 65.0 Hz 5X Harmonic
- 78.0 Hz 6X Harmonic
- 91.0 Hz 7X Harmonic
- 114.0 Hz 8X Harmonic

A typical frequency spectrum of the vertical axle vibration (right front) is shown (Figure 1). The dominant peak was the fundamental 1/rev vibration at 13.0 Hz.

![Figure 1 Typical vibration spectrum at the front right axle at 65 MPH](image-url)
**Capacity of the XACTBalance Weight to compensate for simulated imbalance at a position 180 degrees from the XACTBalance Weight location**

Vibration measurements were taken with a single-plane balance using lead tape-on weights. Then, a series of intentional imbalance weights (0.5, 1.0 and 1.5 oz.) were added on the outside wheel flange at a position 180 degrees opposite the tape-on weight. The positions of all weights were marked to ensure repeatability. For each imbalance weight location, vibration measurements were taken at four combinations of speed and axle load.

The data from this experiment is shown in Table 3. Vertical vibration force (in Newtons) at the fundamental (1/rev) frequency is shown for each test scenario. A data table is shown for both the vertical (z-direction) and the fore-aft (y-direction) vibration. For each direction, values are also shown for the vibration level averaged over the four speed and load combinations. XACTBalance showed a vertical vibration equal to the lead tape-on weight. More importantly, XACTBalance showed significantly lower vibration levels compared to the lead weight when the 0.5 oz., 1.0 oz, and 1.5 oz. imbalance weights were added. This was interpreted as evidence that the XACTBalance weight was compensating for the simulated imbalance. Similar behavior was observed in the Fore-Aft direction, except that the XACTBalance also showed lower vibration than the lead tape-on weight with zero added imbalance.

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<th>SINGLE-PLANE TAPE WTS</th>
<th>XACTBalance WEIGHT</th>
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<td>0.5 OZ</td>
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<td>1.5 OZ</td>
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Table 3 Data for compensation of the XACTBalance to simulated imbalance

CONFIDENTIAL
Comparison of Dual Plane Lead Weight Balance vs. XACTBalance Media and Extrusion Dimensions

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</table>
TO: Bob Fogal, Jr.
FROM: James A. Popio
DATE: October 30, 2006
SUBJECT: Summary of F&M Uniformity

Dear Bob:

Earlier in 2006, we were asked to provide flat surface uniformity data like that which had been done years earlier, to evaluate tire assembly balancing techniques. IMI provided the tires and applied various balance techniques to the tires during the full day of testing. Data was recorded for all of the tire wheel assembly combinations.

Assemblies were run at two loads (600 lbs & 900 lbs) and two speeds (65 mph & 72 mph). An MTS Flat Trac III was used to record the data. The Flat Trac is NOT a “standard” tire uniformity machine. The Flat Trac has the following specifications:

- Tire OD = 910 mm
- Tire Width = 450 mm
- Lateral Force (Fy) = 15,000 N
- Longitudinal Force (Fx) = 10,000 N
- Radial Force (Fz) = 25,000 N
- Overturning Moment (Mx) = 10,000 Nm
- Aligning Moment (Mz) = 1000 Nm
- Camber = -12 to 45°
- Loaded Radius = 200 to 475 mm
- Slip Angle = ±28°
- Spindle torque Max = 2000 Nm (Drive/Brake)

* MTS reported Force and Moment accuracy is +/- 1% of full scale

The test method included the following measurements. The overall balance data was measured by accelerating the tire to 90 mph, and then the tire was removed
from the roadway to allow it to spin freely. Four assembly rotations of data were collected on this free spinning tire that was used to calculate the BALANCE data of the assembly, which is the maximum force minus the minimum force. These calculations were made for clockwise and counterclockwise rotation, and for radial, lateral and tangential force directions. Balance data can be used in processing the data.

The other uniformity measurements were made at each of the two loads (600 lbs & 900 lbs) and at each of the two speeds (65 mph & 72 mph). Four assembly rotations were taken at each of the load speed combinations. The force variation (FV) was calculated by subtracting the maximum force from the minimum force. In addition, the force values at the first 10 harmonic frequencies were calculated using Fourier analysis. These calculations were made for clockwise and counterclockwise rotation, and for radial, lateral and tangential force directions.

Sincerely,

James A. Popio, Ph.D.

Technical Director

Every precaution was taken to ensure the accuracy of the data provided. The results and/or Smithers name, trademarks, and/or logos are not to be used for advertising or promotional purposes without Smithers’ prior written consent, which Smithers may withhold at its sole and absolute discretion. Pursuant to any discovery or legal action arising out of the use of the data and/or services provided by Smithers, IMI Products agrees to compensate Smithers for all professional fees, legal fees, and expenses incurred.

IMI Products agrees to indemnify and hold Smithers harmless from and against any and all claims, liabilities, damages, defense costs, including, without limitation, attorney’s fees and disbursements, and other expenses incurred as a result of or in connection with any third party claim arising out of or relating to (a) a product, service, process, operation, or activity of IMI Products, or (b) the services rendered by Smithers to IMI Products; provided, however, that to the extent that liability for the claim is acknowledged by Smithers or determined by a final, nonappealable order of a court of competent jurisdiction to have been the result of Smithers’s negligence, Smithers shall only be entitled to indemnification for liabilities, damages, costs, and expenses in excess of the value of the services negligently provided.
### Standard Dual Plane Lead Weight Balance

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### XACTBalance Single Plane Center of Wheel

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<th>Radial 900 lbs 65 mph</th>
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### XACTBalance Single Plane at Innermost Position on the Wheel at the Bead Area

