



# Collision reconstruction with telematics

---

**GEOTAB<sup>®</sup>**

# Contents

- What is collision reconstruction?..... 2
- How collision detection works..... 2
- How to analyze and interpret collision data on MyGeotab ..... 7
- First steps to take when a collision occurs..... 8

# What is collision reconstruction?

When a vehicle collision occurs, it's important to know what happened and why. Rebuilding as much information as possible is vital for insurance, training and potential litigation. This is when collision reconstruction with telematics can help.

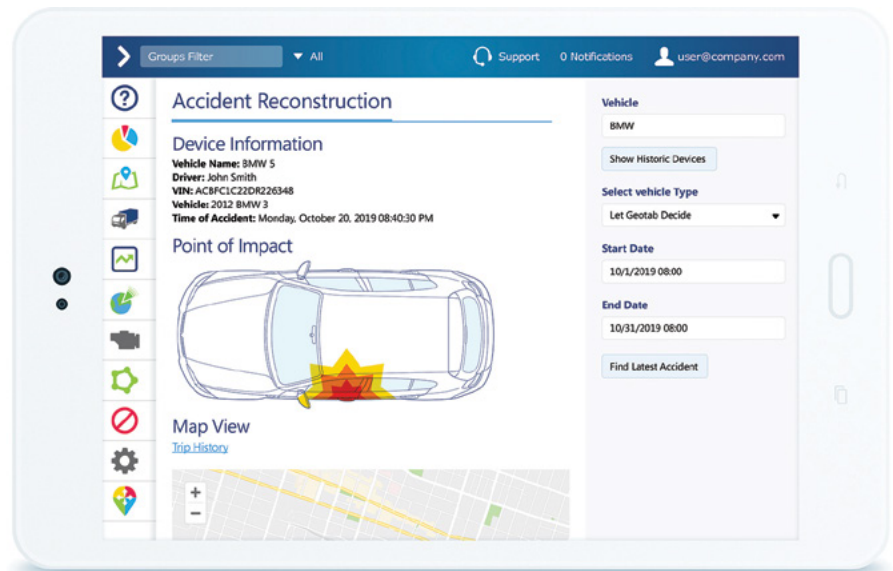
Collision reconstruction with telematics is the process of using [fleet tracking technology and software](#) to understand the events that occurred before, during and after a collision.

Telematics data is highly valuable because it provides an accurate scientific record of events. It allows you to go beyond word-of-mouth testimony. The granularity of the data can tell you many things about a collision. As well, telematics makes it possible to gain a broader perspective by looking at the historical patterns for a specific driver or vehicle.

## Geotab Collision Reconstruction Add-In

The Collision Reconstruction Add-In for MyGeotab is a free solution for viewing, analyzing and interpreting collision data from Geotab tracking devices. Learn more about this solution at [marketplace.geotab.com](https://marketplace.geotab.com).

In MyGeotab, users can access a number of different types of data that are critical to collision reconstruction, including Trips History, Collision and Log Data, Speed Profile, and Accelerometer and RPM graphs. By reviewing and analyzing this data, you can verify the events of the collision.



## How collision detection works

Collisions are detected by the [Geotab GO device](#) upon any acceleration greater than or equal to 2.5 G, where G is 9.81 m/s<sup>2</sup> (the acceleration due to the Earth's gravity). This is classified as a collision-level event. Geotab GO device firmware will not use Up/Down accelerometer data (also known as the Z axis) in this calculation. The calculation uses the magnitude of the hypotenuse between X and Y ( $\sqrt{X^2+Y^2}$ ) where X is Forward/Braking and Y is Side to Side.

When the Geotab GO device detects a 2.5 G event in any direction, the device is triggered to start recording at 100 Hz frequency. This detailed, high resolution information will be reflected in the trip in MyGeotab, and includes acceleration, GPS speed and brake data (if available.)

See also: [What is g-force and how is it related to harsh driving?](#)

## Possible Collision exception rule and notifications

MyGeotab has a built-in rule called Possible Collision. This rule is triggered if the accelerometer detects a change in speed of more than 2.55 g-force in the forward/braking or side-to-side direction. If possible, the device will send detailed forensic information about position, speed and acceleration of the vehicle.

