

# CM Labs Motor Grader Simulator Instructor Guide

1.2

December 13, 2019



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# Table of Contents

---

<b>Motor Grader Simulation .....</b>	<b>1</b>
Features and Benefits .....	4
Learning Program .....	5
Performance Measurement and Assessment .....	6
Hardware .....	7
Vortex Advantage Hardware Platforms .....	8
Vortex Edge Plus .....	9
Vortex Edge .....	11
<b>Getting Started .....</b>	<b>13</b>
Default System Credentials .....	14
Logging into the System .....	15
Using the Simulator Anonymously .....	16
Log into the System for the First Time .....	17
The User Interface .....	18
<b>Managing Accounts and System Access .....</b>	<b>21</b>
Account Management .....	22
User Roles .....	23
Creating a New Account .....	24

---

Add a Student Account .....	26
Add an Instructor Account .....	28
Disabling User Accounts .....	30
Resetting Passwords .....	31
Reset the Password for Another Account .....	32
Change Your Password .....	33
Class Management .....	34
Set Up a New Class .....	35
Deleting Classes .....	36
Generating a Report for an Entire Class .....	37
<b>Operating the Motor Grader .....</b>	<b>39</b>
Physical Controls .....	40
Left Controls .....	41
Right Controls .....	46
Right Control Lever .....	48
Foot Pedals .....	50
Controllers .....	51
Simulated Controls and Human Machine Interface .....	53
Main Page .....	54
Sealed Switch Module .....	57
Operator View Controls .....	63
Conducting Training Exercises from the Instructor Console .....	65
Assigning Exercises to Students .....	66
Modify Scoring Settings .....	67
The Scoring Page .....	68
Scoring Rules .....	70

---

Customize Scoring Rules .....	71
Restore Default Scoring Settings .....	72
Monitoring Operator Performance .....	73
Performance Metrics .....	74
Graphing Performance Metrics .....	80
Bookmarking Events for Review .....	81
Changing Environmental Conditions .....	82
To Change the Weather in the Simulated Environment .....	83
Ending and Evaluating an Exercise .....	85
<b>Training Exercises .....</b>	<b>89</b>
Learning Aids in Training Exercises .....	91
Basic Controls .....	93
Moving the Motor Grader onto a Trailer .....	97
Windrow Management .....	100
Spreading Material .....	104
Leveling Material Near Obstacles .....	108
Stuck in Mud .....	112
V-Ditch .....	115
Tradeshow .....	119
Sandbox .....	121
<b>System Maintenance .....</b>	<b>125</b>



# Motor Grader Simulation

Motor graders are construction machines with a long blade which is used to create flat surfaces during grading operations. In construction, operators use motor graders to:

- Construct and maintain dirt and gravel roads
- Prepare a road for asphalt placement
- Finish grading on soil foundations for the construction of buildings
- Produce inclined surface for road construction
- Produce drainage ditches.

The Vortex Motor Grader Simulator realistically simulates the behavior of a real motor grader, including equipment operation, sounds, blade behavior, and vehicle driving. Operators can move the blade in the same way as on the real machine. The simulated motor grader includes a functional saddle-locking bar and cross-slope functionality.

From the operator seat, the students have a view which realistically reproduces what they see from inside a real motor grader.

## Equipment Specifications



**Engine Power:**

157-205 kW

**Peak Torque:**

1375 Nm (1014 lb.-ft.)

**Operating Mass**

20,303 kg (44,760 lb)

**Blade Pull:**

17,913 kg (3,949 lb)

**Maximum Pump Flow**

212 L/min (55 gallons/min)

**Blade Length:**

4.27 m (14 ft)

Behavior	Features
<b>Equipment Operation</b>	Blade lift
	Blade side shift
	Blade pitch
	Circle side shift
	Circle rotation
	Saddle locking bar
	Steering and articulation
	Front wheel lean
<b>Sounds</b>	Horn
	Door opening/closing
	Engine sounds based on RPM
	Hydraulic valves and cylinders noises
	Sounds of blade scraping
	Back-up alarm when vehicle is reversing
	Alarms
	Blinkers/hazard light sounds
	Wind
	Rain
	Ambient sound
	Chime sound when operators complete goals

## Features and Benefits

The Vortex Motor Grader Simulator gives operators valuable experience in safe grading operations with no wear and tear to the actual equipment, and no risk to themselves or others. Operators build real skills faster than with traditional training alone, and learning organizations save instructor time and reduce equipment costs.

Vortex simulators offer vital benefits to heavy equipment training programs:

- A progressive learning program covers basic grading skills such as blade positioning, creating v-ditches and windrows, and freeing the grader when it becomes stuck in the mud.
- Performance metrics and reporting give students timely and relevant feedback while they practice operating and lifting skills.
- Realistic simulation of the motor grader, work site, and lifting behavior help operators develop real, transferable skills.

# Learning Program

Training exercises are designed to help operators gradually develop core competencies with precision and confidence.

Specifically, the simulator trains students to develop practical knowledge and expertise in the following subjects:

- Understanding controls and positioning
- Becoming familiar with all major components of the equipment and how they behave during operation.
- Understanding the relationship between the machine capabilities and performance.
- Blade positioning, including circle shift, circle-side shift, blade tilt, blade lift, blade-side shift, and returning to straight
- Grading in an open area
- Loading and unloading the motor grader from a trailer
- Creating a V-ditch
- Creating a windrow
- Freeing the grader when it becomes stuck in mud
- Managing material when calling dump trucks

# Performance Measurement and Assessment

The training program provides instructors with objective insight into operator performance and abilities.

For each training exercise, the system records measurements for relevant performance metrics. Instructors can objectively assess students in real time and generate reports to track progress over time. Detailed metrics include (but are not limited to):

- The number of goals the operator accomplishes during the exercise and how long each takes.
- Any collisions the motor grader has with energy lines, humans, or other objects in the environment.
- The amount of traction on each wheel for assessing pulling or pushing force.
- The number of times any wheels slip during the exercise.
- The amount of time the operator spends in each gear (more advanced operators spend more time in the 3rd and 4th gears)
- The number of times the blade touches the vehicle or other obstacles, such as curbs, a manhole, or storm sewer during the exercise.
- The number of times the operator tries to turn the vehicle with the locking differential engaged.
- The amount of time the operator spends idle during the exercise.

Instructors can generate PDF reports detailing measurements for each metric at the end of each exercise, with any instructor comments and a Pass/Fail assessment.

# Hardware

All Vortex simulators feature realistic work sites and equipment simulation. Each simulator includes physical operator controls, a main display for showing the view from the operator cab, and a simulated Human Machine Interface displayed on a secondary display.

For a more immersive training experience, some simulators feature an operator seat with a motion platform and a separate touch-sensitive screen showing simulated controls.

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<b>Vortex Advantage Hardware Platforms .....</b>	<b>8</b>
<b>Vortex Edge Plus .....</b>	<b>9</b>
<b>Vortex Edge .....</b>	<b>11</b>

# Vortex Advantage Hardware Platforms

Vortex Advantage simulator systems feature enclosed computers which run Vortex software. Each simulator includes an operator seat with a motion platform and an LCD touch-sensitive screen which shows simulated controls and engine information.

## Display Configuration

## Simulator System

1-display



3-display



5-display



## Vortex Edge Plus

The Vortex Edge Plus configuration uses a support that fits onto a table or desk. Attached to the support are the vertical monitor, the physical controls, and a laptop which runs simulator software and shows simulated controls.



The Vortex Edge Plus simulator can be easily transported and installed on classroom desktops or trade and job fair booths in minutes. All components, from the configurable pedals to the operator controls and workstation-class laptop, can be ergonomically positioned for optimal trainee comfort.



## Vortex Edge

The Vortex Edge laptop simulator is a compact training tool that allows construction equipment operator trainers to deploy virtual equipment in classrooms, in order to demonstrate machine components, safe operator practices, and equipment behavior.



It can be transported in a single carrying case. The laptop is designed to plug into classroom displays or projectors, or operated as is, out of the box. The Vortex Edge runs on the same engineering-grade simulation that powers the larger Vortex simulators used by training schools.



# Getting Started

Getting started typically involves powering on the simulator, logging into the system for the first time, and navigating the simulator user interface.

## In This Section ...

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[Default System Credentials](#), on the next page

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[Logging into the System](#) , on page 15

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[The Vortex User Interface](#) , on page 18

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# Default System Credentials

The simulator software application is pre-configured with a default Administrator account. As part of preparing the system for other users, the an Administrator can log on using the default account to create accounts for any instructors or users who will use the system.

Default User name	Default Password
admin	Vortex

**Important:** For security purposes, we strongly recommend that you change the password for the default Administrator account when you log in to the system for the first time.

For information about changing your password, see [Change Your Password](#), on page 33.

# Logging into the System

Before you log into the system for the first time, ensure you know the valid user name and password for your user account. Ask the person who set up your training solution for information about your account if you do not know your user name and password.

**Important:** Because the default password for the system administrator account is not private, we strongly recommend that you change your password the first time you log into the system.

## Default User Account Credentials

Role	User name	Password
Administrator	admin	Vortex

## Using the Simulator Anonymously

There may be times when people want to use the simulator without having the system record the session or performance metrics which would typically be associated with their user accounts. For example, an operator may want to test the simulator without negatively contributing to performance reports the system generates for his user account. To conduct anonymous training sessions, you can log into the system using the guest account.

