MaxxForce® 11 and 13 (2007-2009)

Overview: *Gear Down Protection*

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General Overview: Gear Down Protection

The Gear Down Protection (GDP) feature is designed to improve fuel economy by encouraging the driver to operate the vehicle within the engines most efficient speed range, where fuel consumption is lower. This is done by limiting the vehicle speed in lower gears; motivating the driver to up-shift into a higher gear reducing engine rpm and increasing fuel economy.

This document will address unique Gear Down Protection functionality for the MaxxForce® 11 and 13.

Description and Operation

Operation

The GDP feature limits the vehicle speed in top gear minus 1 gear ratio or 2 gear ratios (i.e. 8th and 9th gear on a 10 speed transmission).

Vehicle speed and engine speed are directly related. Therefore, by setting a vehicle speed (MPH) limit you are also effectively setting an engine speed (RPM) limit. GDP can be set to limit vehicle speed significantly. Under light loads, when downshifting is unnecessary, GDP encourages the driver to remain in top gear allowing for optimum performance, higher mph, decreased fuel consumption and lower rpm.

If the engine load exceeds a non-programmable threshold, the GDP feature will increase the vehicle speed limit to allow a higher performance range as required.

Once top gear is reached, GDP is not used and the vehicle speed will be limited to either the Vehicle Speed Governor or Cruise Control maximum value.

> *GDP does not limit vehicle speed or engine speed when the clutch pedal is depressed (i.e. while shifting).*

Feature Interaction

The GDP feature interacts with the following engine features:

- Cruise Control – If GDP and Cruise Control are both active, GDP has the higher priority.

- Progressive Shift – When GDP is active and Progressive Shift is in high gear range, GDP has the higher priority.

- Vehicle Speed Governor – GDP will limit engine speeds unless overridden by lower set speed by the vehicle speed governor.

- Vehicle Setup – GDP uses the vehicle information that is updated by the Vehicle Setup feature. GDP will not operate as desired if the required parameters have not been configured properly.

> *In general, the lowest engine speed limit of GDP, Cruise Control, Progressive Shift or Vehicle Speed Governor will be followed.*

Programmable Parameters

The following programmable parameters are available with the GDP feature. These parameters should be programmed to encourage drivers to up-shift into the highest transmission gears while maintaining drivability of the vehicle.

Parameters indicated as customer programmable can be adjusted differently than the production assembly plant setting to meet the customer's needs. If the parameter is indicated as non-customer programmable, the parameter setting is preset from the factory and can't be changed without dealer authorization.

Parameter Value	Description	Possible Values	Cust Pgrm?	Recommended Settings
GDP Enable (7714)	This parameter enables the gear down protection (GDP) feature in the engine.	**0:** Disable **1:** Enable	YES	Customer Chosen
GDP Low Load Vehicle Speed Limit in Top Gear Minus 1 (7716)	This parameter sets the low load vehicle speed limit in top gear minus 1. For example with a 10 speed manual transmission this parameter would set the vehicle speed limit in 9th gear. This parameter must be set to a value greater than the following parameter: ▪ GDP Low Load Vehicle Speed Limit in Top Gear Minus 2 (7715) This parameter must be set to a value less than the following parameter: ▪ GDP High Load Vehicle Speed Limit in Top Gear Minus 1 (7736)	0 to 127.5 mph	YES	This parameter value is output from GDP Equation A. Refer to GDP Calculations in the Parameter Setup section of this document for more information.
GDP Low Load Vehicle Speed Limit in Top Gear Minus 2 (7715)	This parameter sets the low load vehicle speed limit in top gear minus 2. For example with a 10 speed manual transmission this parameter would set the vehicle speed limit in 8th gear. This parameter must be set to a value less than the following parameters: ▪ GDP Low Load Vehicle Speed Limit in Top Gear Minus 1 (7716) ▪ GDP High Load Vehicle Speed Limit in Top Gear Minus 1 (7736) ▪ GDP High Load Vehicle Speed Limit in Top Gear Minus 2 (7735)	0 to 127.5 mph	YES	This parameter value is output from GDP Equation B. Refer to GDP Calculations in the Parameter Setup section of this document for more information.