To receive a notification when a possible collision is detected, a user can set this rule to “On” in MyGeotab. Even if the Possible Collision rule is not enabled, you can still see details in the Log Details and Collision report. This rule is separate from the Collision Reconstruction Add-In and can be set even if the Add-In isn't installed.

Note: False alarms are possible. Knocking the device can trigger the rule accidentally, so installing the device out of the driver's way is recommended.

## Minor Collision detection

Sometimes a collision occurs where an accelerometer reading is less than 2.5 g. For example, in a low speed collision where both vehicles continued driving afterwards or a slight rear end collision, a Collision Level Event might not be triggered.

However, in these circumstances the data reported by the GO device is still very important and helpful as accelerometer data is coming through at 100 Hz. The data is event-driven, so as there are more changes in direction or speed, there are more updates, resulting in a greater than normal number of logs.

In these circumstances an Exception Rule can be created to detect these instances and a notification can be set to notify a user when a Minor Collision is detected.

## Possible Minor Collision rules

The Possible Minor Collision rule currently does not exist as a built-in rule but can be added as a custom rule in the database. The sensitivity of the Exception Rule is fully customizable and should be modified to meet user preference. Based on our past experience, we recommend setting the G-force thresholds as listed below.

Harsh events are defined as following in the Geotab system:

### Passenger vehicle:

- + Harsh Acceleration:  
> 3.88 m/s<sup>2</sup>
- + Harsh Braking:  
< -6 m/s<sup>2</sup>
- + Harsh Cornering:  
> 4.59 m/s<sup>2</sup> or < -4.59 m/s<sup>2</sup>

### Pickup truck/Cube van:

- + Harsh Acceleration:  
> 3.35 m/s<sup>2</sup>
- + Harsh Braking:  
< -5.3 m/s<sup>2</sup>
- + Harsh Cornering:  
> 4.59 m/s<sup>2</sup> or < -4.59 m/s<sup>2</sup>

### Heavy-duty truck:

- + Harsh Acceleration:  
> 2.82 m/s<sup>2</sup>
- + Harsh Braking:  
< -4.59 m/s<sup>2</sup>
- + Harsh Cornering:  
> 3.18 m/s<sup>2</sup> or < -3.18 m/s<sup>2</sup>



## Rules adjustment

Adjust Harsh Event rules (Up to 1 G= 9.81 m/s<sup>2</sup>) or create additional rules based on the following:

### Passenger vehicles

The following rules for Passenger vehicles should improve the detection of all possible collision events:

- + Harsh Acceleration Rule for Passenger vehicles
  - Status Data Diagnostic “Acceleration forward or braking” > 3.88 m/s<sup>2</sup> and Status Data Diagnostic “Acceleration forward or braking” < 9.81 m/s<sup>2</sup>
- + Harsh Braking Rule for Passenger vehicles
  - Status Data Diagnostic “Acceleration forward or braking” < -6 m/s<sup>2</sup> and Status Data Diagnostic “Acceleration forward or braking” > -9.81 m/s<sup>2</sup>
- + Harsh Cornering Rule for Passenger vehicles
  - Status Data Diagnostic “Acceleration side to side” > 4.59 m/s<sup>2</sup> and Status Data Diagnostic “Acceleration side to side” < -4.59 m/s<sup>2</sup> and Status Data Diagnostic “Acceleration side to side” > -9.81 m/s<sup>2</sup> and Status Data Diagnostic “Acceleration side to side” < 9.81 m/s<sup>2</sup>

### Pickup truck/Cube van vehicles

The following rules for Pickup Truck/Cube Van vehicles should improve the detection of all possible collision events:

- + Harsh Acceleration Rule for Pickup Truck/ Cube Van vehicles
  - Status Data Diagnostic “Acceleration forward or braking” > 3.35 m/s<sup>2</sup> and Status Data Diagnostic “Acceleration forward or braking” < 9.81 m/s<sup>2</sup>
- + Harsh Braking Rule for Pickup Truck/ Cube Van vehicles
  - Status Data Diagnostic “Acceleration forward or braking” < -5.3 m/s<sup>2</sup> and Status Data Diagnostic “Acceleration forward or braking” > -9.81 m/s<sup>2</sup>
- + Harsh Cornering Rule for Pickup Truck/ Cube Van vehicles
  - Status Data Diagnostic “Acceleration side to side” > 4.59 m/s<sup>2</sup> and Status Data Diagnostic “Acceleration side to side” < -4.59 m/s<sup>2</sup> and Status Data Diagnostic “Acceleration side to side” > -9.81 m/s<sup>2</sup> and Status Data Diagnostic “Acceleration side to side” < 9.81 m/s<sup>2</sup>

