



Tier 4 Regeneration - Information

June 5, 2017

- Attachments:**
1. Parked Regeneration Procedure with 3-Button InfoCenter
 2. Parked Regeneration Procedure with 5-Button InfoCenter
 3. Tier 4 Regeneration Brochure

Announcement: Toro Commercial Tier 4 products were introduced in 2013 due to changes in Environmental Protection Agency (EPA) emission compliance requirements for diesel engines.

Understanding the function of the engine's diesel particulate filter (DPF) and the regeneration process are important aspects of owning these machines. When an engine exhaust DPF (soot filter) becomes restricted, it must be addressed immediately.

In order to keep these products operating at peak performance levels and to avoid any "down time", it is important that customers understand the Tier 4 regeneration process, and the Tier 4 specific maintenance requirements.

We ask that you take a moment to review the material in this bulletin in order to familiarize yourself with Tier 4 maintenance requirements. Additionally, please share this information with anyone in your organization who operates or maintains Toro Tier 4 products. Should you have any questions, contact your local Toro distributor.

Also, please visit Toro's updated Tier 4 website to view the *Tier 4 Engine Parked Regeneration* video and much more:

<https://www.toro.com/en/customer-support/tier-4>



Operation

Diesel Particulate Filter Regeneration

Parked Regeneration



Figure 1

Parked-regeneration request icon

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- The parked-regeneration requested icon displays in the InfoCenter (Figure 1).
- If a parked regeneration is needed, the InfoCenter displays engine warning SPN 3719, FMI 16 (Figure 2) and the engine computer derates engine power to 85%.



Figure 2

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Important: If you do not complete a parked regeneration within 2 hours, the engine computer derates engine power to 50%.

- A parked regeneration requires 30 to 60 minutes to complete.
- If you are authorized by your company, you need the PIN code to perform the parked-regeneration process.

Preparing to Perform a Parked or Recovery Regeneration

1. Ensure that the machine has at least 1/4 tank of fuel.
2. Move the machine outside to an area away from combustible materials.
3. Park the machine on a level surface.
4. Ensure that the traction control or motion-control levers are in the NEUTRAL position.
5. If applicable, lower the cutting units and shut them off.
6. Engage the parking brake.
7. Set the throttle to the low IDLE position.

Performing a Parked Regeneration

Note: For instructions on unlocking protected menus, refer to (page).

1. Access the protected menu and unlock the protected settings submenu (Figure 3); refer to (page).

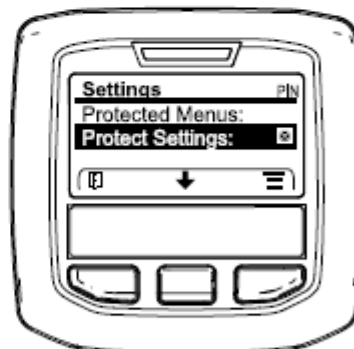


Figure 3

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2. Navigate to the MAIN MENU, press the center button to scroll down to the SERVICE MENU, and press the right button to select the SERVICE option (Figure 4).

Note: The InfoCenter should display the PIN indicator in the upper right corner of the display.



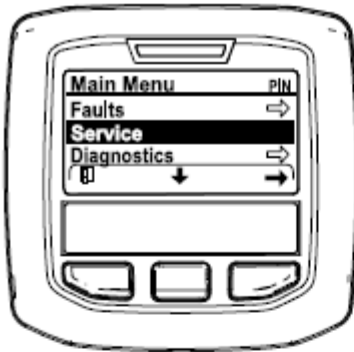


Figure 4

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Figure 6

g212125


- In the SERVICE MENU, press the middle button until the DPF REGENERATION options displays, and press the right button to select the DPF REGENERATION option (Figure 5).



Figure 5

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- When the "Initiate DPF Regen. Are you sure?" message displays, press the center button (Figure 6).

- If the coolant temperature is below 60°C (140°F) the "Insure  is running and above 60C/140F" message displays. (Figure 7).

Observe the temperature in the display, and run the machine at full throttle until the temperature reaches 60°C (140°F), then press the center button.

Note: If the coolant temperature is above 60°C (140°F) this screen is skipped.



Figure 7

g211966

- Move the throttle control to LOW IDLE and press the center button (Figure 8).



Figure 8

g212372



Figure 10

g212406

7. The following messages display as the parked regeneration process begins:

A. The "Initiating DPF Regen." message displays (Figure 9).



Figure 9

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B. The "Waiting on [DPF icon]" message displays (Figure 10).