Users logged into the system as guest can conduct training exercises and view performance metrics for training exercises, but have no access to the instructor menu, student account information, or class information. When you log out of the system from the guest account, the system records no information on training exercises completed during the session.

# Log into the System for the First Time

Before you log in to the system for the first time, ensure the simulator is on and the Vortex console is open. You must know the valid user name and password for your account.

To log in for the first time, from the instructor console, do the following:

1. In the **Username** text box, type the valid user name for your account.
2. In the **Password** text box, type the valid password for your account.
3. Click **Login**.

The system logs you in. In the upper-left of the console window, your name is displayed as Administrator.

**Note:** If you are the administrator logging in for the first time, the system displays your name as *Administrator*.

Now you are ready to change your password.

## Change Your Password

To change your password from the instructor console, do the following:

1. In the upper-left of the console, click on your name.  
The system displays details about your user account and information about any training scenarios you have completed.
2. Click **Change Password**.
3. In the **Old Password** text box, type your current password.
4. In the **New Password** text box, type a new password.
5. In the **Confirm New Password** text box, type the new password again.
6. Click **OK**.

Now you are ready to add an instructor account.

## Log Out

Before you can log out of the system, you must close any open training exercises.

To log out, in the lower-left of the screen, click **Log off**.

# The User Interface

The instructor desktop interface consists of a side menu and controls to help you manage students, navigate training exercises, and assess operator performance.

When you first open the Vortex application, the following menu options are available on the side menu.

Side Menu	Menu Option	Description
 Christian Larsen Instructor		
 Select Exercise No exercise in progress	<b>1 User settings</b>	Click to display information about your account, change your password, or generate performance reports for your work in training scenarios.
 Instructor		
 Students	<b>2 Select Exercise</b>	Click to conduct training exercises for operators.
 Manage Class		
	<b>3 Instructor</b>	Click to manage student accounts and classes.
	<b>4 Settings</b>	Click to view information about control mapping and the version of software installed.
 Settings		
 Log Off	<b>5 Log Off</b>	Click to log out of the system so that another user can log on.
 Quit	<b>6 Quit</b>	Click to close the application.

# Instructor Menu

The Instructor menu offers controls for managing student accounts and classes.

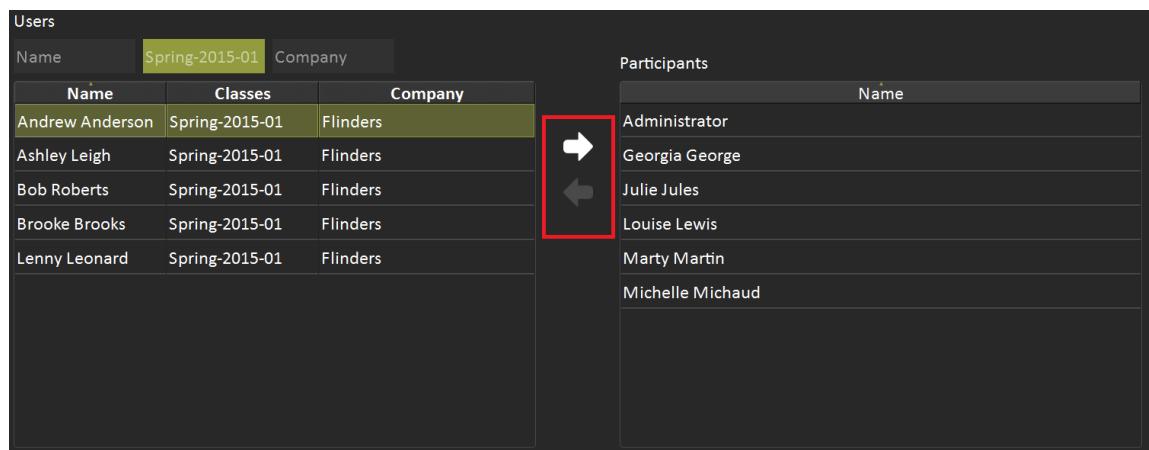
Instructor Menu	Menu Option	Description
	<b>1 Students</b>	Click to see controls for adding and modifying student accounts.
	<b>2 Manage Class</b>	Click to see controls for adding new classes and assigning students to a given class.

## Common Controls in the Instructor Console

The instructor desktop interface uses graphical controls to help you filter search results, add and remove users from classes and training exercises, and manage user accounts.

### List Selectors

Use list selectors to manage participation in classes and user scenarios. By selecting a list item, you can click the arrows to add or remove it from one list to the other.

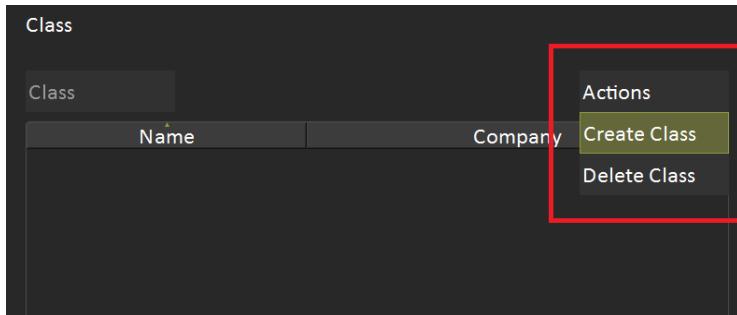


The screenshot shows two lists side-by-side. The left list is titled 'Users' and contains columns for Name, Classes, and Company. The right list is titled 'Participants' and contains a single column for Name. Between the two lists is a vertical bar with a red box around a central arrow icon. This arrow has a solid black outline pointing right, indicating the direction to move items from the 'Participants' list to the 'Users' list.

### Action Menus

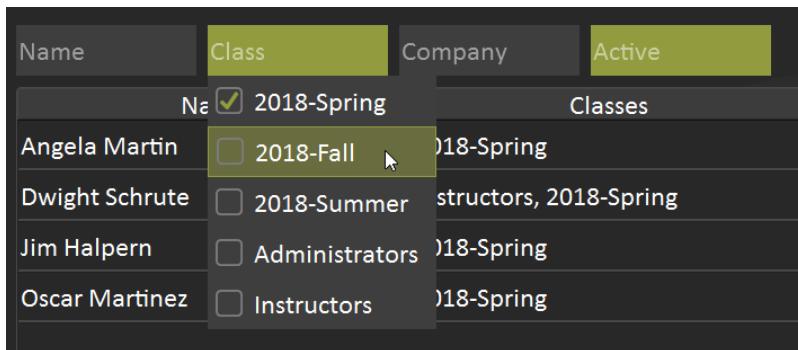
Action menus are typically located in the upper right of the screen and are labeled **Actions**. Clicking an Action menu shows the activities you can perform in a given

context. For example, to add a new student account from the **Students** page, you must click the **Action** menu and then click **Create User**.



## Filter Selectors

Filter selectors help you find list items quickly. You can type in the text boxes to filter any list by category, or check boxes the system displays based on the existing entries in the system. When you enter a search term or select a check box for a term, the system displays only the list items that correspond with your terms.



## Clearing filters

To clear filters and view an unfiltered list again, on the **Action** menu, click **Clear Filters**.

# Managing Accounts and System Access

Before operators can begin using the simulator, an Instructor must set up the training environment. Preparing the training environment for users typically involves creating new accounts for students and setting up classes to manage students.

## In this section

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[Account Management](#), on the next page

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[Class Management](#), on page 34

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# Account Management

Before students can train using the system, an Administrator must set up user accounts for any instructors or students who will access the system. Once student accounts are created, the system can track individual performance for any training exercises an instructor assigns to them.

## In This Section ...

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[User Roles](#), on the facing page

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[Creating a New Account](#), on page 24

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[Deactivating a User Account](#), on page 30

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[Resetting Passwords](#), on page 31

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# User Roles

This training solution was designed to support multiple types of users. The role associated with your account reflects the kind of work you do as the way you interact with the simulator.

User Role	Permissions
Administrator	Responsible for setting up the system for regular use by instructors and students. The administrator should add at least one instructor account.
Instructor	Responsible for managing students and classes. The instructor can add accounts for students and associate them with classes. As operators use the simulator to complete training exercises, the instructor monitors their performance, offers feedback, and triggers unexpected events during training exercises. Instructors can also review sessions using record and playback functions, and generate performance reports.
Student	Uses the simulator to complete training exercises and become a better operator. As the student works through each exercise, the system assesses performance and records the session for the student and instructor to review together.
Guest	Can explore scenarios and crane controls anonymously. The system does not assess performance or store information about Guest sessions.

# Creating a New Account

The system uses user names to uniquely identify students and instructors in the system. Users must have a valid user name and password to log into the system. To make searching for users easier, you can enter other identifying attributes for each user.

When you create a new user account, the system prompts you for the following information:

Attribute	Description	Example
User Name	A combination of letters, numbers, or both which uniquely identify the user in the system. Instructors and students must type their user names every time they log into the system.	jsmith
Full Name	The user's given name and surname. This name will be displayed throughout the user interface and on any performance reports for the user.	John Smith
Password	The password the user can use to access the system.	\$Chang3Me!
Type	<p>The type of user account. Choose from the following:</p> <ul style="list-style-type: none"><li>■ Student</li><li>■ Instructor</li><li>■ Administrator</li></ul>	Student
	<p><b>Note:</b> Only administrators can create administrator and instructor accounts. Students cannot create new accounts in the system.</p>	
Company	The name of the company or organization the user account is associated with. It can be useful to sort user accounts by company.	ACME Training

Attribute	Description	Example
User ID	Any other identifying information for the user. For example, a birthday or employee ID. User ID is helpful if you know you will want to search for user accounts with a unique identifier other than User Name.	19840408

# Add a Student Account

Add a Student account for each student you want to train using the simulator. For each Student account, the system records every training session and records performance metrics which you can review in the form of reports.