Parameter Value	Description	Possible Values	Cust Pgrm?	Recommended Settings
GDP High Load Vehicle Speed Limit in Top Gear Minus 1 (7736)	This parameter sets the high load vehicle speed limit in top gear minus 1. For example with a 10 speed manual transmission this parameter would set the vehicle speed limit in 9th gear. This parameter must be set to a value greater than the following parameter: • GDP High Load Vehicle Speed Limit in Top Gear Minus 2 (7735) This parameter must be set to a value less than the following parameters: • GDP Low Load Vehicle Speed Limit in Top Gear Minus 1 (7716) • GDP Low Load Vehicle Speed Limit in Top Gear Minus 2 (7715)	0 to 127.5 mph	YES	This parameter value is output from GDP Equation C. Refer to GDP Calculations in the Parameter Setup section of this document for more information.
GDP High Load Vehicle Speed Limit in Top Gear Minus 2 (7735)	This parameter sets the high load vehicle speed limit in top gear minus 2. For example with a 10 speed manual transmission this parameter would set the vehicle speed limit in 8th gear. This parameter must be set to a value greater than the following parameter: • GDP High Load Vehicle Speed Limit in Top Gear Minus 1 (7736) This parameter must be set to a value less than the following parameter: • GDP Low Load Vehicle Speed Limit in Top Gear Minus 2 (7715)	0 to 127.5 mph	YES	This parameter value is output from GDP Equation D. Refer to GDP Calculations in the Parameter Setup section of this document for more information.

Parameter Setup

GDP Calculations

Calculate a vehicle speed limit based on an engine speed (shift point) that meets your vehicle application. Higher engine speeds provide more power, but reduce fuel economy. Vehicle speed changes not only based on the speed of the engine, but also based on the transmission gear ratio, rear axle ratio and the tire size (revs per mile).

The table below indicates the recommended engine RPM limits that should be chosen to be used in the GDP equations based on desired engine performance.

> *The recommended values vary according to the vehicle configuration and customer application.*

Desired Engine Performance	Recommended RPM for GDP Equation- Low Load	Recommended RPM for GDP Equation – High Load
Fuel Economy	1500 RPM	1650 RPM
Horsepower (HP)	1600 RPM	1800 RPM
Blend of Performance and fuel Economy	Choose an RPM between 1500 and 1600 RPM	Choose an RPM between 1600 and 1900 RPM

Refer to the following GDP equations before deciding an appropriate vehicle speed limit value. The output of the equation (resulting GDP vehicle speed limits) is based on how the vehicle was built and the customer's needs/desires.

GDP Equation A

GDP Low Load Vehicle Speed Limit in Top Gear Minus 1 (7716) =

$$\frac{60 * \text{Desired RPM}}{\text{Top Gear Minus 1 Gear Ratio (7729)} * \text{Rear Axle Ratio Low (8002)} * \text{Tire Revs per Mile (8001)}}$$

GDP Equation B

GDP Low Load Vehicle Speed Limit in Top Gear Minus 2 (7715) =

$$\frac{60 * \text{Desired RPM}}{\text{Top Gear Minus 2 Gear Ratio (7730)} * \text{Rear Axle Ratio Low (8002)} * \text{Tire Revs per Mile (8001)}}$$

GDP Equation C

GDP High Load Vehicle Speed Limit in Top Gear Minus 1 (7736) =

$$\frac{60 * \text{Desired RPM}}{\text{Top Gear Minus 1 Gear Ratio (7729)} * \text{Rear Axle Ratio Low (8002)} * \text{Tire Revs per Mile (8001)}}$$

GDP Equation D

GDP Low Load Vehicle Speed Limit in Top Gear Minus 2 (7735) =

$$\frac{60 * \text{Desired RPM}}{\text{Top Gear Minus 2 Gear Ratio (7730)} * \text{Rear Axle Ratio Low (8002)} * \text{Tire Revs per Mile (8001)}}$$

Rear axle ratio and tire revs per mile are already programmed into the engine software and can be retrieved using an electronic service tool.

The resulting value from each equation can now be programmed into the respective GDP vehicle speed limit parameters.

Round up to the next whole number before inputting the resulting vehicle speed limit values into the GDP vehicle speed limit parameters.