C. The computer determines whether the regeneration runs. One of the following messages displays in the InfoCenter:

- If the regeneration is allowed, the "Regen Initiated. Allow up to 30 minutes for completion" message displays in the InfoCenter, wait for the machine to complete the parked regeneration process (Figure 11).

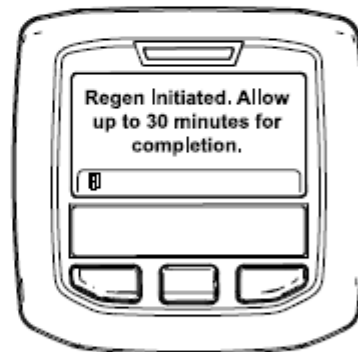


Figure 11

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- If the regeneration process is not allowed by the engine computer, the "DPF Regen Not Allowed" message displays in the InfoCenter (Figure 12). Press the left button to exit to the home screen

Important: If you did not meet all the requirements for regeneration or if less than 50 hours have passed since the last regeneration, the "DPF Regen Not Allowed" message appears.

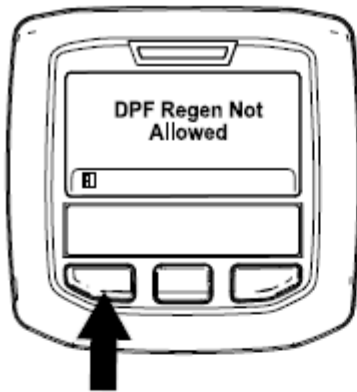


Figure 12

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8. While the regeneration is running, the InfoCenter returns to the home screen and shows the following icons:



The engine is cold—wait.



The engine is warm—wait.



The engine hot—regeneration in progress (percent complete).

9. The parked regeneration is complete when the “Regen Complete” message displays in the InfoCenter. Press the left button to exit to the home screen (Figure 13).

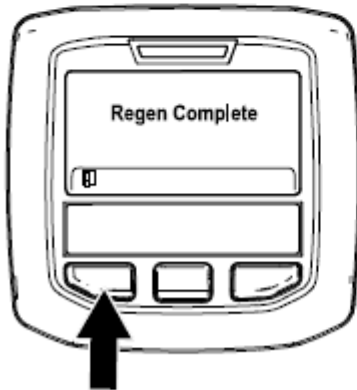


Figure 13

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Diesel Particulate Filter - 5 Button InfoCenter

Operation

Diesel Particulate Filter Regeneration

Parked Regeneration and Recovery Regeneration

Parked Regeneration

- The parked-regeneration requested icon displays in the InfoCenter (Figure 1).

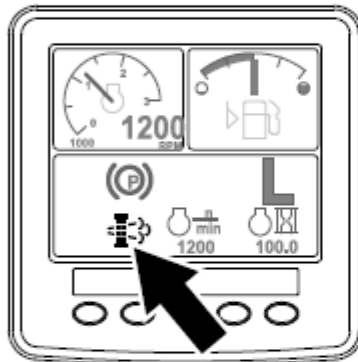


Figure 1

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- If you ignore the request for a parked regeneration (displayed in the InfoCenter) and continue to operate the machine (Figure 2), a critical amount of soot may accumulate in the DPF.



Figure 2

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- If you are authorized by your company, you need the PIN code to perform the parked-regeneration process.

Recovery Regeneration

- The recovery-regeneration icon displays in the InfoCenter (Figure 3).

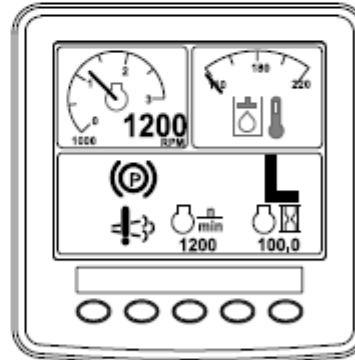


Figure 3

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- If you ignore the request for a parked regeneration (displayed in the InfoCenter) and continue to operate the machine (Figure 4), a critical amount of soot may accumulate in the DPF.