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<th>Radial 600 lbs 72 mph</th>
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<tr>
<td>2H</td>
<td>0.68</td>
<td>0.94</td>
<td>1.08</td>
<td>1.46</td>
</tr>
<tr>
<td>3H</td>
<td>3.07</td>
<td>3.40</td>
<td>3.31</td>
<td>4.09</td>
</tr>
<tr>
<td>4H</td>
<td>6.69</td>
<td>7.01</td>
<td>6.20</td>
<td>6.84</td>
</tr>
<tr>
<td>5H</td>
<td>2.07</td>
<td>2.29</td>
<td>2.58</td>
<td>2.87</td>
</tr>
<tr>
<td>6H</td>
<td>1.66</td>
<td>1.54</td>
<td>1.40</td>
<td>1.38</td>
</tr>
<tr>
<td>7H</td>
<td>2.12</td>
<td>1.09</td>
<td>2.68</td>
<td>1.02</td>
</tr>
<tr>
<td>8H</td>
<td>0.72</td>
<td>0.20</td>
<td>0.86</td>
<td>0.16</td>
</tr>
<tr>
<td>9H</td>
<td>0.18</td>
<td>0.17</td>
<td>0.35</td>
<td>0.17</td>
</tr>
<tr>
<td>10H</td>
<td>0.13</td>
<td>0.07</td>
<td>0.34</td>
<td>0.23</td>
</tr>
<tr>
<td>FV</td>
<td>33.15</td>
<td>39.64</td>
<td>34.08</td>
<td>37.97</td>
</tr>
</tbody>
</table>
OBJECTIVE:
Determine if and to what degree XactBalanced wheels (single-plane balance) reduce the affect of wheel couple imbalance on vibration transmitted to the vehicle relative to dual-plane balanced wheels. The influence of the lateral location of XactBalance is also to be examined.

Method:
1. Instrument a 2004 Nissan Maxima with tri-axial accelerometers located on the front suspension swing-arms.
2. Dual-plane balance the front wheels with lead weight and acquire baseline acceleration levels from which to compare XactBalance.
3. Single-plane balance the front wheels with XactBalance located in the center of the rim.
4. Note the residual static couple imbalance of the wheels.
5. Road test the vehicle and acquire acceleration levels for the same test conditions that were used for the dual-plane balance test.
6. Repeat steps 3) – 5) for XactBalance located at the far inside of the rim.
7. Repeat steps 3) – 5) for XactBalance located at the far outside of the rim.
8. For XactBalance located in the center of the wheel, add additional couple imbalance to the wheels.
9. Road test the vehicle and acquire acceleration levels for the same test conditions that were used for the dual-plane balance test.
10. Repeat steps 8) - 9) until the acceleration levels are worse than the dual plane balance case.

Notes:
1. It is difficult to implement a measurement method that isolates the influence of the couple imbalance on the vibration transmitted to the vehicle.
2. The fore/aft, vertical, and lateral acceleration levels in the swing-arm all will be affected by a couple imbalance due to the boundary conditions imposed on the wheels.
3. Monitoring the fore/aft, vertical, and lateral acceleration levels on the swing-arm is a sufficient method for determining the influence of the couple imbalance on the vibration levels transmitted to the vehicle.

Setup:
1. A tri-axial accelerometer is epoxy bonded to a vertical surface on the suspension (in this case, the "knuckle").
2. The mounting location is chosen to be on a smooth surface free of rotating equipment, and one that is as close as possible to the wheel hub. A picture of the location on a previous test with the Maxima test is shown. NOTE: the duct-tape is used as a precaution only; the accelerometer is fixed with epoxy/superglue.
3. The accelerometer signal in all three (Vertical, Fore-Aft, and Lateral) directions is acquired in a 0-200 Hz bandwidth with a signal analyzer.
4. The FFT spectrum is averaged over 18 averages, which cover approximately 1 mile of highway travel.
5. The reported data is the peak in the acceleration FFT spectrum at the 1/rev fundamental frequency. The acceleration is reported in average peak amplitude in g's (where one "g" corresponds to 9.81 m/s^2).

⇒ NOTE: The test setup described here is for vibration measurements of the suspension arms as measured with an accelerometer and expressed in g's (units of acceleration). Other testing (i.e. on a fixed-axle) measures Force, as expressed in N (Newtons, units of force).

EXPERIMENTAL RESULTS:

<table>
<thead>
<tr>
<th>Average Couple Imbalance</th>
<th>Wheel</th>
<th>Location of XactBalance</th>
<th>Vertical</th>
<th>Fore/Aft</th>
<th>Lateral</th>
<th>Average over all directions</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.43</td>
<td>Left Front</td>
<td>Far Outside</td>
<td>33%</td>
<td>17%</td>
<td>-1%</td>
<td>17%</td>
</tr>
<tr>
<td>1.13</td>
<td>Left Front</td>
<td>Center</td>
<td>55%</td>
<td>-4%</td>
<td>4%</td>
<td>18%</td>
</tr>
<tr>
<td>2.00</td>
<td>Right Front</td>
<td>Far Outside</td>
<td>30%</td>
<td>27%</td>
<td>27%</td>
<td>28%</td>
</tr>
<tr>
<td>2.00</td>
<td>Right Front</td>
<td>Center</td>
<td>32%</td>
<td>33%</td>
<td>21%</td>
<td>28%</td>
</tr>
<tr>
<td>2.38</td>
<td>Right Front</td>
<td>Far Inside</td>
<td>48%</td>
<td>18%</td>
<td>22%</td>
<td>29%</td>
</tr>
<tr>
<td>2.88</td>
<td>Left Front</td>
<td>Far Inside</td>
<td>51%</td>
<td>36%</td>
<td>26%</td>
<td>38%</td>
</tr>
<tr>
<td>4.00</td>
<td>Right Front</td>
<td>Center w/added imbalance</td>
<td>41%</td>
<td>-44%</td>
<td>10%</td>
<td>2%</td>
</tr>
<tr>
<td>4.50</td>
<td>Left Front</td>
<td>Center w/added imbalance</td>
<td>7%</td>
<td>-58%</td>
<td>-2%</td>
<td>-18%</td>
</tr>
</tbody>
</table>