To add a new Student account for an operator, do the following:

1. On the side menu, click **Instructor** and then click **Students**.  
The system displays a list detailing of all existing user accounts.
2. On the Action menu, click **Create User**. The following control appears:

The dialog box contains the following fields:

- User Name
- Full Name
- Type: A dropdown menu showing "Student" as the selected option.
- Active: A checked checkbox.
- Password
- Confirm Password
- Company
- User ID

At the bottom are two buttons: "Create" and "Cancel".

3. In the **User Name** text box, type a unique identifier the user can use to log into the system.
4. In the **Full Name** text box, type the user's full name.
5. In the **Type** drop-down list, select **Student**.
6. Do one of the following:
  - To activate the account immediately, select the **Activate** check box.
  - To leave the account inactive after you create it, clear the **Activate** check box.
7. In the **Password** text box, type a password for the new user account.
8. In the **Confirm Password** text box, confirm the password.
9. In the **Company** text box, type the name of the company the user works for.
10. In the **User ID** text box, type other identifying information about the user.
11. Click **Create**.

The new account appears in the list of all users.

Before the operator can log in to the system, you must communicate the user name and password he will need to use.

# Add an Instructor Account

Instructors manage operator training and student accounts on the system. We recommend that you add at least one instructor account for the person who will manage the students training on the simulator.

To add a user account for an instructor, do the following:

1. On the side menu, click **Instructor** and then click **Students**.  
The system displays a list detailing all existing user accounts.
2. On the Action menu, click **Create User**. The following control appears:

The dialog box has the following fields:

- User Name: A text input field containing a placeholder character.
- Full Name: A text input field.
- Type: A dropdown menu set to "Instructor".
- Active: A checked checkbox.
- Password: A text input field.
- Confirm Password: A text input field.
- Company: A text input field.
- User ID: A text input field.

At the bottom are two buttons: "Create" and "Cancel".

3. In the **User Name** text box, type a unique identifier the user can use to log into the system.
4. In the **Full Name** text box, type the user's full name.
5. In the **Type** drop-down list, select **Instructor**.
6. Determine whether the account will be active once it is created. Inactive accounts cannot be used to log into the system or complete exercises.
  - To activate the account immediately, select the **Activate** check box.
  - To leave the account inactive after you create it, clear the **Activate** check box.
7. In the **Password** text box, type a password for the new user account.
8. In the **Confirm Password** text box, confirm the password.
9. In the **Company** text box, type the name of the company the user works for.
10. In the **User ID** text box, type other identifying information about the user.

**11. Click **Create**.**

The new user appears in the list of all users.

Before the instructor can log in to the system, you must communicate the user name and password he will need to use.

# Disabling User Accounts

By default, user accounts you create in the system are active. When a user is no longer active, you can disable their user account to prevent them from logging into the system.

## To Disable a User Account

Disabling a user account involves modifying settings for the user whose account you want to disable in the system.

**Note:** You must be logged into the system with a valid Administrator account to disable a user account.

To disable an account, from the instructor console, do the following:

1. On the side menu, click the **Instructor** tab and then click **Students**.
2. In the list of students, click on the user account you want to disable.
3. Click the **Action** menu and then click **Modify User**.
4. To disable the account, in the **Active** field, click to clear the check box.

The screenshot shows a 'Modify User' dialog box with the following fields:

- User Name: ahansen
- User ID: (empty)
- Full Name: Alexander Hansen
- Type: Student
- Active: (checkbox is unchecked)
- Company: (empty)

At the bottom are 'Modify' and 'Cancel' buttons.

5. Click **Modify**.

In the list of students, the system now shows the status of the user account as **Disabled**.

# Resetting Passwords

Your user role determines your privileges in the Vortex user interface. Only users with Administrator or Instructor roles can reset passwords for other user accounts. Any user can reset his or her own password at any time.

User Role	Privileges
Administrator	Can create Administrator, Instructor, and Student accounts and reset passwords for all other users.
Instructor	Can create Instructor and Student accounts, and reset passwords for Instructor and Student accounts.
Student	Can only change own password.

## Reset the Password for Another Account

To reset the password for another user, you must be logged in with a valid Administrator or Instructor account.

**Note:** Only Administrators can reset the password for other Administrator accounts.

From the instructor console, do the following.

1. On the side menu, click **Instructor** and then click **Students**.
2. In the list of accounts, click to select the user account you want to modify.
3. Click the **Action** menu and then click **Reset Password**.

A dialog box for resetting the password appears.

4. In the **New Password** text box, type a new password for the user account.
5. In the **Confirm New Password** text box, confirm the new password.
6. Click **OK**.

The password for the user account is changed.

# Change Your Password

Before changing your password, you must be logged in with a valid user account.

**Note:** If you do not know your password or have forgotten it, you must contact a system Administrator or Instructor to reset your password for you.

From the user interface, do the following:

1. In the upper left of the screen, click on your user name.
2. Click **Change Password**.

A dialog box appears.

3. In the **Old Password** text box, type the current password for your account.
4. In the **New Password** text box, type a new password for the user account.
5. In the **Confirm New Password** text box, confirm the new password.
6. Click **OK**.

Your password is changed.

# Class Management

The system is designed as a training tool which you can use for multiple classes of students. The Vortex student database lets the instructor group students into classes. Once students are grouped into classes, the instructor can generate separate reports for each class.

## In this section

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[Set Up a New Class](#), on the facing page

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[Deleting Classes](#), on page 36

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[Generating a Report for an Entire Class](#), on page 37

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# Set Up a New Class

Setting up a new class involves creating a new class and then adding students accounts to it.

To set up a new class, from the instructor console, do the following:

1. On the side menu, click **Instructor** and then click **Manage Class**.
2. On the **Action** menu, click **Create Class**.
3. In the **Enter new class name** text box, type a name for the class. This name will be displayed throughout the user interface. For example, type **Summer-2018**.
4. Click **Create**.

The new class name appears above the **Class** list.

5. To add a student to the class, select the student's name in the **Users** list, then click the arrow button to add it to the **Class** list for the new class.

In the **Users** list, in the row for the student, the **Classes** column now shows the new class name.

# Deleting Classes

If you create a class by mistake, or would like to retire a class label, you can delete it from the **Manage Classes** page.

The screenshot shows the Instructor Station interface. On the left, there's a sidebar with icons for Christian Larsen (Instructor), Select Exercise (No exercise in progress), Instructor, Students, and Manage Class. The main area has two tables: 'Users' and 'Class'. The 'Users' table lists users by Name, Company, and Classes. The 'Class' table lists classes by Name, Company, and Actions. A yellow box highlights the 'Autumn-2016' class in the 'Class' table. An arrow points from the 'Autumn-2016' class in the 'Class' table to the 'Delete Class' button in the 'Actions' column of the same row. Another arrow points from the 'Delete Class' button back to the 'Autumn-2016' class in the 'Class' table.

To delete a class, from the Instructor Station, do the following:

1. On the side menu, click **Instructor** and then click **Manage Class**.
2. Under the **Class** section, in the **Class** filter box, click to select the class you want to delete.
3. On the Action menu, click **Delete Class**.
4. In the confirmation window, click **Yes**.

The class is deleted. The students which were previously grouped into the class you deleted still appear in the list of Users, but they are no longer associated with the class you deleted.

This screenshot shows the Instructor Station interface after a class has been deleted. The 'Class' table now only contains the 'Instructors' class, which is highlighted with a green background. An arrow points from the 'Instructors' class in the 'Class' table to the 'Delete Class' button in the 'Actions' column of the same row. Another arrow points from the 'Delete Class' button back to the 'Instructors' class in the 'Class' table.

# Generating a Report for an Entire Class

You can generate PDF reports which detail the performance of all students in a given class for each training exercise. These can be useful for reviewing progress or discussing plans for improvement.

## Generate a Class Report

To generate a class report, do the following:

1. On the side menu, click **Instructor** and then click **Manage Class**.
2. Click the **Class** drop-down and then click to select the class you want to generate a performance report for.
3. Click anywhere in the **Class** list.
4. On the **Action** menu, click **Generate class report**.

The system generates the report and exports it as a PDF file that you can view and save.



# Operating the Motor Grader

Depending on your hardware configuration, the controls you use to operate the motor grader may differ. Simulators can include joysticks, control levers, a steering wheel, and foot pedals.

Students also use simulated controls on the touch-sensitive screen near the operator seat for setting up the motor grader to begin work and monitoring the machine performance.

## In this section

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[Physical Controls](#) , on the next page

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[Simulated Controls and Human Machine Interface](#), on page 53

# Physical Controls

The system supports the following control configurations for operating the motor grader during training exercises.