Figure 4

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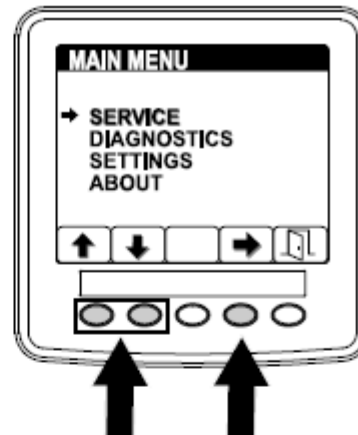


Figure 5

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- If you are authorized by your company, you need the PIN code to perform the recovery-regeneration process.

Preparing to Perform a Parked or Recovery Regeneration

1. Ensure that the machine has fuel in the tank for the type of regeneration you are performing:
 - **Parked Regeneration:** Ensure that you have 1/4 tank of fuel before performing the parked regeneration.
 - **Recovery Regeneration:** Ensure that you have 1/2 tank of fuel before performing the recovery regeneration.
2. Move the machine outside to an area away from combustible materials.
3. Park the machine on a level surface.
4. Ensure that the traction control or motion-control levers are in the NEUTRAL position.
5. If applicable, lower the cutting units and shut them off.
6. Engage the parking brake.
7. Set the throttle to the low IDLE position.

Performing the Regeneration

Note: For instructions on unlocking protected menus, refer to Accessing Protected Menus on the Software Guide for your machine.

1. On the MAIN MENU, press button 1 or button 2 to navigate to the SERVICE option, and press button 4 to select the SERVICE entry (Figure 5).

2. On the SERVICE menu, press button 1 or button 2 to navigate to the REGENERATION option, and press button 4 to select the REGENERATION entry (Figure 6).

If an UNAVAILABLE MESSAGE displays in the InfoCenter, perform the recommended actions described in the unavailable message table of (page).

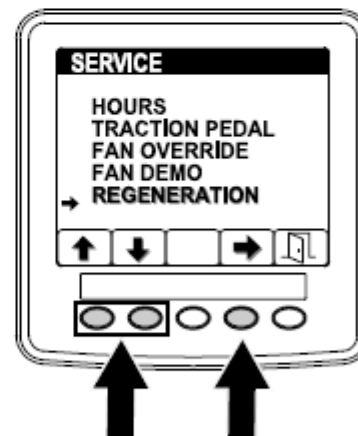


Figure 6

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3. On the regeneration screen, press button 4 to start the regeneration process (Figure 7).

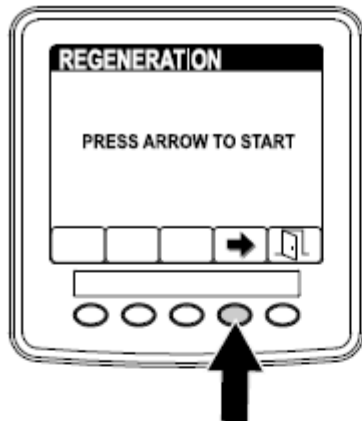


Figure 7

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Note: If you press button 5 while the regeneration is processing, you will exit the regeneration process. At the EXIT screen press button 5 to return to the SERVICE menu (Figure 9).

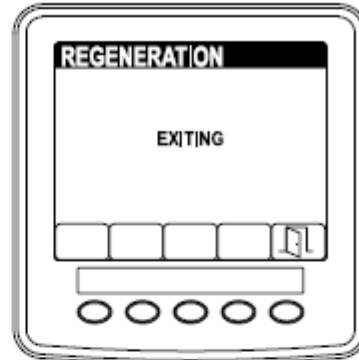


Figure 9

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4. The InfoCenter displays a series of screens (Figure 8) as the regeneration processes:

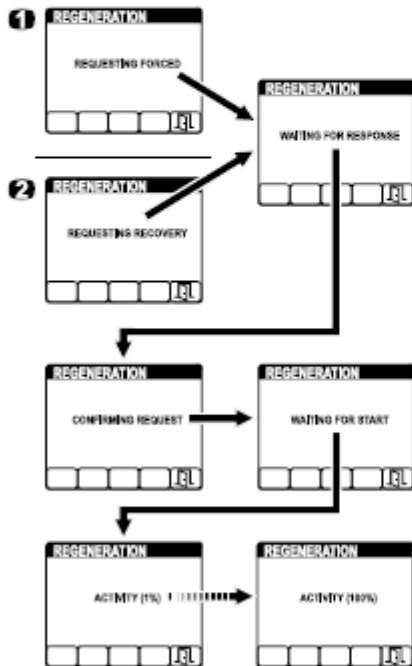


Figure 8

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5. When regeneration completes, the COMPLETE screen displays in the InfoCenter. Press button 5 to return to the SERVICE menu (Figure 10).