Notes:
1. The couple imbalance is for stick-on weight located in the inside of the rim.
2. Negative reductions in acceleration correspond to increases relative to the dual-plane balanced wheel.
**DATE:** 10-Jul-06  
**TEST:** ASPHALT CHAMBERSBURG TO SCOTLAND  
**Road Test:** I-81 CHAMBERSBURG  
**SPEED:** 72  
**Vehicle:** NISSAN MAXIMA  
**YEAR:** 2004  
**Mileage:** 9754  
**vehiclen:** 1n4ba41e24c914199  
**REC PSI:** 35 COLD TEST PS 38 WARM  
**Tires:** Goodyear Eagle RS-A  
**Start Time:** 10:07  
**FILENAME:** 1BBN0  
**FILE SET:** Fund  
**TIRE SET:** Fund  
**CH1 LFX:** DPB  
**AVG:** 0.133  
**N:** 0.145  
**0.126**  
**0.125**  
**0.135**  
**S:** 0.131  
**0.118**  
**0.134**  
**0.170**  
**DPB:** Dual-plane balance with lead weights  
**RF:** 1.25 oz stick-on outside  
**LF:** 3.5 oz stick-on outside, 0.5 oz stick-on inside  
**A1:** XactBalance at center of rim  
**RF:** 1.0 oz XactBalance center, Couple imbalance calls for 2.0 oz & 2.0 oz stick-on  
**LF:** 2.75 oz XactBalance center, Couple imbalance calls for 1.0 oz & 1.25 oz stick-on  
**A2:** XactBalance at far outside of rim  
**RF:** 1.0 oz XactBalance center, Couple imbalance calls for 2.0 oz & 2.0 oz stick-on  
**LF:** 2.75 oz XactBalance center, Couple imbalance calls for 0.5 oz & 0.35 oz stick-on  
**A3:** XactBalance at far inside of rim  
**RF:** 1.0 oz XactBalance center, Couple imbalance calls for 2.25 oz & 2.5 oz stick-on  
**LF:** 2.75 oz XactBalance center, Couple imbalance calls for 3.0 oz & 3.0 oz stick-on  
**A4:** XactBalance at center of rim; Add lead stick-on weight to increase couple imbalance, Single plane balanced  
**RF:** 1.0 oz XactBalance center, 4.0 oz added in 2 places, Couple imbalance calls for 3.75 oz & 4.25 oz stick-on  
**LF:** 3.25 oz XactBalance center, 4.0 oz added in 2 places, Couple imbalance calls for 4.25 oz & 4.75 oz stick-on

**CH2 LFY:** DPB  
**AVG:** 0.017  
**N:** 0.014  
**0.016**  
**0.017**  
**S:** 0.015  
**0.015**  
**0.022**  
**DPB:** Dual-plane balance with lead weights  
**RF:** 1.0 oz XactBalance center, Couple imbalance calls for 2.0 oz & 2.0 oz stick-on  
**LF:** 2.75 oz XactBalance center, Couple imbalance calls for 1.0 oz & 1.25 oz stick-on  
**A1:** XactBalance at center of rim  
**RF:** 1.0 oz XactBalance center, Couple imbalance calls for 2.0 oz & 2.0 oz stick-on  
**LF:** 2.75 oz XactBalance center, Couple imbalance calls for 0.5 oz & 0.35 oz stick-on  
**A2:** XactBalance at far outside of rim  
**RF:** 1.0 oz XactBalance center, Couple imbalance calls for 2.0 oz & 2.0 oz stick-on  
**LF:** 2.75 oz XactBalance center, Couple imbalance calls for 0.5 oz & 0.35 oz stick-on  
**A3:** XactBalance at far inside of rim  
**RF:** 1.0 oz XactBalance center, Couple imbalance calls for 2.25 oz & 2.5 oz stick-on  
**LF:** 2.75 oz XactBalance center, Couple imbalance calls for 3.0 oz & 3.0 oz stick-on  
**A4:** XactBalance at center of rim; Add lead stick-on weight to increase couple imbalance, Single plane balanced  
**RF:** 1.0 oz XactBalance center, 4.0 oz added in 2 places, Couple imbalance calls for 3.75 oz & 4.25 oz stick-on  
**LF:** 3.25 oz XactBalance center, 4.0 oz added in 2 places, Couple imbalance calls for 4.25 oz & 4.75 oz stick-on