## Control Configurations

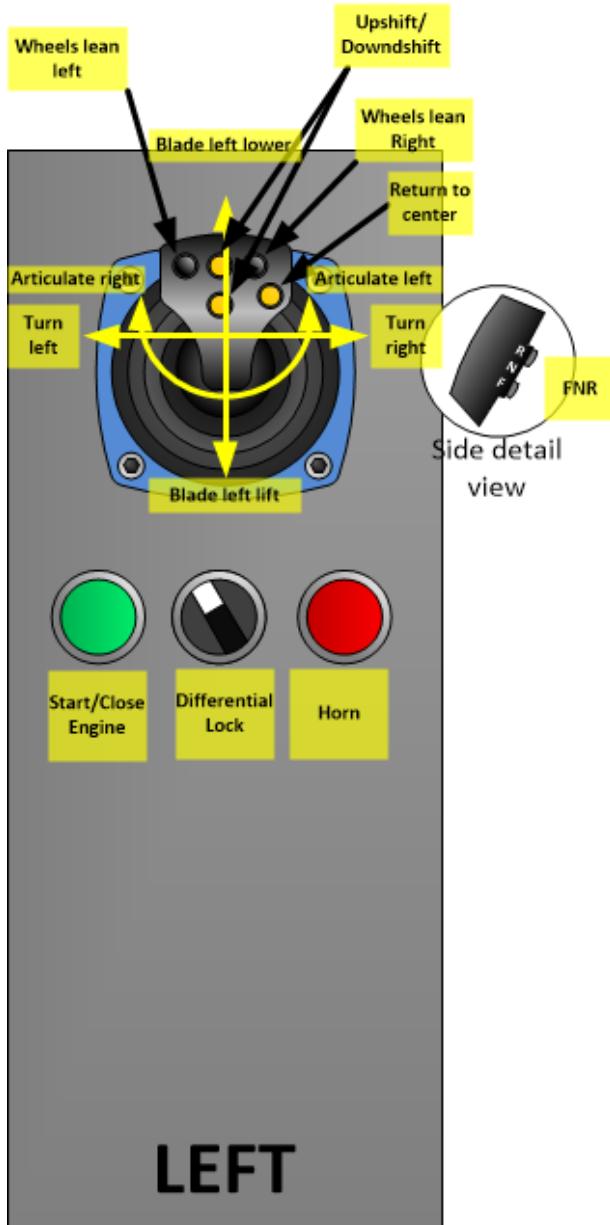
[Left Controls](#), on the facing page

[Right Controls](#), on page 46

[Pedals](#), on page 50

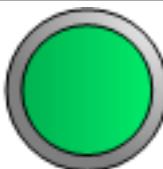
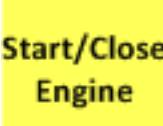
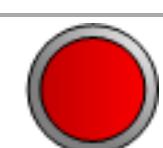
[Gamepad](#), on page 51

# Left Controls

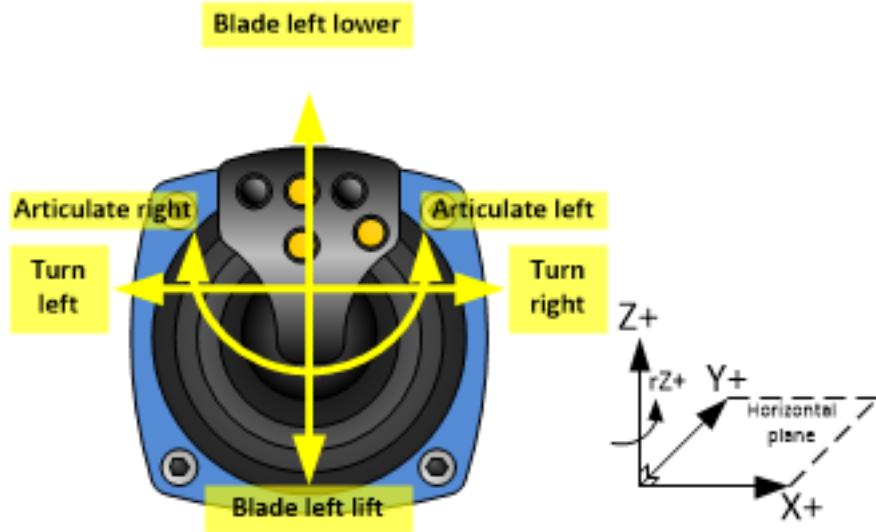


The left controls are mapped as follows:

## Left Controls - Buttons and Switches

Function	Description
	Press to starts equipment engine and boots up the HMI display.
 <b>Start/Close Engine</b>	
	Differential front locking axle can be engaged on the go at full torque up to 10 km/h. When the vehicle will go back, the differential will be reengaged if the switch is in the locking position.
	Press to sound the horn.
 <b>Horn</b>	

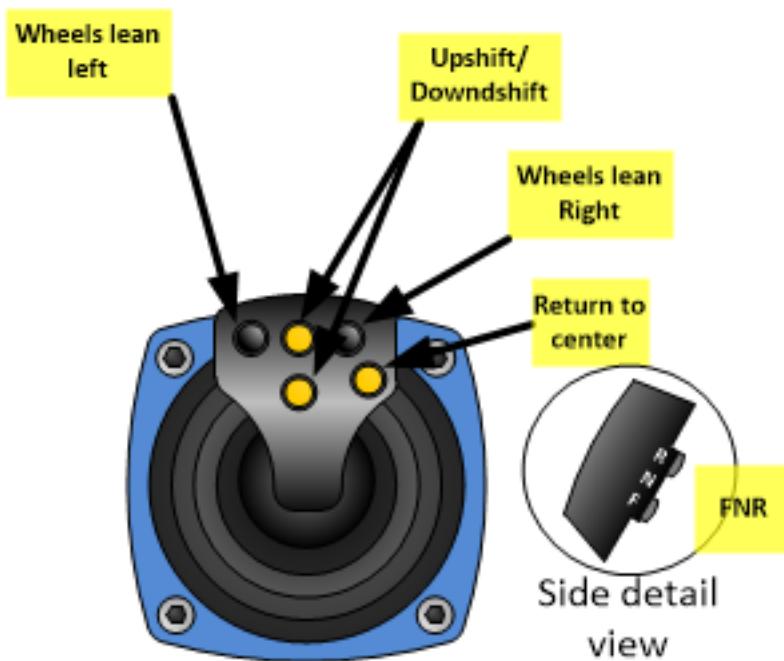
## Left Control Lever



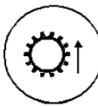
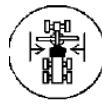
All movement on this joystick is proportional to the lever position and the engine revolution (throttle pedal position).

Function	Axis	+/-	Description
Turn Right	X	+	Steer right.
Turn Left	X	-	Steer left.
Blade Left Lower	Y	+	Lower the left side of the blade.
Blade Left Lift	Y	-	Lift the left side of the blade.
Articulation Left	rZ	+	Rotate the articulation to the left.
Articulation Right	rZ	-	Rotate the articulation to the right.

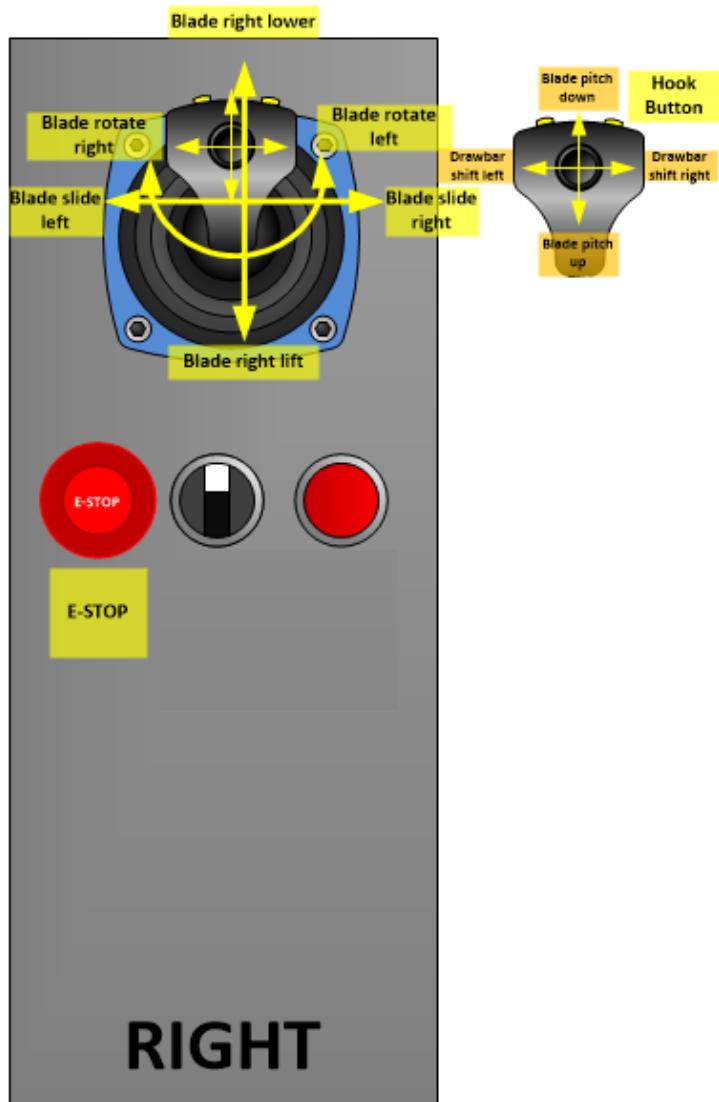
## Left Control Lever - Buttons



Function	Description
 Wheels Lean Left	To lean the wheels to the left, press the indicated control button. When you release the control button, the wheel lean will remain in the selected position.
 Wheels Lean Right	To lean the wheels to the right, press the indicated control button. When you release the control button, the wheel lean will remain in the selected position.
 Downshift Switch	Press to downshift the transmission to the desired forward speed or the desired reverse speed.