## Heavy-duty trucks

The following rules for Heavy Duty Truck vehicles should improve the detection of all possible collision events:

- + Harsh Acceleration Rule for Heavy Duty Truck Van vehicles
  - Status Data Diagnostic “Acceleration forward or braking”  $> 2.82 \text{ m/s}^2$  and Status Data Diagnostic “Acceleration forward or braking”  $< 9.81 \text{ m/s}^2$
- + Harsh Braking Rule for Heavy Duty Truck vehicles
  - Status Data Diagnostic “Acceleration forward or braking”  $< -4.59 \text{ m/s}^2$  and Status Data Diagnostic “Acceleration forward or braking”  $> -9.81 \text{ m/s}^2$
- + Harsh Cornering Rule for Heavy Duty Truck vehicles
  - Status Data Diagnostic “Acceleration side to side”  $> 3.18 \text{ m/s}^2$  and Status Data Diagnostic “Acceleration side to side”  $< -3.18 \text{ m/s}^2$  and Status Data Diagnostic “Acceleration side to side”  $> -9.81 \text{ m/s}^2$  and Status Data Diagnostic “Acceleration side to side”  $< 9.81 \text{ m/s}^2$

### Possible minor collision rule for all vehicles (Between 1 G and 2.5 G)

- Status Data Diagnostic “Acceleration forward or braking”  $> 9.81 \text{ m/s}^2$  and Status Data Diagnostic “Acceleration forward or braking”  $< 24.5 \text{ m/s}^2$  and Status Data Diagnostic “Acceleration forward or braking”  $< -9.81 \text{ m/s}^2$  and Status Data Diagnostic “Acceleration forward or braking”  $> -24.5 \text{ m/s}^2$

Note: These rules can cause a lot of false alarms as these instances of Possible Minor Collisions could be just harsh events. The sensitivity can and should be adjusted based on experience.

## Possible reasons for not detecting a collision

There are several possible reasons that a vehicle collision might not be detected:

- + The event did not meet the condition of the system level threshold that is set on the internal firmware of the GO device:
  - A Collision Level Event is defined as an acceleration greater than  $24.5 \text{ m/s}^2$  in the forward/reverse (longitudinal) or side to side (lateral) direction.
  - Collisions are detected by the GO device upon any acceleration greater than or equal to 2.5 G where G is the gravitational constant of  $9.81 \text{ m/s}^2$ . The firmware will not use accelerometer Up/Down (also known as Z axis) in this calculation. The calculation uses the magnitude of the hypotenuse between X and Y ( $\sqrt{X^2+Y^2}$ ) Where X is Forward/Braking (longitudinal) and Y is Side to Side (lateral).
- + Device losing power (usually the battery gets disconnected or the power to the device getting cut at any point of the circuit due to the impact or bad installation).
- + Cellular connectivity:
  - The device continues to record data on the memory of the device if the device loses cellular connection. A device can store up to 79848 records without requiring to transmit them to the server.
  - If the device involved in a collision is recoverable and in working condition, contact Geotab Support to have a custom parameter applied to the device which triggers the upload of the data that is stored on the collision buffer. After, the device can be installed in a vehicle or power can be supplied to the device so it can start communicating to Geotab’s servers to upload the data.
  - If the device is not in working condition, contact Geotab Support to get an RMA to send the device to Geotab for a manual extraction of the data that is stored on the collision buffer.

## Data accuracy

GPS coordinates are accurate to approximately 2.5 m in any direction. Speed is accurate to 0.52 m/s. The GO device processes and analyzes accelerometer data at 100Hz before the [curve logic](#) is applied and the resulting data is sent to MyGeotab. This allows for real-time detection of collision-level events.