**CH3 LFZ:** DPB  
**AVG:** 0.017  
**N:** 0.092  
**0.094**  
**0.095**  
**S:** 0.052  
**0.052**  
**0.137**  

**CH4 RFX:** DPB  
**AVG:** 0.146  
**N:** 0.156  
**0.154**  
**0.134**  

**CH5 RFY:** DPB  
**AVG:** 0.098  
**N:** 0.027  
**0.028**  
**S:** 0.027  

**CH6 RFZ:** DPB  
**AVG:** 0.097  
**N:** 0.087  
**0.092**  
**S:** 0.124  

**DPB:** Dual-plane balance with lead weights  
**RF:** 1.25 oz stick-on outside  
**LF:** 3.5 oz stick-on outside, 0.5 oz stick-on inside  
**A1:** XactBalance at center of rim  
**RF:** 1.0 oz XactBalance center, Couple imbalance calls for 2.0 oz & 2.0 oz stick-on  
**LF:** 2.75 oz XactBalance center, Couple imbalance calls for 1.0 oz & 1.25 oz stick-on  
**A2:** XactBalance at far outside of rim  
**RF:** 1.0 oz XactBalance center, Couple imbalance calls for 2.0 oz & 2.0 oz stick-on  
**LF:** 2.75 oz XactBalance center, Couple imbalance calls for 0.5 oz & 0.35 oz stick-on  
**A3:** XactBalance at far inside of rim  
**RF:** 1.0 oz XactBalance center, Couple imbalance calls for 2.25 oz & 2.5 oz stick-on  
**LF:** 2.75 oz XactBalance center, Couple imbalance calls for 3.0 oz & 3.0 oz stick-on  
**A4:** XactBalance at center of rim; Add lead stick-on weight to increase couple imbalance, Single plane balanced  
**RF:** 1.0 oz XactBalance center, 4.0 oz added in 2 places, Couple imbalance calls for 3.75 oz & 4.25 oz stick-on  
**LF:** 3.25 oz XactBalance center, 4.0 oz added in 2 places, Couple imbalance calls for 4.25 oz & 4.75 oz stick-on
**DATE:** 7/10/2006  
**TEST:** ASPHALT CHAMBERSBURG TO SCOTLAND  
**Road Test** I-81 CHAMBERSBURG  
**Vehicle:** NISSAN MAXIMA  
**Mileage:** 9754  
**VIN:** 1n4ba41e24c91419  
**YEAR:** 2004  
**FRNT:** 2469  
**REAR:** 2097  
**GVWR:** 4546  
**Mileage:** 9754  
**REC PSI:** 35 COLD  
**TEST PSI:** 38 WARM

### Vehicle Information
- **Vehicle:** NISSAN MAXIMA  
- **Year:** 2004  
- **Mileage:** 9754  
- **Vin:** 1n4ba41e24c91419

### Test Details
- **Speed:** 72  
- **Gvwr:** 4546  
- **Rec Psi:** 35 Cold  
- **Test Psi:** 38 Warm

### Tire Details
- **Tires:** Goodyear Eagle RS-A P245/45R18

### Test Results

<table>
<thead>
<tr>
<th>Dual-plane lead</th>
<th>Center (A1) w/ increase couple imbalance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RIGHT FRONT</strong></td>
<td></td>
</tr>
<tr>
<td>Couple Imbalance (oz)</td>
<td>0</td>
</tr>
<tr>
<td>VERTICAL vibration (g)</td>
<td>0.097</td>
</tr>
<tr>
<td>FORE/AFT vibration (g)</td>
<td>0.145</td>
</tr>
<tr>
<td>LATERAL Average vibration (g)</td>
<td>0.028</td>
</tr>
<tr>
<td><strong>LEFT FRONT</strong></td>
<td></td>
</tr>
<tr>
<td>Couple Imbalance (oz)</td>
<td>0</td>
</tr>
<tr>
<td>VERTICAL vibration (g)</td>
<td>0.104</td>
</tr>
<tr>
<td>FORE/AFT vibration (g)</td>
<td>0.133</td>
</tr>
<tr>
<td>LATERAL Average vibration (g)</td>
<td>0.017</td>
</tr>
</tbody>
</table>

*(g) - is the average peak vibration measurement at the 1/rev frequency expressed in units of acceleration

### Reduction in Vibration

<table>
<thead>
<tr>
<th>Average Couple Imbalance</th>
<th>Wheel Location of XactBalance</th>
<th>Reduction in Vibration Relative to Dual-Plane Balance</th>
<th>Average over all directions</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.43</td>
<td>Left Front Far Outside (A2)</td>
<td>33% 17% -1% 17%</td>
<td>17%</td>
</tr>
<tr>
<td>1.13</td>
<td>Left Front Center (A1)</td>
<td>35% 27% 27% 27%</td>
<td>27%</td>
</tr>
<tr>
<td>2.00</td>
<td>Right Front Far Outside (A2)</td>
<td>32% 21% 21% 21%</td>
<td>21%</td>
</tr>
<tr>
<td>2.00</td>
<td>Right Front Center (A1)</td>
<td>48% 22% 22% 22%</td>
<td>22%</td>
</tr>
<tr>
<td>2.38</td>
<td>Right Front Far Inside (A3)</td>
<td>51% 26% 26% 26%</td>
<td>26%</td>
</tr>
<tr>
<td>2.88</td>
<td>Left Front Far Inside (A3)</td>
<td>51% 36% 36% 36%</td>
<td>36%</td>
</tr>
<tr>
<td>4.00</td>
<td>Right Front Center w/added couple imbalance (A4)</td>
<td>41% -44% 10% 2%</td>
<td>2%</td>
</tr>
<tr>
<td>4.50</td>
<td>Left Front Center w/added couple imbalance (A4)</td>
<td>7% -38% -2% -18%</td>
<td>-18%</td>
</tr>
</tbody>
</table>

### XACTBalance

- **DPB:** Dual-plane balance with lead weights
  - RF - 1.25 oz stick-on outside
  - LF - 3.5 oz stick-on outside, 0.5 oz stick-on inside