Function	Description
 <b>Upshift Switch</b>	Press switch to up-shift the transmission to the desired forward speed or the desired reverse speed.
 <b>Return to Center</b>	Press and release the indicated control button to return the machine articulation to the CENTER (NEUTRAL) position. The machine articulation gradually moves the machine to the CENTER position.
<b>Trigger FNR</b>	The FNR switch controls the driving direction of the equipment between Forward-Neutral-Reverse.

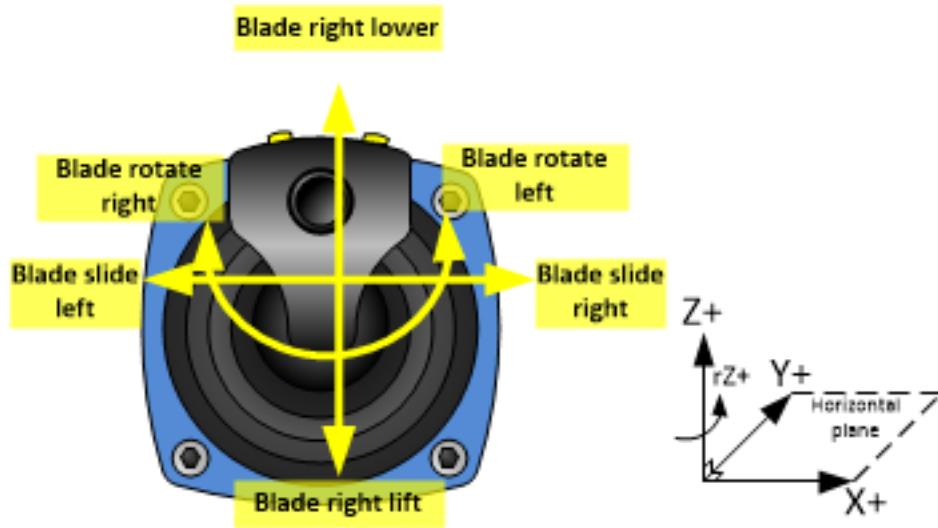
# Right Controls



## Right Controls - Buttons and Switches

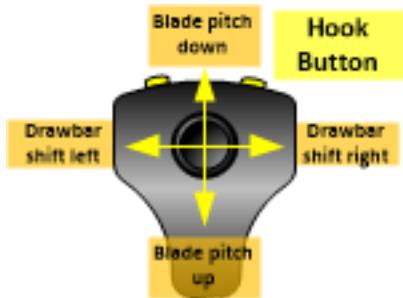
Function	Description
 	Press to stop equipment and motion platform in case of an emergency.

# Right Control Lever



Function	Axis +/-	Description
Blade Slide Right	X +	Move the right-hand joystick left to side shift the blade to the left.
Blade Slide Left	X -	Move the right-hand joystick right to side shift the blade to the right.
Blade Right Lower	Y +	Lower the right side of the blade.
Blade Right Lift	Y -	Lift the right side of the blade.
Blade Rotate Left	rZ +	To rotate the blade in a counterclockwise direction, twist the right-hand joystick counterclockwise.
Articulation Right	rZ -	To rotate the blade in a clockwise direction, twist the right-hand joystick clockwise.

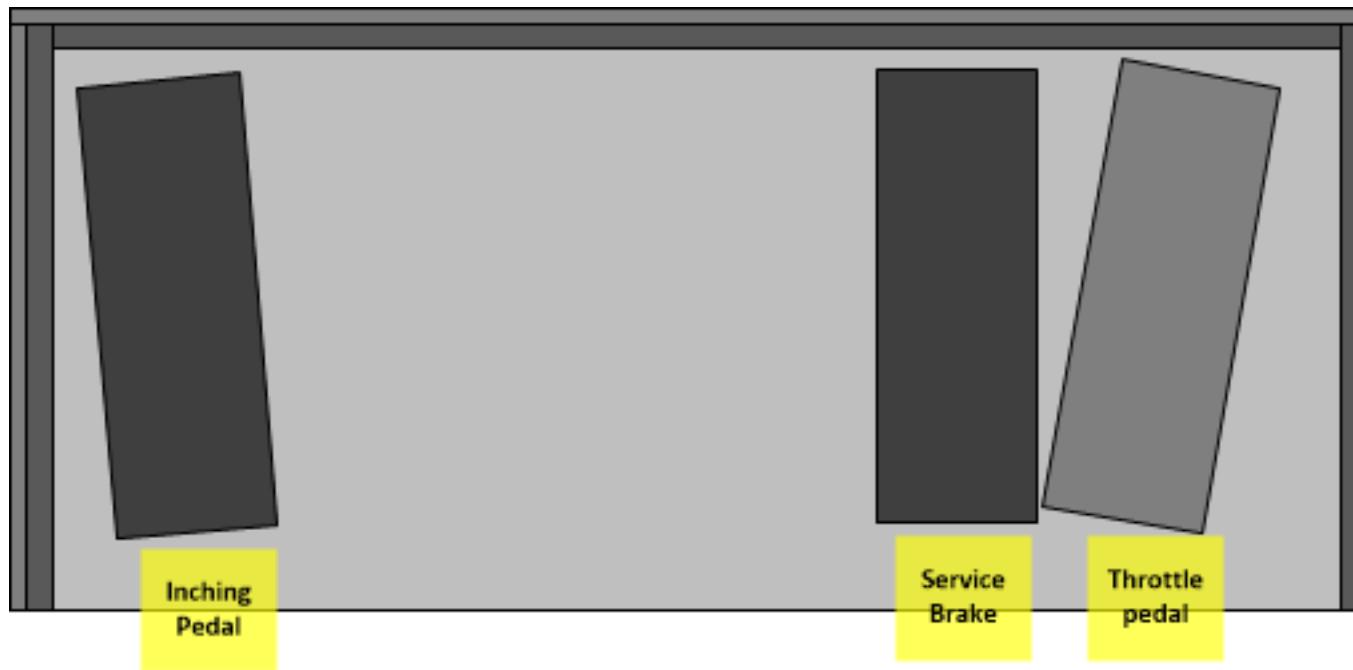
## Right Control Lever - Buttons



Function	Axis +/- Description		
Drawbar Shift Right	X	+	To move the drawbar to the right, push the right side of the thumb button.
Drawbar Shift Left	X	-	To move the drawbar to the left, push the left side of the thumb button.
Blade Pitch Down	Y	+	To pitch the blade forward, push the top of the thumb button.
Blade Right Lift	Y	-	To pitch the blade backward, push the bottom of the thumb button.

## Foot Pedals

The simulator comes equipped with pedals, as described below.



Control	Description
Throttle	Push down to increase engine revolution from idle to maximum revolution.
Service Brake	Push down to engage the service brake on the tandem wheels.
Inching Pedal	Push down to disengage the transmission (Acts like a neutral).

# Controllers

From the instructor station, instructors can use a gamepad controller to navigate the work site or control the avatar.

Joysticks are used to operate the Motor Grader on Vortex Edge (laptop).

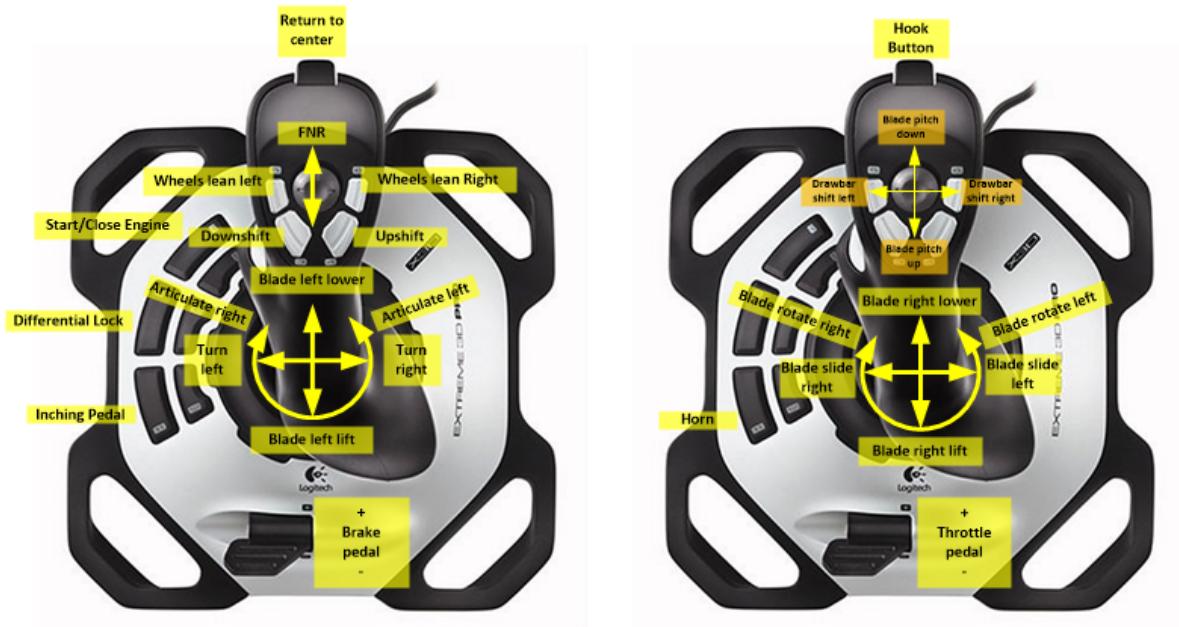
## Controlling the Avatar Using a Gamepad



## Controlling an Beholder Using a Gamepad



## Controlling the Motor Grader Using Joysticks (Vortex Edge)



# Simulated Controls and Human Machine Interface

The touch-sensitive screen near the operator seat shows controls for operating the motor grader, setting up equipment to begin work, and key performance information during operation.