When in top gear minus 3, the vehicle speed is not limited by GDP. It is limited to the programmed High Idle Engine Speed (8203) value.
When in top gear, the vehicle speed is limited to the programmed Max Vehicle Speed with Road Limiting On (7902) value or Max Vehicle Speed with Cruise Control (7909) value; whichever is applicable.
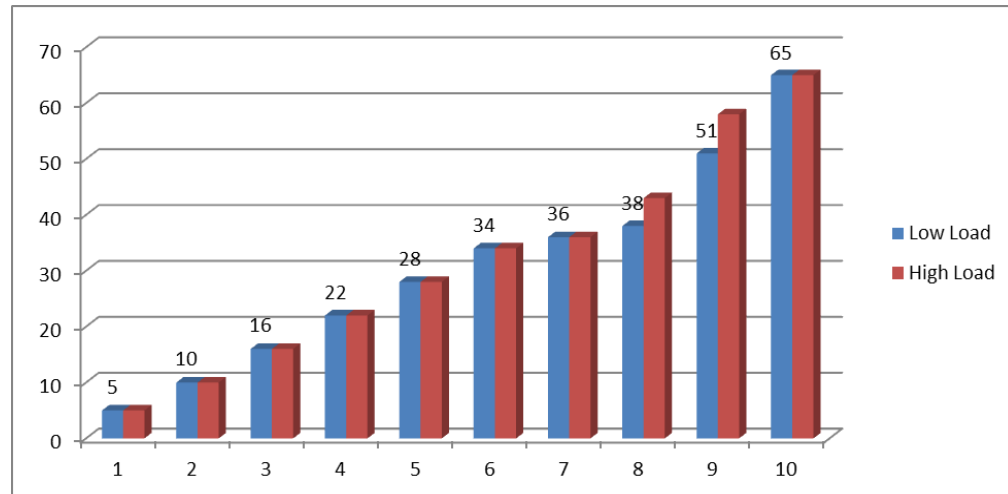
GDP Calculation Examples

This section helps demonstrate how the GDP parameter setup can affect GDP operation while driving.

Example A

The following "Example A" table and graph illustrates the vehicle speed limit and corresponding engine speed limit in each gear for a 10 speed manual transmission with Gear Down Protection parameters set according to the "Example A" values.

GDP Programmable Parameter Setup for Example A:		
Parameter	Value	Units
GDP Enable (7714)	Enabled	
GDPLow Load Vehicle Speed Limit in Top Gear Minus 1 (7716)	51	MPH
GDPLow Load Vehicle Speed Limit in Top Gear Minus 2 (7715)	38	MPH
GDP High Load Vehicle Speed Limit in Top Gear Minus 1 (7736)	58	MPH
GDP High Load Vehicle Speed Limit in Top Gear Minus 2 (7735)	43	MPH
Tire Revs Per Mile (8001)	492	Revs/Mile
Rear Axle Ratio Low (8002)	3.58	Ratio
Top Gear Minus 1 Gear Ratio (7729)	1	Trans Ratio
Top Gear Minus 2 Gear Ratio (7730)	1.36	Trans Ratio
Max Vehicle Speed with Road Speed Limiting ON (7902) or Maximum Vehicle Speed with Cruise Control (7909)	65	MPH
High Idle Engine Speed (8203)	2200	RPM

GDP Graph - Example A

"Example A" Discussion (observe the graph)

Gear Down Protection

In less than 8th gear, the driver will be limited, not by GDP, but by the High Idle Engine Speed (8203) value of 2200 rpm.

In 8th Gear under Low Engine Loads, GDP will limit the vehicle speed to 38 mph and force the driver to up shift due to the GDP Low Load Vehicle Speed Limit in Top Gear Minus 2 (7715) parameter as demonstrated by the blue vertical column. If you wanted to force the driver to shift from 8th to 9th gear sooner, the GDP Low Load Vehicle Speed Limit in Top Gear Minus 2 (7715) could be set to a lower value.

In 8th Gear under High Engine Loads, GDP will limit the vehicle speed to 43 mph and force the driver to up shift due to the GDP High Load Vehicle Speed Limit in Top Gear Minus 2 (7735) parameter as demonstrated by the blue vertical column. If you wanted to force the driver to shift from 8th to 9th gear sooner, the GDP High Load Vehicle Speed Limit in Top Gear Minus 2 (7735) could be set to a lower value.