### XactBalance

- **A1:** XactBalance at center of rim  
  - RF - 1.0 oz XactBalance center, Couple imbalance calls for 2.0 oz & 2.0 oz stick-on  
  - LF - 2.75 oz XactBalance center, Couple imbalance calls for 1.0 oz & 1.25 oz stick-on

- **A2:** XactBalance at far outside of rim  
  - RF - 1.0 oz XactBalance center, Couple imbalance calls for 2.0 oz & 2.0 oz stick-on  
  - LF - 2.75 oz XactBalance center, Couple imbalance calls for 0.5 oz & 0.35 oz stick-on

- **A3:** XactBalance at far inside of rim  
  - RF - 1.0 oz XactBalance center, Couple imbalance calls for 2.25 oz & 2.5 oz stick-on  
  - LF - 2.75 oz XactBalance center, Couple imbalance calls for 2.75 oz & 3.0 oz stick-on

- **A4:** XactBalance at center of rim; Add lead stick-on weight to increase couple imbalance, Single plane balanced  
  - RF - 1.0 oz XactBalance center, 4.0 oz added in 2 places, Couple imbalance calls for 3.75 oz & 4.25 oz stick-on  
  - LF - 3.25 oz XactBalance center, 4.0 oz added in 2 places, Couple imbalance calls for 4.25 oz & 4.75 oz stick-on

### Graphs

- **Reduction in Acceleration Using XactBalance Compared to Dual-Plane Balance**

- **Reduction in Acceleration Using XactBalance Compared to Dual-Plane Balance by Wheel Location**
CONCLUSIONS:

1) The position of XactBalance in the rim does not significantly influence its reduction of vibration due to couple imbalance.

2) By performing a polynomial regression fit to the data, the couple imbalance threshold for when XactBalance performs worse than a dual-plane balanced wheel was determined as follows:

3) Fore/Aft: ~3.25 oz

4) Average for Vertical, Fore/Aft, and Lateral: ~4.0 oz

5) Vertical: >4.5 oz

6) A single-plane balanced wheel with XactBalance will perform better than a lead dual-plane balanced wheel even if a couple imbalance of 3.25 oz remains in the wheel.
XactBalance Test Summary
Low profile XactBalance road tests

OBJECTIVE:

Measure the wheel-balancing performance of conventional and low-profile XactBalance compared to wheels that are dual-plane balanced with lead weights. Measurements are taken as reductions in average wheel-induced vibration measured on the suspension arm in the vertical, fore/aft and lateral directions. The correlation between radial force variation in wheels and the degree that XactBalance reduces vibration transmission is also examined.

METHOD:

1. Instrument vehicle with tri-axial accelerometers located on the front suspension swing-arms.
2. Dual-plane balance each wheel with lead stick-on weights and note their location and size.
3. Measure the "radial force variation" in each wheel.
4. Road test the vehicle and acquire acceleration levels.
5. Replace the weights according to the following test matrix for each of the four vehicles.

<table>
<thead>
<tr>
<th>Test Description</th>
<th>2007 GMC Envoy</th>
<th>2006 Toyota Tundra</th>
<th>2003 F150 Ford</th>
<th>2004 Porsche Cayenne</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual-plane with lead stick-on weights</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Dual-plane with XactBalance</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dual-plane with low-profile XactBalance</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Single-plane with XactBalance</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Single-plane with low-profile XactBalance</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

SETUP:

1. A tri-axial accelerometer is epoxy bonded to a surface on the suspension (in this case, the lower suspension arm).
2. The mounting location is chosen to be on a smooth surface free of rotating equipment, and one that is as close as possible to the wheel hub.
3. The accelerometer signal in all three (Vertical, Fore-Aft, and Lateral) directions is acquired in a 0-200 Hz bandwidth with a signal analyzer.
4. The FFT spectrum is averaged over 18 averages, which covers approximately 1 mile of highway travel.
5. The reported data is the peak in the acceleration FFT spectrum at the 1/rev fundamental frequency. The acceleration is reported in average peak amplitude in g's (where one "g" corresponds to 9.81 m/s^2).

⇒ NOTE: The test setup described here is for vibration measurements of the suspension arms as measured with an accelerometer and expressed in g's (units of acceleration). Other testing (i.e. on a fixed-axle) measures Force, as expressed in N (Newtons, units of force).
EXPERIMENTAL RESULTS:

Table 1: Reduction in vibration measured on the suspension compared to a dual-plane lead balance.

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Fore/aft</th>
<th>Lateral</th>
<th>Vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual-plane with XactBalance</td>
<td>2.7%</td>
<td>11.0%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Dual-plane with low-profile XactBalance</td>
<td>2.5%</td>
<td>12.9%</td>
<td>7.7%</td>
</tr>
<tr>
<td>Single-plane with XactBalance</td>
<td>15.5%</td>
<td>7.8%</td>
<td>5.1%</td>
</tr>
<tr>
<td>Single-plane with low-profile XactBalance</td>
<td>16.1%</td>
<td>10.9%</td>
<td>7.3%</td>
</tr>
</tbody>
</table>

Table 1: Average vibration (mg) at the 1/rev fundamental measured at the suspension arm.

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Fore/aft</th>
<th>Lateral</th>
<th>Vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007 GMC Envoy</td>
<td>38.6</td>
<td>41.9</td>
<td>205.3</td>
</tr>
<tr>
<td>2006 Toyota Tundra</td>
<td>37.6</td>
<td>36.8</td>
<td>147.8</td>
</tr>
<tr>
<td>2003 F150 Ford</td>
<td>20.6</td>
<td>36.6</td>
<td>158.9</td>
</tr>
<tr>
<td>2004 Porsche Cayenne</td>
<td>108.3</td>
<td>28.4</td>
<td>204.3</td>
</tr>
</tbody>
</table>
Figure 1: Reduction in the fore/aft vibration transmitted to the vehicle relative to that of a dual-plane lead balance.