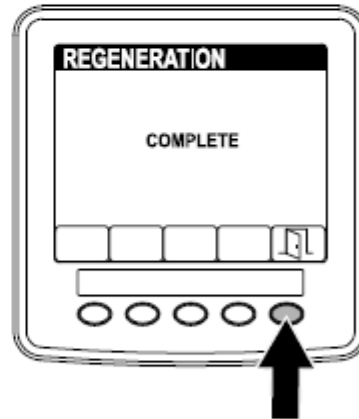


Figure 10

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1. REQUESTING FORCED is displayed during a parked regeneration
 2. REQUESTING RECOVERY is displayed during a recovery regeneration

What is Tier 4?

Tier 4 is a series of EPA-mandated regulations for the reduction of harmful exhaust gases produced by diesel-powered commercial equipment. Tier 4 standards require significant emission reductions of particulate matter (PM) and nitrogen oxides (NOx). PM is unburned fuel and is the black smoke/soot seen in diesel engine exhaust. NOx is nitrogen monoxide and nitrogen dioxide, and is created during the heat of combustion.

What is a Diesel Particulate Filter?

A diesel particulate filter (DPF) is a device used to remove diesel PM (soot) from the exhaust gas of a diesel engine. The DPF consists of two components:

- Diesel oxidation catalyst (DOC), which helps create heat and convert carbon monoxide (CO) and other compounds into carbon dioxide (CO₂) and water vapor.
- The soot filter is made of ceramic. It removes the particulate matter from the exhaust gases that flow through it.

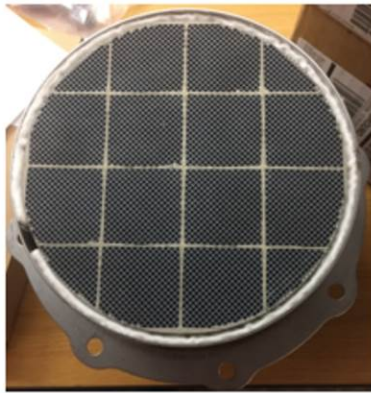


Figure 1 - A DPF filter from a normally operating engine. Regeneration is keeping the PM burned off.

What is soot and ash?

Soot is the particulate matter or incompletely burned fuel in the engine exhaust. Ash is the incombustible material (heavy metals) resulting from the regeneration process.

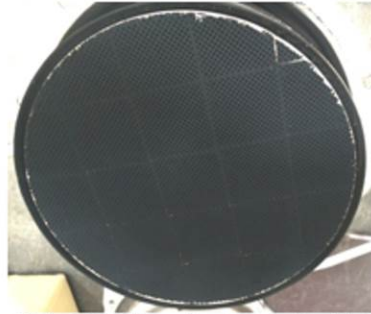


Figure 2 - This DPF filter is clogged with PM due to prolonged low-load engine operation, extended low rpm idle time, or lack of maintenance.

What is Regeneration?

Regeneration is the process of incinerating the soot that has collected in the soot filter. High heat burns the PM captured within the filter, and turns it into ash. The ash collects in the soot filter. The filter will eventually require cleaning as a normal maintenance requirement, as regeneration will no longer clear the system completely.

Regeneration Fundamentals

The engine control unit (ECU) monitors the soot levels in the DPF and automatically initiates the regeneration process when engine conditions are optimal. Currently, Yanmar engines use five different regeneration methods: three are automatic, while two others require the operator or technician to perform procedure steps.

Automatic Regeneration Methods:

1. **Passive (Self)** – This occurs automatically as the engine operates at higher rpm ranges and generates enough exhaust heat to burn off the PM.
2. **Assist** – Uses the throttle valve to reduce the amount of fresh air coming into the engine, and increases the exhaust temperature as a result.
3. **Reset** – Uses a combination of the intake throttle and post fuel injection to further raise the exhaust temperature and burn off the particulate matter.