In 9th Gear under Low Engine Loads, GDP will limit the vehicle speed to 51 mph and force the driver to up shift due to the GDP Low Load Vehicle Speed Limit in Top Gear Minus 1 (7716) parameter as demonstrated by the blue vertical column. If you wanted to force the driver to shift from 9th to 10th gear sooner, the GDP Low Load Vehicle Speed Limit in Top Gear Minus 1 (7716) parameter could be set to a lower value.

In 9th Gear under High Engine Loads, GDP will limit the vehicle speed to 58 mph and force the driver to up shift due to the GDP High Load Vehicle Speed Limit in Top Gear Minus 1 (7736) parameter as demonstrated by the blue vertical column. Again, if you wanted to force the driver to shift from 9th to 10th gear sooner, the graph illustrates that the GDP High Load Vehicle Speed Limit in Top Gear Minus 1 (7736) parameter could be set to a lower value.

> *NOTE: The limits for 8th and 9th gear above are only examples and we recommended that you use the appropriate "GDP Equation" to find appropriate GDP vehicle speed limits for your specific vehicle application.*

> *In 10th Gear, the vehicle speed governor feature will limit the vehicle speed to 65 mph.*
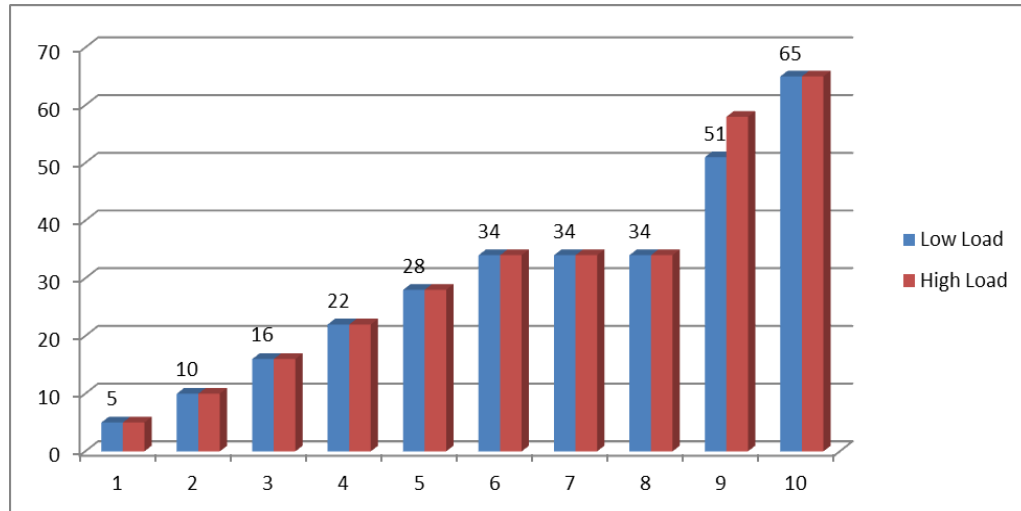
Example B

The following "Example B" table and graph illustrates the vehicle speed limit (and corresponding engine speed limit) in each gear for a 10 speed manual transmission with Gear Down Protection parameters set according to the "Example B" values.

GDP Programmable Parameter Setup for Example B:		
Parameter	Value	Units
GDP Enable (7714)	Enabled	
GDP Low Load Vehicle Speed Limit in Top Gear Minus 1 (7716)	51	MPH
GDP Low Load Vehicle Speed Limit in Top Gear Minus 2 (7715)	34	MPH

GDP High Load Vehicle Speed Limit in Top Gear Minus 1 (7736)	58	MPH
GDP High Load Vehicle Speed Limit in Top Gear Minus 2 (7735)	34	MPH
Tire Revs Per Mile (8001)	492	Revs/Mile
Rear Axle Ratio Low (8002)	3.58	Ratio
Top Gear Minus 1 Gear Ratio (7729)	1	Trans Ratio
Top Gear Minus 2 Gear Ratio (7730)	1.36	Trans Ratio
Max Vehicle Speed with Road Speed Limiting ON (7902) or Maximum Vehicle Speed with Cruise Control (7909)	65	MPH
High Idle Engine Speed (8203)	2200	RPM

GDP Graph (Example B):

"Example B" Discussion (observe the graph)

In Example B, observe what happens if the GDP Low Load Vehicle Speed Limit in Top Gear Minus 2 (7715) and the GDP High Load Vehicle Speed Limit in Top Gear Minus 2 (7735) parameters are set incorrectly. In this example, these parameters are both set to 34 mph.