There are many ways in which automatically generated reports can be in error. Some directly measured quantities in the report, such as acceleration, speed and GPS location, are subject to their usual uncertainties and measurement errors. Derived quantities, such as possible point of impact, are also subject to potential calculation errors.

Accuracy:

- + GPS: Accurate to 2.5 m.
- + Speed: Accurate to 0.52 m/s.
- + Curve logic: Polls at a 300 Hz error rate and upon detection re-polls at a rate of 100 Hz.

## Data validation

Sources of error for vehicle position, speed and acceleration are dependent on the specific model of device; verify these with Geotab for your specific device.

In cases where the Geotab GO device was not rigidly attached to the OBD II connector of a vehicle, the initial acceleration data from the device remains correct, but the reaction (or reverse) acceleration will be in error due to the flexing of the harness. Additionally, the actual acceleration measured by the device may not be identical to the acceleration of the center of gravity of the vehicle depending on the device's location relative to the center of gravity of the vehicle.

Data for Geotab GO devices are stored in secure data centers only accessible by Geotab. Always state the VIN (Vehicle Identification Number) for the vehicle Engine Control Module (ECM) data collected by the Geotab GO device when reaching out to Geotab Support.

# How to analyze and interpret collision data on MyGeotab

The blog post “[Collision reconstruction with telematics data](#)” explains collision reconstruction and setting possible collision rules in MyGeotab. This article provides an overview of the types of collision data available in MyGeotab, and how to interpret that data.

## Relevant data to collision reconstruction

The following types of telematics data are useful in collision reconstruction for fleets:

- + GPS data
  - GPS location (GPS coordinates, map view, satellite view and street view)
  - GPS speed
    - + GPS Speed Raw data points (can be found in MyGeotab under **Collision and Log Data Report**)
    - + Speed Profile
- + Accelerometer data (if the device is at least on Pro Plan)
  - Raw values and Graph
- + Engine speed
  - Raw values and Graph
- + Exceptions
  - Speeding, Seatbelt, Harsh events, Collision-related Custom Rules, etc.

Fleets can access this kind of information on their vehicles by using Geotab GO devices.

[Learn more about the GO device hardware and its features in this post.](#)

## Key reports for analyzing collision data

These MyGeotab reports provide details on vehicle trip dates, times, locations, exceptions and more.

- + Advanced Detailed Trips Report
- + Advanced Collision and Log Data Report
- + Advanced Detailed Exceptions Report
- + Advanced Engine Status Report
  - Accelerometer Data – Engine measurements to include: Acceleration forward or braking and Acceleration side to side (Acceleration up down only if there was a rollover)
  - Engine RPM – Engine measurements to include: Engine Speed

Note: For legal purposes, court cases or insurance purposes, a trained engineering or physics expert should be consulted.



# First steps to take when a collision occurs

## Step 1:

1. Confirm the GO device serial number for the device installed in the involved vehicle.
  2. Confirm the exact date, time, and location of the collision (for example, via a police report).
  3. In MyGeotab, check if the telematics device was able to detect the collision.
- + In MyGeotab, select:
- Engine and Maintenance
  - Engine and Device
  - Faults
  - Using the Options field select Device, Date, and Time
  - Apply changes

If the device was able to detect the collision you will see the fault “ALERT: Collision limit for acceleration exceeded” listed.

To read about possible reasons why a collision was not detected, please refer back to the section: [Possible reasons for not detecting a collision](#).

## Step 2:

Collect the relevant data for the time of the collision-level event:

### GPS data (Trips History, Map, and GPS Speed)

The Trips history and Map in MyGeotab provide the date, time and location of the trips recorded by the telematics device throughout the day. You can filter by the trip on which the collision occurred and get the details on date, time, and location of the event.

#### Trips history

To navigate to the Advanced Trips History report:

1. From the MyGeotab main menu, select **Map** and click on the **Trips history** button.
2. Select the vehicle.
3. Click on the **Options** dropdown menu and select the **Date Period**. Click **Apply changes**.
4. Select **View > Advanced**.
5. You can download the report as a PDF or Excel file.

## Map

Include a screenshot of the location of the collision in your report. We recommend a Map, Satellite, and Street view.