## In this section

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[Main Page](#), on the next page

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[Sealed Switch Module](#), on page 57

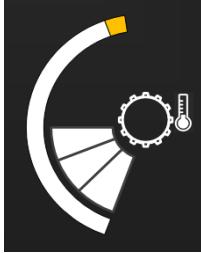
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[POV Widget](#), on page 63

## Main Page

The main page on the touch-sensitive screen shows the following feedback to the operator.



Display	Description
<b>14:36</b>	Current time
	Transmission temperature

Display	Description
	Coolant temperature
	Hydraulic temperature
	Fuel gauge
	Articulation gauge
 Current Slope : 1.1%	Current slope
<b>2F</b>	Gear indicator
<b>12</b> <b>KM/H</b>	Speedometer

Display	Description
<b>1460</b> <b>RPM</b>	Tachometer
<b>7.6</b> <b>L/H</b>	Fuel consumption

The following button is also available on this screen:

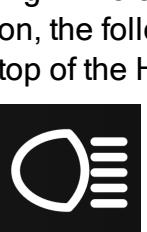
Display	Description
	Activates the rear view camera. The rear view camera will be displayed in the top-center of the front screen.

# Sealed Switch Module

The following switches are simulated:



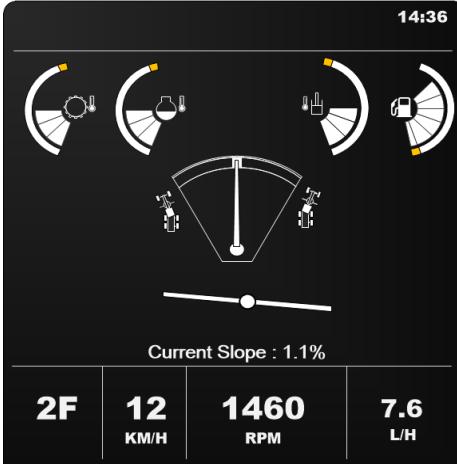
Switch	Description
1 Parking Brake	Press to engage the parking brake. 
2 Hazard Lights	Press to turn on hazard lights. 

Switch	Description
<b>3 Hydraulic Lock</b>	<p>The hydraulic lock disables every input from the instructor to the bucket and boom control. No movement is allowed. An alarm sounds when the operator tries to activate controls while locked.</p>
<b>4 Beacon Light</b>	<p>When activated, the following indicator is displayed on the HMI:</p> 
<b>5 Steering Joystick</b>	<p>Press and release switch to turn on beacon light on or off.</p> <p>Indicator illuminates when joystick steering is activated. Joystick steering is designed to complement the steering wheel of the motor grader. If you bump the steering wheel while operating the joystick steering, the wheel automatically takes over.</p>
<b>6 Lights</b>	<p>Activate all the working lights on the vehicle for nighttime operation. When the working lights are on, the following indicator is displayed along the top of the HMI display.</p> 
<b>7 6WD</b>	<p>Activate the six wheel drive function.</p> 

Switch	Description
<b>8 Saddle Lock Pin</b>	<p>Push and hold saddle lock pin switch for approximately three seconds. After three seconds, saddle lock pin unlocks, LED on sealed switch module illuminates, and saddle lock pin indicator illuminates. Push and hold saddle lock pin switch to lock. When lock pin is engaged, LED on sealed switch module shuts off and saddle lock pin indicator on the monitor shuts off.</p> 
<b>9 Cross Slope</b>	<p>The cross slope control system is designed to control the slope of the blade cutting edge.</p> <p>The operator selects the desired slope using buttons on the HMI. After selecting the desired slope, the operator chooses which side of the blade the cross slope system will automatically control. The system uses sensors mounted on the machine to calculate the current slope of the blade and determines if the blade slope needs to be adjusted up or down to maintain the operator's desired slope.</p> <p>The operator manually controls the elevation of the blade as the cross slope system maintains the slope of the cut. The slope can be adjusted any time using increment and decrement buttons. The direction of the slope can be easily swapped at the end of the pass. See the table below for more information on the different cross slope/auto blade setting combinations.</p>

Switch	Description
	Activate or deactivate the auto blade function when the cross slope function is ON.
<b>10</b> <b>Blade Auto Left</b> <b>(cross slope input)</b>	When Blade Auto Left is activated, the left joystick becomes the slave and the right joystick becomes the master; the operator only needs to operate the right joystick and the left side will follow. At any time, the operator can override the controls on the left side by using the joystick. When the joystick returns to neutral position, the blade will return to the desired position by itself.
<b>11</b> <b>Blade Auto Right</b> <b>(cross slope input)</b>	Opposite functionality of Blade Auto Left.
<b>12</b> <b>Increment/Decrement Left</b> <b>(cross slope input)</b>	When the cross slope function is ON and the auto blade is ON, this button increments or decrements the slope by 0.1% at a time for the left cylinder. Press and hold to increase the increment speed.
<b>13</b> <b>Increment/Decrement Right</b> <b>(cross slope input)</b>	When the cross slope function is ON and the auto blade is ON, this button increments or decrements the slope by 0.1% at a time for the right cylinder. Press and hold to increase the increment speed.
<b>14</b> <b>Slope Mirror</b> <b>(cross slope input)</b>	To change the direction of the desired slope ("mirror" the slope setting), momentarily press Slope Mirror button.

The following table describes the various cross slope/auto blade setting combinations:

Setting	Description
<p><b>Cross Slope OFF</b></p> 	<p>Current Slope indicates the rolling angle based on a sensor located under the cabin.</p> <p>The cross slope angle indicator slopes to the right, left or flat to show the direction of the current slope:</p> 
<p><b>Cross Slope ON – Auto Blade OFF</b></p> 	<p>When the cross slope function is activated, the automatic blade control indicator illuminates:</p>  <p>The grade indicator appears on the left side as the current slope is transferred to the desired slope:</p>  <p>When the current grade matches the desired grade, the middle bar of the grade indicator turns orange:</p>  <p>When the current grade is off the desired slope, the middle bar is white and the relevant dots illuminate:</p> 

Setting	Description
	When the cross slope and the auto blade are activated on the left or right as follows: 
Cross Slope ON – Auto Blade ON Left	Both Cross Slope and Auto Blade indicators are displayed: 
	When auto blade is activated on the left or right , the grade indicator is displayed on the corresponding side of the display:  To change the direction of the desired slope ("mirror" the slope setting), momentarily press the Slope Mirror button: 
	The blade changes slope angle and the slope indicator updates. <b>Note:</b> If one side is being automatically controlled, use the blade lift lever for the other side to manually control the depth of cut. The lift cylinder adjusts to maintain the desired slope. You can use the blade lift lever to temporarily override the automatic system if necessary (for example, to lift the blade up to clear a manhole cover).

# Operator View Controls

The HMI displays controls which operators can use to change their Point-of-View (POV) in the simulated environment.



Button	Description
1 Memory Set #1	Pressing this button for three seconds records the current position of the operator POV. Once the position is recorded, the operator has to press the button one time to align the operator POV with the defined position. The default preset of Memory #1 should be the left side of the blade.
2 Memory Set #2	Pressing this button for three seconds records the current position of the operator POV. Once the position is recorded, the operator has to press the button one time to align the operator POV with the defined position. The default preset of Memory #2 should be the right side of the blade.
3 Reset	Reset the operator POV to the default position.
4 Lateral Offset	The lateral offset will side shift the operator POV on the horizontal axis to represent the operator head movement. The limit zone of side shift will be the machine cabin. The lateral offset can affect the auto follow by moving the attachment point on the lateral axis. The operator needs to press the Reset button to go back to the default POV/Auto Follow.

<b>Button</b>	<b>Description</b>
<b>5 Orientation Control</b>	The orientation control is a representation of the operator head movement. By pressing and dragging the traction ball on the HMI, the operator will modify the focus point of the operator POV based on the traction ball direction. The operator needs to press the Reset button to reset the view to the default setting.
<b>6 Auto Follow</b>	When auto follow is activated, the operator point of view will follow a predefined point of the machine mechanism. For the motor grader, the attachment point will be the center of the blade.

# Conducting Training Exercises from the Instructor Console

The Vortex instructor console is designed to help the instructor train operators on the simulator. You can access the main features of the console from options on the instructor console side menu. The side menu is designed to help you accomplish different tasks in the user interface.

When you start the simulator from the instructor station, the instructor console appears on one of the two monitors. Once you launch a training exercise, you can accomplish the following from the side menu of the instructor console:

- View the simulation as the operator works through the exercise.
- Monitor an operator's performance metrics in real time. You can also add comments.
- Record an exercise, then play it back (for example, to review it with the operator).
- Modify weather conditions.

**Note:** For simulator configurations with no instructor console, the operator perform these operations from menus on the operator console.