Notice that the GDP Low Load Vehicle Speed Limit in Top Gear Minus 2 (7715) and the GDP High Load Vehicle Speed Limit in Top Gear Minus 2 (7735) parameters in this example are limiting the vehicle speed to 34 MPH in 6th, 7th, and 8th gear. The vehicle in this example would most likely not be drivable as it is currently programmed.

> *In "Example A" (above), we arbitrarily chose 51 and 38 mph as "desired" Low Load GDP Vehicle Speed Limits for a 10 speed manual transmission. This means that in 9th gear the vehicle speed is limited to 51 mph and in 8th gear the vehicle speed his limited to 38 mph. However, it is recommended that you choose a vehicle speed limit based on an engine speed (shift point) that meets your vehicle application. Higher engine speeds provide more power, but reduce fuel economy.*

> *Before you start selecting a vehicle speed it is important to understand the relationship between vehicle speed and engine speed. It is also important to understand that GDP limits the vehicle speed by limiting engine speed.*

GDP Applications

This section describes only a few possible feature applications and how the programmable parameters can be effectively configured for each application. This is not a comprehensive list, and does not include all possible applications that an owner/operator might encounter

Please review the description and operation section and the programmable parameter for a better understanding of how the various engine parameters might be best configured to your vehicle.

Application A – Customer desires to maximize fuel economy due to light vehicle loads.

Adjust parameters as follows:

Parameter Name	Action Required
GDP Enable (7714)	Select enabled (1)
GDP Low Load Vehicle Speed Limit in Top Gear Minus 1 (7716)	To calculate this value, input a Desired RPM of 1500 into GDP Equation A
GDP Low Load Vehicle Speed Limit in Top Gear Minus 2 (7715)	To calculate this value, input a Desired RPM of 1500 into GDP Equation B
GDP High Load Vehicle Speed Limit in Top Gear Minus 1 (7736)	To calculate this value, input a Desired RPM of 1650 into GDP Equation C
GDP High Load Vehicle Speed Limit in Top Gear Minus 2 (7735)	To calculate this value, input a Desired RPM of 1650 into GDP Equation D

Application B – Customer desires to maintain engine performance due to heavy vehicle loads.

Adjust parameters as follows:

Parameter Name	Action Required
GDP Enable (7714)	Select enabled (1)
GDP Low Load Vehicle Speed Limit in Top Gear Minus 1 (7716)	To calculate this value, input a Desired RPM of 1600 into GDP Equation A
GDP Low Load Vehicle Speed Limit in Top Gear Minus 2 (7715)	To calculate this value, input a Desired RPM of 1600 into GDP Equation B
GDP High Load Vehicle Speed Limit in Top Gear Minus 1 (7736)	To calculate this value, input a Desired RPM of 1800 into GDP Equation C
GDP High Load Vehicle Speed Limit in Top Gear Minus 2 (7735)	To calculate this value, input a Desired RPM of 1800 into GDP Equation D

Frequently Asked Questions

My driver gets excellent fuel economy. Will I see an improvement with GDP?

No, if your driver follows the driver training recommended by Navistar this feature will provide no benefit. This feature is designed to "push" the driver to shift as the engine is designed.

Can I use this feature as part of a driver reward program?

Yes, if you want your top drivers to be rewarded you can turn GDP off to allow the full engine power range to be available. This may encourage good driving behavior, such as using the cruise control feature and shutting down the engine during extended idle time.

Definitions/Acronyms

The following terms are referenced in this document:

Acronym	Definition
ECM	Engine Control Module
GDP	Gear Down Protection
MPH	Miles Per Hour
RPM	Revolutions Per Minute