1. In MyGeotab, select **Map > Trips history**
2. Select the vehicle.
3. Using **Options**, select **Date** and **Vehicle**.
4. Select **Date**.
5. Select the trip on which the collision occurred.
6. Zoom in to the collision location.
7. Take a screenshot of the **map view**.
8. Next, switch to **satellite view** and take a screenshot.
9. Right click on the location of the collision.
10. Select **street view** and take a screenshot.

The trips are based on the GPS coordinates recorded by the telematics device. Please refer to Collision & Log Data report to get the exact timestamps of the recorded GPS coordinates.



## GPS speed

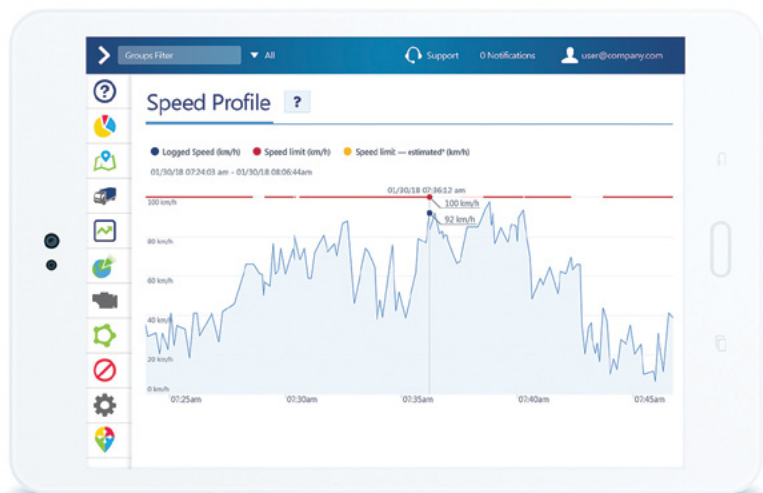
Use the Speed Profile to see a real-time graph of the speed of the vehicle.

From the MyGeotab main menu, select **Activity > Speed Profile**.

What the line colours mean:

- + Blue lines indicate the speed recorded by the telematics device.
- + Red lines indicate a confirmed posted road speed.
- + Yellow lines (not shown) indicate an estimated posted road speed.

The trips are based on the GPS coordinates recorded by the telematics device. Please refer to Collision & Log Data report to get the exact timestamps of the recorded GPS coordinates.



# Analyzing accelerometer data

## Raw accelerometer data points

To look up the raw data points:

1. In MyGeotab, select **Engine and Maintenance > Engine and Device > Measurements**.
2. Using the **Options** dropdown menu, select the **Date Period** and **Vehicle**.
3. At Diagnostics, use the dropdown menu to select **Acceleration forward** or **braking** and **Acceleration side to side**. Include **Acceleration up down** only if there was a rollover.
4. Apply changes.
5. You can download the report as a PDF or Excel file.

Use raw values as reference for your analysis. Geotab GO7, GO8 and GO9 devices report accelerometer data with a precision of approximately +/-1 mG\*, processed ~100 times a second, subject to a 16 sample smoothing function and standard [curve logic](#). That means accelerometer data should only be reported on up to 3 decimal places.

Example:  $-2.2947559356689453 \text{ m/s}^2 = -2.294 \text{ m/s}^2$

## Graph

1. In MyGeotab, select **Engine and Maintenance > Engine and Device > Measurements**.
2. Using the **Options** field select **Device, Date**.
3. For Diagnostics, select: **Acceleration forward** or **braking** and **Acceleration side to side**. Include **Acceleration up down** only if there was a rollover.
4. Select any of the graphs from the corner.
5. Using **Options**, reselect the **Diagnostics** and include **Acceleration forward** or **braking** and **Acceleration side to side** (as well as **Acceleration up down** for rollover incidents).
6. Apply changes.

The graph provides a useful representation of the acceleration recorded by the telematics device. This helps to determine the acceleration experienced by the telematics device in all directions (longitudinal, lateral and vertical directions) at one point in time.