# Assigning Exercises to Students

Once operators are prepared to begin a training exercise, you can assign them exercises to complete by name from the Instructor station. While anyone can operate the simulator anonymously using the system Guest account, assigning an exercise to a student by name lets you record performance metrics for each student and generate specific reports tracking their improvement over time.

## To Assign a Training Exercise

**Prerequisites:** Before you can assign a training exercise, you must be logged into the system with an **Instructor** account.

To assign an exercise for a specific operator to complete, from the Instructor station, do the following:

1. While logged in as the Instructor, on the side menu, click **Select Exercise**.
2. Under **Equipment**, click **Motor Grader**.
3. Click **Select Exercise**.
4. Click to select the training exercise you want to assign the student.
5. Click **Select Students**.
6. In the **Users** list, double-click to select the user you want to assign the training exercise to. Typically, this is the person who will operate the equipment during the exercise.

**Note:** By default, the name of the Instructor appears in the **Participants** list for each training exercise they conduct while logged in.

7. Click **Load**.
8. The exercise **Initial Setup** wizard loads and you can configure the training exercise.

# Modify Scoring Settings

Evaluation and assessment are an important part of operator training. The system is designed to record measurements of key performance metrics and use them to evaluate operator performance at the end of each exercise. Depending on your curriculum and training objectives, the metrics and thresholds you use to assess performance may differ from the default settings.

For each training exercise, the system lets you customize the metrics the system uses to score operators. From the Scoring page for any exercise, system administrators can weight each metric and specify thresholds which the operator must not exceed.

The score is displayed to the operator at the end of each training exercise. Any reports the instructor generates for the exercise also display the score. Once you customize scoring settings, the system saves your configuration for future exercises. You can revert to system settings at any time.

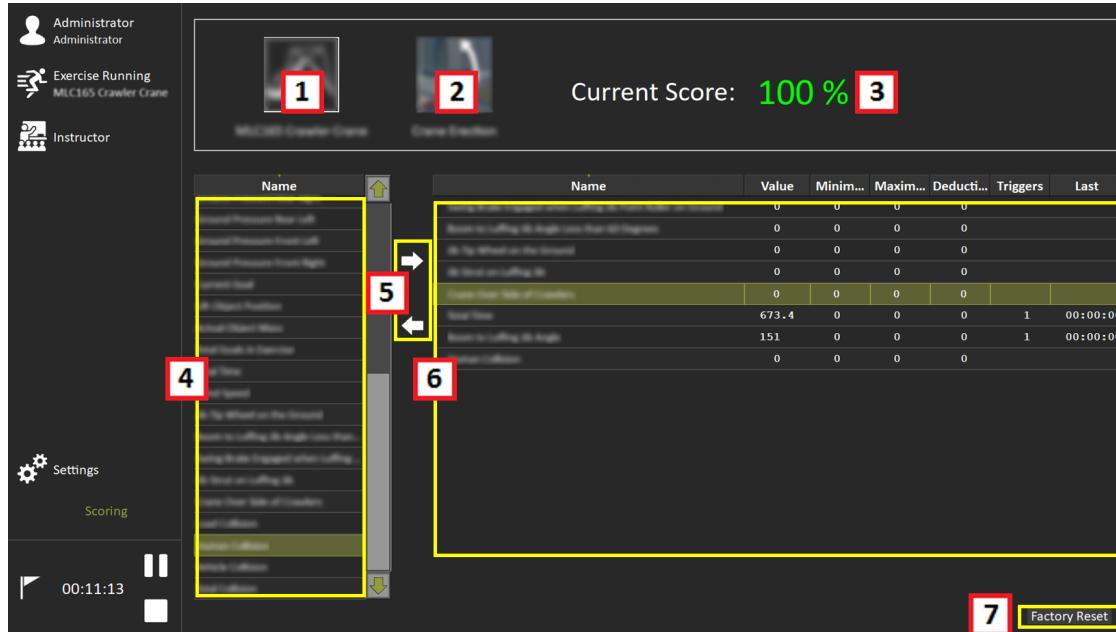
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<b>The Scoring Page .....</b>	<b>68</b>
<b>Scoring Rules .....</b>	<b>70</b>
<b>Customize Scoring Rules .....</b>	<b>71</b>
<b>Restore Default Scoring Settings .....</b>	<b>72</b>

# The Scoring Page

The **Scoring** page shows the specific metrics and thresholds the system uses to evaluate operator performance for each exercise.

The first time you view the **Scoring** page, the system shows the default settings for each metric. Once you customize scoring thresholds for a given metric, you can revert to default settings by clicking the **Factory Reset** button in the lower right of the screen.



Feature Description	Description
1 Equipment Name	Shows the name of the equipment simulation
2 Training Exercise	Shows the name of the training exercise you started.
3 Current Score	The current score, as calculated using the scoring thresholds configured in the table below.
4 Metrics	List shows the metrics the system records measurements for during the exercise.
5 Selector Arrows	Use selector arrows to add metrics you want to add scoring thresholds for to the list of configured thresholds.

Feature Description	Description
<b>6</b> List of Scoring Thresholds	<p>A table shows each scoring threshold that the system currently uses to calculate the score for the exercise. Each threshold has the following attributes:</p> <ul style="list-style-type: none"> <li>■ A metric</li> <li>■ The current measurement in the system for the metric</li> <li>■ A minimum threshold for the metric</li> <li>■ A maximum threshold for the metric</li> <li>■ A penalty (point deduction) the system applies when the system observes values which are outside the minimum and maximum thresholds</li> <li>■ The number of times the system observed values outside the thresholds.</li> <li>■ The time when the system applied the last penalty.</li> </ul>
<b>7</b> Factory Reset Button	Press to return all scoring settings to system defaults.

# Scoring Rules

By default, the system records measurements for many metrics, such as Collisions, Idle Time, and Fuel Consumption. You can configure scoring rules to make the system deduct points from the operator's score whenever measurements for a metric reach a specific value.

For example, you can create a rule that makes the system deduct 10 points when the operator exceeds a time limit you define.

Adding a new rule involves the following activities:

1. You use the selector arrows to add a metric to the list of configured rules. For example, you add a rule for the **Collisions** metric.
2. You specify when you want the system to deduct points. For example, when the system observes a collision.
3. You specify how many points the system should deduct for the rule. (For example, 10 points).

For each scoring rule, the system displays the following information:

Column Head	Description
<b>Value</b>	The current system measurement for the metric.
<b>Minimum</b>	The lower limit of the threshold the system uses to assess operator performance for the metric.
<b>Maximum</b>	The upper limit of the threshold the system uses to assess operator performance for the metric.
<b>Deduction</b>	The number of percentage points the system deducts if the value for the metric exceeds the maximum limit of the threshold or is below the minimum.
<b>Triggers</b>	The number of times the value for the metric was outside the defined threshold.
<b>Time</b>	The time stamp of the last event.

# Customize Scoring Rules

**NOTE:** Only users logged into the system with an Administrator account can modify scoring settings.

1. Log into the system using the **Administrator** account.
2. Launch the exercise you want to customize scoring settings for.
3. Press the **Horn** or **Hook** button to start the exercise.

Note: You cannot edit scoring rules until the exercise is running.

4. On the side menu, click **Settings** and then click **Scoring**.

The system displays the default scoring rules for the exercise, and the current score for the exercise.

5. In the **Name** list, click the metric you want to create a new rule for and then click the selector arrow button to move it to the list of metrics the system uses to score the exercise.
6. For each column, click to select and then enter custom values for the following:

<b>Minimum</b>	Type a minimum value for the threshold.
<b>Maximum</b>	Type a maximum value for the threshold.
<b>Deduction</b>	Type the number of percentage points the system will deduct if values for the metric exceed or are below the maximum and minimum values for the threshold.

The system updates the current score to reflect the updated scoring rules immediately.

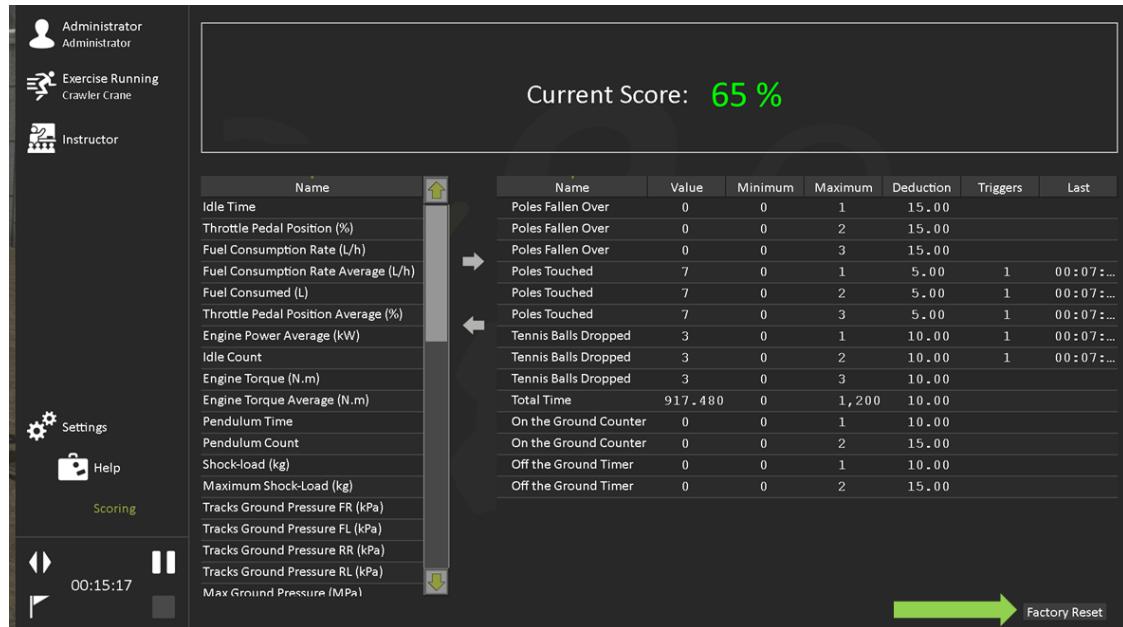
7. (Optional) Select and modify other metrics as needed.