Figure 2: Reduction in the lateral vibration transmitted to the vehicle relative to that of a dual-plane lead balance.
Figure 3: Reduction in the vertical vibration transmitted to the vehicle relative to that of a dual-plane lead balance versus radial force variation.

Table 1: Radial force variation (lbs) for each of the tires on the four test vehicles.

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Tires</th>
<th>Left Front</th>
<th>Right Front</th>
<th>Left Rear</th>
<th>Right Rear</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007 GMC Envoy</td>
<td>Michelin P245/65R17</td>
<td>8</td>
<td>24</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>2006 Toyota Tundra</td>
<td>Michelin P265/50R20</td>
<td>6</td>
<td>16</td>
<td>7</td>
<td>26</td>
</tr>
<tr>
<td>2003 F150 Ford</td>
<td>Kelly P265/70R17</td>
<td>25</td>
<td>13</td>
<td>16</td>
<td>14</td>
</tr>
<tr>
<td>2004 Porsche Cayenne</td>
<td>Rosso P Zero 275/40ZR20</td>
<td>27</td>
<td>48</td>
<td>38</td>
<td>29</td>
</tr>
</tbody>
</table>
CONCLUSIONS:

1. The XactBalance single-plane balance reduced the fore/aft vibration by 15.5% the lateral vibration by 7.8%, and the vertical vibration by 5.1% relative to a lead dual-plane balance.
2. The single-plane balance with low-profile XactBalance reduced the fore/aft vibration by 16.1%, the lateral vibration by 10.9%, and the vertical vibration by 7.3% relative to a lead dual-plane balance.
3. The low-profile and standard XactBalance reduced the vibration levels a greater amount for wheels with high radial force variation than that of wheels with low radial force variation.
4. The radial force variation threshold at which XactBalance appears to have a significant influence on reducing vibration is between 20 and 25 lbs.
XACTBalance Cartridge & Adhesive Tape
Technical Bulletins
As of January 1, 2005 IMI has chosen the Normount Z530H adhesive tape for use on all XACTBalance wheel weights developed and manufactured by IMI. Test reports and approvals for the Normount Z530H product on a balance weight has been approved by Toyota, Honda, GM, Ford, Chrysler and Nissan.

XACTBalance cartridge temperature range is -40° Fahrenheit to 320° Fahrenheit.

Questions regarding the above technical bulletin may be directed to:

INTERNATIONAL MARKETING, INC.
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Chambersburg, Pennsylvania 17201
Toll Free: 800-233-7086
E-mail: imi@imiproducts.net
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XACTCleaner
ABSOLUTELY ESSENTIAL FOR ADHESIVE WEIGHTS

- Safe for all wheel finishes
- Penetrates even the worst accumulations of grease and brake dust
  - Contains corrosion inhibitors to protect wheel surfaces
  - Environmentally safe -- contains no solvent-based VOCs
  - Spray-on/wipe-off ease of use
  - Leaves NO residue
**Installation Instructions**

1. **Check caliper clearance before removing wheels.**
   
   **CAUTION:** To plan for tire rotation, position XACTBalance where it will clear BOTH front and rear brake calipers. If the brake calipers do not allow proper clearance, the XACTBalance weight can be placed in a lateral position on the inner or outer area of the wheel just inside the flange area.

2. **Use a properly calibrated wheel balancer to determine the location and amount of weight (if more than 3 oz./ 85 g. is called for in one location, see page 6 for more details).**

   NOTE: XACTBalance is designed to perform in single-plane mode for many applications. We recommend dual-plane mode for wheels that are over 1" of OE fitment/specifications.

3. **Spray XACTCleaner directly on the wheel surface and use clean paper towels to prepare the weight location.**

   **WARNING:**
   - Even NEW wheels have residue on the wheel surface that will compromise adhesion of weights -- thoroughly clean new wheels.
   - Shop rags leave residue on the wheel surface that will compromise the adhesion of weights.
   - *Break Cleaner* leaves residue on the wheel surface that will compromise the adhesion of weights and can damage wheel finishes -- use XACTCleaner.
   - Avoid contact with the surface that has been cleaned.

   XACTCleaner is specifically engineered to remove contaminants and leave no residue. Apply XACTCleaner directly to the wheel surface. Use a non-abrasive brush or sponge to scrub heavily soiled surfaces. Always be sure to dry the surface with a clean paper towel.

4. **Set the proper wheel width on the placement tool, center the weight (using the logo on the weight) on the magnetic end of the tool and gently place the weight into position.**

   **BE CAREFUL:** Do not let the adhesive touch anything after the protective backing is removed. When gently placed on the wheel surface, the weight can be repositioned if necessary.

5. **Spin again to confirm balance.**

   If the balancer calls for additional weight of 0.25 oz. (5 g.) or less, spin again before adding weight -- a second spin ensures the steel particles are fully adjusted to the current position.

   If repositioning the weight does not balance the assembly, place additional weight as called for by the balancer. When adding another XACTBalance weight, add the second weight at the exact circumferential position requested by the balancer. The second weight should be attached next to and parallel with the first weight.

   (Page 6 contains more information about situations that call for more than 3 oz./ 85 g. in a single location)

6. **Press firmly into place (this makes the adhesion permanent).**

   For more information and tips to achieve the best results, please see the “Tips and Troubleshooting” section on pages 5 and 6.
How It Works

XACTBalance® is the first and only wheel weight that is truly dynamic. XACTBalance adapts to changing tire and driving conditions yielding a better, long lasting balance. The heart of XACTBalance lies in the free-moving steel particles housed within a flexible thermoplastic shell. These particles move and adjust to changing conditions, targeting the exact location of the imbalance and correcting it. XACTBalance is positioned on the inside of the wheel to provide a clean look and secure placement.