Manual Regeneration Methods:

4. **Parked (Stationary)** - Is used when the passive, assist, and reset regenerations did not clean the soot filter. This process requires the operator or technician to start parked regeneration through a PIN-protected option within the InfoCenter's Service menu. This regeneration is performed while the machine is parked, and combines throttle control and additional post-combustion fuel injection while running the engine at higher rpm levels. The machine cannot be in service while you are performing a parked regeneration. **If this regeneration request is ignored, engine performance will degrade and unplanned machine downtime may result.**

5. **Recovery** – This backup regeneration process requires assistance from your distributor and is used in the event automatic regeneration methods did not clean the soot filter. The engine will enter a reduced-power (backup) mode, and triggers a fault code. A recovery regeneration is an extended-length process carried out by a Toro distributor service technician using special diagnostic software.

Once the recovery regeneration process completes, the engine returns to normal operation.

What are the Operator's and Technician's roles with Tier 4 vehicles?

Machine Operator:

- Operate the engine at full throttle and under load whenever possible
- Do not allow the engine to idle for long periods of time
- Know and understand the various regeneration icons that appear on the InfoCenter (see table)



Machine Technician:

- Know and understand Tier 4 engine maintenance requirements
- Know how to initiate a Parked (stationary) regeneration process
- Understand all of the regeneration-related functions of the InfoCenter
- Know how to properly instruct a new operator on proper engine usage
- Reference the latest Operators Manual for Tier 4 maintenance requirements

Is There a Special Diesel Fuel Requirement for a Tier 4 Engine?

Ultra-low sulfur diesel fuel is absolutely required for use in all Tier 4 engines for both regulatory and technical reasons. Ultra-low sulfur fuel is defined as having less than 15 parts-per-million (PPM) sulfur content. Diesel fuel with higher than 15 ppm sulfur content can degrade the DOC, which can potentially cause operational problems and may jeopardize long-term component life.

InfoCenter Icon Meanings and Actions

Regeneration Symbol	Event/Meaning	Operator Action
	Assist or Reset Regeneration is in process.	No action required from operator. Continue operating machine normally.
	Parked (stationary) Regeneration NEEDED NOW.	<ul style="list-style-type: none"> • Parking Brake Applied • Fuel level min. ¼ full • Engine at Idle • Coolant Temp greater than 140 °F • Follow InfoCenter prompts.

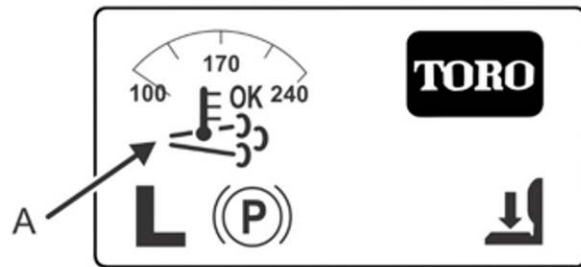


Figure 3 - When this icon (A) is shown on the InfoCenter screen (3-button shown), the regeneration is in progress. The thermometer symbol will fill as the temp rises. When it is full (as shown), the process is nearly complete.

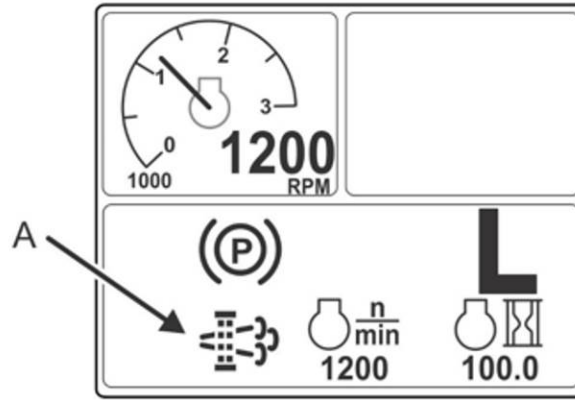


Figure 4 - When a stationary regeneration is needed, this icon (A) will appear on the InfoCenter screen (5-button shown). Ensure adequate fuel is available to complete the process.

Are there specific engine oil requirements for a Tier 4 engine?

Tier 4 diesel engines require CJ-4 specification (or higher) low-ash oil. The CJ-4 oil is approved for all pre-Tier 4 machines as well, so owners need to keep only CJ-4 oil on hand.

What is special about CJ-4 Low Ash engine oil?

CJ-4 engine oil is engineered to sustain emission control system durability with diesel particulate filters and other advance after-treatment systems used on higher-power Tier 4 engines. Using engine oils other than CJ-4 can cause premature clogging of the DPF and a subsequent reduction in engine performance.



Diesel Particulate Filter (DPF) Regeneration



For more information about Toro Tier 4, visit:

www.toro.com/en/customer-support/tier-4