The screenshot shows the Geotab interface for filtering accelerometer data. It includes a 'DATE PERIOD' dropdown with options: Today, Yesterday, This week, Last week, This month, Last month, and Custom. Below this is a date range selector with '05/08/19 12:00 am' and '05/08/19 11:59 pm'. To the right, 'DISPLAY OPTIONS' include 'Include historical data' (Yes/No), 'Vehicles' (Search vehicles), and 'Diagnostics' (Search diagnostics). A 'Selected: vehicle 2' is shown, and 'Selected: Acceleration forward or braking, Acceleration side to side, Acceleration up down' is listed. An 'Apply changes' button is at the bottom right.

## Engine Measurements

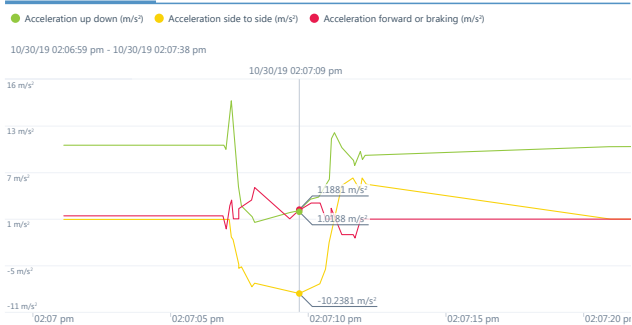
test 2 Company group	
Acceleration forward or braking	
Acceleration side to side	
10/30/18 02:03:37 pm	0 m/s <sup>2</sup>
10/30/18 02:07:06 pm	0 m/s <sup>2</sup>
10/30/18 02:07:06 pm	0 m/s <sup>2</sup>
10/30/18 02:07:07 pm	0 m/s <sup>2</sup>
10/30/18 02:07:07 pm	-2.2947559356689453 m/s <sup>2</sup>
10/30/18 02:07:07 pm	-2.3535959720611572 m/s <sup>2</sup>
10/30/18 02:07:07 pm	-2.6281819343566896 m/s <sup>2</sup>

## Engine Measurements

Total items 150

test 2 Company group	
Acceleration forward or braking	-2.5...4.1 m/s <sup>2</sup>
Acceleration side to side	-10.2...5.6 m/s <sup>2</sup>
Acceleration up down	-0.6...15.3 m/s <sup>2</sup>

## Engine Data Profile Vehicle 2



### Accelerometer movement description:

- + Acceleration Forward or Braking
  - Acceleration in the forward direction is always a positive value.
  - Deceleration or braking is always a negative value.
- + Acceleration Side to Side
  - Acceleration to the left is always a positive value.
  - Acceleration to the right is always a negative value.
- + Acceleration Up Down (Vertical) Acceleration up down measures acceleration applied on the vehicle in the vertical plane, such as speed bumps and potholes
  - Positive is up acceleration.
  - Negative is down acceleration.

It is recommended to reference the peak acceleration values experienced by the telematics device at the time of the Collision Level Event (use raw data points). The graph is a plot based on the raw data points recorded by the telematics device and interpolates between recorded data points. Please refer to Collision & Log Data report to get the exact timestamps of the recorded raw accelerometer data points.

### What if no accelerometer data reported by a device?

Here are some reasons why this could happen:

- + Accelerometer calibration
  - In some instances, the accelerometer in the GO device may not have been calibrated at the time of a Collision Level Event. In these instances, three-axis accelerometer data and graphs are not available.
  - Despite not being calibrated, a GO device's accelerometer may still be used to detect Collision Level Events if a sufficiently large movement is measured between data points. The accelerometer is functioning and measuring acceleration, but the directions of measurement have not been aligned with the axes of the vehicle.
- + Device plan
  - If the GO device is on any plan lower than the Pro plan, three-axis accelerometer data and graphs are not available.
  - Nevertheless, the accelerometer may still be used to detect Collision Level Events if a sufficiently large movement is measured between data points.
- + Accelerometer has been disabled due to excessive logging (usually caused by a loose installation).

## Engine Speed (Raw data points and Graph)

### Raw engine speed data points

1. From the MyGeotab main menu, select **Engine and Maintenance > Engine and Device > Measurements**.
2. Using the **Options**, select the **Date Period** and **Vehicle**.
3. At **Diagnostics**, select **Engine Speed**.
4. Click **Apply changes**.
5. You can download the report as a PDF or Excel file.