XACTCleaner is a specially-formulated solution that safely removes contaminants, leaves no residue, does not contain harsh solvents and promotes adhesion without damaging the finish of the wheel.

XACTBalance® HONORED WITH SEMA INTERNATIONAL NEW PRODUCT AWARDS
Over 15 years of technical development pays off with patent and latest recognition

January 25, 2006 - IMI's newest automotive product, XACTBalance®, was recently granted a patent for its unique design and was recognized at the 2005 SEMA Show in the show's first-ever International New Product Awards. SEMA - the Specialty Equipment Market Association - represents the $31 billion style, performance, comfort, and convenience automotive product industry.

XACTBalance® WINS "INNOVATION AWARD" AT REIFEN 2006 TIRE EXPO
Environmental performance, safety, innovation among award criteria

June 22, 2006 - The accolades for IMI's newest automotive product keep coming, this time at the REIFEN 2006 (Tire Expo) in Essen, Germany. XACTBalance won the Expo's Innovation Award in the category of Technical/Products. REIFEN is the world's largest international tire expo.

Tips and Troubleshooting

1. Verify the wheel balancer has been properly calibrated, all components.
2. Verify the wheel balancer is set up for “stick-on” or “tape-on” weights.
3. Confirm measurements needed to perform an accurate balance when using a “stick-on” weight (wheel diameter, wheel width, distance from the balancer to the placement of the weight). Refer to the wheel balancer operation manual for obtaining this information.
4. Has the wheel been properly mounted to the balancer? Before mounting the wheel, make sure that the contact surfaces of the basic adapter and rim are free from dirt and grease. Most standard wheels have accurately machined center holes and can be mounted with center cones. Accurate balancing depends on accurate mounting of the wheel and correct seating of the cone in the pilot hole to insure that the wheel is centered on the shaft.

Many alloy wheels today are lug-centric wheels and require the use of a flange/pin-plate system. The use of a flange/pin-plate system will ensure accurate and consistent balancing. The following OE vehicle manufacturers either mandate or recommend the use of the flange/pin-plate system: Audi, BMW, Chrysler, Daewoo, GM, Jaguar, Land Rover, Lexus, Mercedes, Nissan, Opel, Porsche, Rolls Royce, Toyota, and Volkswagen.

5. Examine the wheels to verify that the XACTBalance product that was applied is still on the wheel. If not, note the following:
   • Was the XACTBalance product applied to a location with adequate clearance from the brake caliper? If not, the brake caliper knocked the XACTBalance weight off the wheel surface. Select a location laterally (inner or outer) away from the brake caliper.
   • Was the wheel surface adequately prepared before the XACTBalance weight was applied to it? If the surface was not thoroughly clean and dry, the adhesive will not work properly and any adhesive weight will fall off. See Step 3 on page 2.

6. A “static” or “single plane” balance will produce optimum results provided the wheels are within 1” of the OE's specified wheel diameter. But if the vehicle is known to a ride problem, dual-plane mode is recommended. We recommend dual-plane mode for wheels that are over 1” of OE fitment/specifications.

A road test should precede any service to provide additional information. Once service corrections are made, a road test should follow to verify performance. The following questions will help the diagnostic procedure:
   • When was the problem first noticed?
   • When does the problem occur?
   • How is the problem noticed?
   • Does the problem appear suddenly or gradually?
   • Were any repairs done to the vehicle prior to the problem appearing?
   • Has the vehicle been involved in any minor or major accident(s)?

Get specific information. Factors such as temperature, road surfaces, vehicle speed and different loads can play major roles in vehicle handling.

Troubleshooting continued next page...
Tips and Troubleshooting (cont’d)

Use the instructions below when either of the following conditions occur: (a) balancing a wheel with an extreme negative offset in dual-plane mode; or (b) the distance is less than 4 inches between the weight on the left plane and the weight on the right plane. NOTE: When the wheel assembly is being balanced in dual-plane mode, follow the instructions below for the right plane before balancing the left plane.

If the amount of weight needed in one location* is between 3 - 4.75 oz. (85 - 135 g):
- Attach a 2.5 oz. (70 g.) XACTBalance weight as indicated by the balancer.
- Spin the wheel assembly again to determine the amount of additional weight needed and location. Attach the second XACTBalance weight gently next to and parallel with the first weight applied.
- Spin the wheel assembly again to confirm it is balanced. If needed, the XACTBalance weight can be repositioned to achieve balance.
- After the balance has been confirmed, press firmly on the XACTBalance weight to attach it permanently.

If the amount of weight needed in one location* is 5 oz. / 140 g., or more:
- Attach a 3 oz. (85 g.) XACTBalance weight as indicated by the balancer.
- Spin the wheel assembly again to determine the amount of additional weight needed and location. Attach the second XACTBalance weight gently next to and parallel with the first weight applied.
- Spin the wheel assembly again to confirm it is balanced. If needed, the XACTBalance weight can be repositioned to achieve balance.
- After the balance has been confirmed, press firmly on the XACTBalance weight to attach it permanently.