### Engine Speed (RPM) Graph

1. From the MyGeotab main menu, select **Engine and Maintenance > Engine and Device > Measurements**.
2. Using the **Options** field select **Device, Date**
3. At **Diagnostics**, select **Engine Speed**.
4. Click **Apply changes**.
5. Select Graph on the top right corner.

The graph is a plot based on the raw data points recorded by the telematics device and interpolates between those data points. Please refer to the Collision & Log Data report to get the exact timestamps of the recorded raw engine speed data points.

## Advanced collision and log data report

This report provides the raw data including GPS, Accelerometer and Engine data that was recorded by the telematics device.

1. In MyGeotab, select **Activity > Log Data and Collisions > Options**.
2. Using the **Options**, select **Date Period** and **Vehicle**.
3. Click **Apply changes**.
4. You can download the report as a PDF or Excel file

Geotab's Collision Reconstruction is a free software Add-In from the Geotab Marketplace.

Learn more about this solution at [marketplace.geotab.com](https://marketplace.geotab.com).

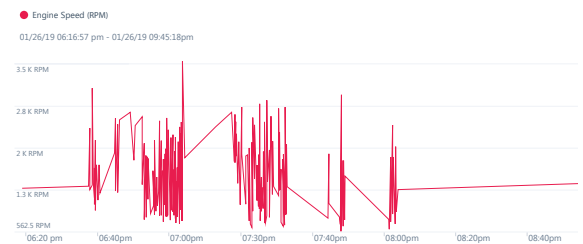
**GEOTAB**

### Engine Measurements

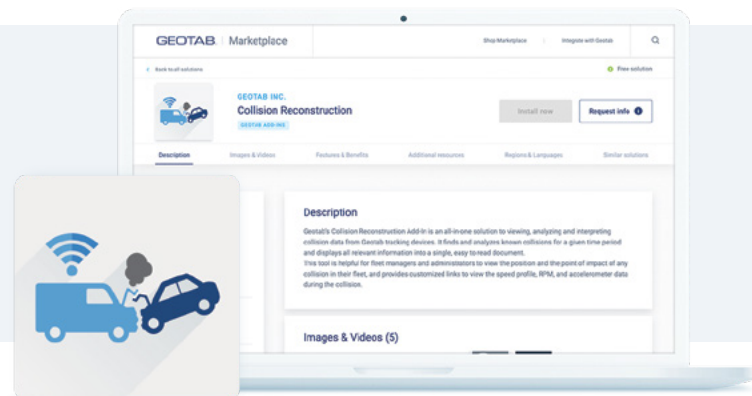
Total items 929

Fleet Vehicle 2	Company group
Engine speed	629.5...3268.8 RPM

### Engine Data Profile Vehicle 2



Note: We recommend running the report for one vehicle at a time and to keep the date time range small as there will be a lot of data processed which can cause slow interface performance.



## Author

Omed Sherzad, Engineering Support Specialist, Geotab Inc.

---

© 2020 Geotab Inc. All rights reserved.

This white paper is intended to provide information and encourage discussion on topics of interest to the telematics community. Geotab is not providing technical, professional or legal advice through this white paper. While every effort has been made to ensure that the information in this white paper is timely and accurate, errors and omissions may occur, and the information presented here may become out-of-date with the passage of time.

# About Geotab

Geotab is advancing security, connecting commercial vehicles to the internet and providing web-based analytics to help customers better manage their fleets. Geotab's open platform and Marketplace, offering hundreds of third-party solution options, allows both small and large businesses to automate operations by integrating vehicle data with their other data assets. As an IoT hub, the in-vehicle device provides additional functionality through IOX Add-Ons. Processing billions of data points a day, Geotab leverages data analytics and machine learning to help customers improve productivity, optimize fleets through the reduction of fuel consumption, enhance driver safety, and achieve strong compliance to regulatory changes. Geotab's products are represented and sold worldwide through Authorized Geotab Resellers.

To learn more, please visit [www.geotab.com](http://www.geotab.com) and follow us [@GEOTAB](https://twitter.com/GEOTAB) and on [LinkedIn](https://www.linkedin.com/company/geotab).

# GEO TAB<sup>®</sup>

—— [www.geotab.com](http://www.geotab.com) ——