Symptom / Possible Causes

Vibration - a repetitive movement back and forth or up or down. Rotating components will vibrate if there is too much imbalance or runout:
- Wheel imbalance
- Excessive wheel or tire runout. On average, the maximum allowable lateral runout of the assembly is .050".
- Drum or rotor imbalance
- Worn "LJ" joints or "CV" joints
- Wheel cover imbalance
- Worn wheel bearings
- Improper tire inflation
- Worn shocks or damaged shock mountings
- Worn or loose motor mounts
- Drive train misalignment
- Drive shaft imbalance

Shimmy - a side-to-side motion:
- Wheel imbalance
- Loose or worn components
- Excessive wheel or tire runout
- Under inflated tires
- Worn tires
- Loose wheel bearings
- Improperly torqued lug nuts
- Excessive steering gear play
- Extremely high positive caster
- Defective steering dampener
- Tire construction problems

Glossary

Amplitude (Magnitude) - The amount of force or the intensity of the vibration.
Back Coning - When the wheel requires the cone to center the wheel on the balancer’s shaft from the backside, primarily due to the chamfer of the wheel. Also referred to as Back-Cone Mounting.
Backspacing - The distance measured from the mounting face to the back edge of the wheel.
BDC - The abbreviation for bottom dead center also referred to as 6 o’clock.
Bead seating - The process of seating the tire to the rim bead seats. Bead seating preferably occurs just after the tire and rim have been assembled, but may gradually change and optimize over a longer period.
Bolt Pattern Circle - The diameter of an imaginary circle drawn through the center of each lughole, and virtually always on the same centerline as the hub bore of the wheel.
Computerized Vibration Analyzer - A device used to determine the frequency of the vibration by isolating the vibrations with the greatest magnitude.
Couple Imbalance (Forces) - Two equal and opposite forces whose lines of action do not coincide/overlap. Two equal forces located on opposite ends and sides.
Cycle - One complete disturbance.
Dampen - To decrease the magnitude of a vibration or sound.
Dampers - Used to reduce the magnitude of a given vibration. Rubber is commonly used to isolate and dampen vibrations.
Dynamic Balance - A procedure that balances the wheel assembly by applying correction weights in two planes so that up and down imbalance and wobble imbalance are eliminated.
Electro-Mechanical Ear - A device used much like a doctor’s stethoscope and is for noise diagnosis problems only.
Forced Vibration - Vibrates when energy is applied.
Free Vibration - Continues to vibrate after the outside energy stops.
Frequency - The number of disturbances that occur per unit of time.
Front Coning - When the wheel requires the cone to center the wheel on the balancer’s shaft from the front. Also referred to as Front-Cone Mounting.
Harmonic - A vibration that is identified by the number of occurrences per revolution. For example, a 1st harmonic vibration has a once per revolution vibration component.
Harmonic Vibration - A vibration in a tire and rim assembly can be caused by: Imbalance; Change in Sidewall Stiffness (Force Variation); Rim Bent/Out-of-Round; Tyre Out-of-Round; Wheel to Axle Mounting Error; Brake Component Wear or Failure; Drive-train or Engine Component Wear or Failure; Vehicle Component Characteristics; Combination of Some or All Factors;
Hertz - A unit of frequency; one disturbance per second.
Hub Centric - The wheel is centered using the center hole of the wheel.
Lateral Runout - The amount of side-to-side movement as the tire/wheel assembly rotates.
Lug Centric - The wheel is centered using the lugholes rather than the wheel center hole.
Magnitude (Amplitude) - The amount of force or the intensity of the vibration.
Natural Frequency - The point at which an object will vibrate the easiest.
Order - The number of disturbances per cycle (rotation). For example, a 1st order vibration occurs once per cycle, and a 2nd order vibration occurs twice per cycle.
P, PS, SUV, LT - "P" Tires refers to passenger tires, "LT" Tires refers to light truck tires, and "PS"/"SUV" Tires refers to P-Rated sport utility vehicle tires.
Phase - The position of a vibration cycle relative to another vibration cycle in the same time reference.
Phasing - The cycle pattern of two or more vibrations that overlap and combine to increase the overall magnitude.
Pressure Ring - The accessory used to prevent the wing nut from contacting the wheel when on the balancer shaft.
Radial Force Variation (RFV) - A term describing a measurement of the tire uniformity, under load, measuring the variation of the load acting toward the tire center. A change in force exerted on the axle by the tire/wheel assembly while rotating under load. Units of measurement are in pounds, Newton’s, etc.
Glossary (cont’d)

Radial Runout - A condition where the tire and wheel assembly is slightly out of round forcing the spindle to move up and down as the vehicle rolls along a smooth surface.

Reed Tachometer - A mechanical device that uses reeds to indicate the frequency and magnitude of the vibration.

Resonance - The point where a vibrating component’s frequency matches the natural frequency of another component.

Responding Component - The noticeable component that is vibrating.

Source Component - A component causing another object to vibrate, such as a tire/wheel assembly.

Static Balance - A procedure that balances the wheel assembly using only a single weight plane.

TDC - An abbreviation for top dead center. Also referred to as 12 o’clock.

Torque Sensitive Vibration - The vibration occurs when accelerating, decelerating, or applying the throttle.

Transference Path - The object(s) that transfer the frequency.

Vibration - A shaking or trembling, which may be heard or felt.

Wheel Diameter - Dimension measured on the inside of the rim at the bead seats.

Wheel Offset - The measured distance between the mounting face of the wheel and the centerline of the rim.

Wheel Width - Dimension measured on the inside of the rim between the bead seats.

XACTBalance Wheel Weight - A thermoplastic cartridge containing steel particles that move freely, targeting the precise location influenced by the changing loads and speeds of a wheel assembly offsetting the imbalance conditions. The steel particles also distort/disrupt frequencies produced by the imbalances and force variation of the wheel assembly.