# Restore Default Scoring Settings

System Administrators can restore scoring settings to system defaults at any time. To reset scoring settings, do the following:

**NOTE:** Only users logged into the system with an Administrator account can reset Scoring settings.

1. Log into the system using the **Administrator** account.
2. Launch and start the exercise you want to reset Scoring settings for.
3. In the lower right of the screen, press the **Factory Reset** button.



Scoring values for each metric return to system defaults. The score at the top of the screen is updated at the same time.

# Monitoring Operator Performance

Once a training exercise is running, the application automatically displays the **Dashboard** page. The instructor can monitor and assess operator performance in real-time using the charts and metrics, or bookmark specific moments during the training exercise to give timely, written feedback.



The Dashboard page shows multiple panes monitoring performance and offering timely, relevant feedback.

## Dashboard Pane Description

<b>Metrics</b>	View various statistics for assessing performance during the training exercise. Click any metric to plot it over time in the <b>Chart</b> pane.
<b>Chart</b>	Select up to two metrics displayed in the <b>Metrics</b> pane to Chart over time.
<b>Bookmarks</b>	Bookmark any specific time in the exercise and comment for later review.
<b>Comments</b>	Type general comments for the operator to review here.

# Performance Metrics

During each training exercise, the system records measurements for performance metrics which the instructor can use to assess operator progress.

Depending on the exercise, the system may measure different metrics.

Metric	Description
<b>Barrels Knocked Over</b>	The number of barrels the operator knocked over during the exercise.
<b>Barrels Touched</b>	The number of barrels the operator touched with the load during the exercise.
<b>Cones Knocked Over</b>	The number of cones the operator knocked over during the exercise.
<b>Cones Touched</b>	The number of cones the operator touched with the load during the exercise.
<b>Critical Collisions</b>	The number of collisions which the system characterized as Critical during the exercise.
<b>Major Collisions</b>	The number of collisions which the system characterized as Major during the exercise.
<b>Minor Collisions</b>	The number of collisions which the system characterized as Minor during the exercise.
<b>Goals</b>	The number of goals which the operator accomplished.
<b>Total Time</b>	The total time elapsed during the exercise.
<b>Articulation Angle (°)</b>	The articulation angle of the blade, displayed in degrees in real time. When the blade is straight the articulation angle is zero.
<b>Average Force Front Left (kg)</b>	The average force on the front left wheel during the exercise, in kg.
<b>Average Force Front Right (kg)</b>	The average force on the front right wheel during the exercise, in kg.
<b>Average Force Left Front (kg)</b>	The average force on the left front wheel during the exercise, in kg.
<b>Average Force Left Rear (kg)</b>	The average force on the left rear wheel during the exercise, in kg.

Metric	Description
Average Force Right Front (kg)	The average force on the right front wheel during the exercise, in kg.
Average Force Right Rear (kg)	The average force on the right rear wheel during the exercise, in kg.
Average Speed	The average speed at which the motor grader travels during the exercise. (Only calculated while the vehicle is moving.)
Average Torque Consumption Percentage (%)	The average percentage of torque consumed (of the total power available) over the time elapsed during the exercise.
Average Traction Front Left (N)	Average traction (torque) of the front left wheel during the exercise.
Average Traction Front Right (N)	Average traction (torque) of the front right wheel during the exercise.
Average Traction Left Front (N)	Average traction (torque) of the left front wheel during the exercise.
Average Traction Left Rear (N)	Average traction (torque) of the left rear wheel during the exercise.
Average Traction Right Front (N)	Average traction (torque) of the right front wheel during the exercise.
Average Traction Right Rear (N)	Average traction (torque) of the right rear wheel during the exercise.
Average Wheel Lean Angle (°)	Average lean angle of the front wheels during the exercise, in degrees. When the wheels are straight, the angle is 0°.
Axle Load Front (kg)	The load, in kg, applied to the front axle, in real time.
Axle Load Front Average (kg)	The average amount of load, in kg, applied to the front axle during the exercise.
Axle Load Rear (kg)	The load, in kg, applied to the rear tandem axle, in real time.
Axle Load Rear Average (kg)	The average load, in kg, applied to the rear tandem axle during the exercise.

Metric	Description
Blade Contact	The number of times the blade came into contact with the vehicle or obstacles, such as concrete curbs, a manhole, or storm sewer during the exercise.
Brake Pedal Position (%)	The current position of the operator brake pedal, expressed as a percentage.
Brake Pedal Position Average (%)	The average position of the operator brake pedal during the exercise, expressed as a percentage.
Current Engine Power (kW)	The current amount of engine power consumed, in kW.
Current Force Front Left (kg)	The current force on the front left wheel, in kg.
Current Force Front Right (kg)	The current force on the front right wheel, in kg.
Current Force Left Front (kg)	The current force on the left front wheel, in kg.
Current Force Left Rear (kg)	The current force on the left rear wheel, in kg.
Current Force Right Front (kg)	The current force on the right front wheel, in kg.
Current Force Right Rear (kg)	The current force on the right rear wheel, in kg.
Current Torque Consumption (%)	The current percentage of torque consumed (of the total power available).
Current Traction Front Left (N)	The current traction (torque) on the front left wheel, in N.
Current Traction Front Right (N)	The current traction (torque) on the front right wheel, in N.
Current Traction Left Front (N)	The current traction (torque) on the left front wheel, in N.
Current Traction Left Rear (N)	The current traction (torque) on the left rear wheel, in N.
Current Traction Right Front (N)	The current traction (torque) on the right front wheel, in N.

Metric	Description
<b>Current Traction Right Rear (N)</b>	The current traction (torque) on the right rear wheel, in N.
<b>Current Wheel Lean Angle (°)</b>	Current lean angle of the front wheels, in degrees. When the wheels are straight, the angle is 0°.
<b>Engine Power Average (kW)</b>	The average amount of engine power consumed over the time elapsed during the exercise, in kW.
<b>Fuel Consumed (L)</b>	The current amount of fuel consumed, in liters.
<b>Fuel Consumption (L/h)</b>	The current rate of fuel consumption, in liters per hour.
<b>Fuel Consumption Rate Average (L/h)</b>	The average amount of fuel consumed per hour over the time elapsed in the exercise, in liters per hour.
<b>Gear Time -1</b>	The amount of time the vehicle spent in reverse 1st gear during the exercise.
<b>Gear Time -2</b>	The amount of time the vehicle spent in reverse 2nd gear during the exercise.
<b>Gear Time -3</b>	The amount of time the vehicle spent in reverse 3rd gear during the exercise.
<b>Gear Time -4</b>	The amount of time the vehicle spent in reverse 4th gear during the exercise.
<b>Gear Time -5</b>	The amount of time the vehicle spent in reverse 5th gear during the exercise.
<b>Gear Time -6</b>	The amount of time the vehicle spent in reverse 6th gear during the exercise.
<b>Gear Time -7</b>	The amount of time the vehicle spent in reverse 7th gear during the exercise.
<b>Gear Time -8</b>	The amount of time the vehicle spent in reverse 8th gear during the exercise.
<b>Gear Time 1</b>	The amount of time the vehicle spent in forward 1st gear during the exercise.
<b>Gear Time 2</b>	The amount of time the vehicle spent in forward 2nd gear during the exercise.
<b>Gear Time 3</b>	The amount of time the vehicle spent in forward 3rd gear during the exercise.
<b>Gear Time 4</b>	The amount of time the vehicle spent in forward 4th gear during the exercise.

Metric	Description
<b>Gear Time 5</b>	The amount of time the vehicle spent in forward 5th gear during the exercise.
<b>Gear Time 6</b>	The amount of time the vehicle spent in forward 6th gear during the exercise.
<b>Gear Time 7</b>	The amount of time the vehicle spent in forward 7th gear during the exercise.
<b>Gear Time 8</b>	The amount of time the vehicle spent in forward 8th gear during the exercise.
<b>Ground Level Sensor</b>	The height of the field based on the goal grade.
<b>Idle Count</b>	The number of times the operator let the machine idle during the exercise.
<b>Idle Time</b>	The total amount of time the machine was idle during the exercise.
<b>Lock Differential Turning Count</b>	The number of times the operator tried to turn the vehicle while the differential lock was engaged or the transmission was in the 5th gear or higher (forward or reverse).
<b>Lock Differential Turning Time</b>	The total amount of time the vehicle spent with an articulation angle exceeding 10° while the differential lock was engaged or the transmission was in the 5th gear or higher (forward or reverse).
<b>Neutral Pedal Position</b>	The current position of the operator neutral pedal, expressed as a percentage.
<b>Neutral Pedal Position Average (%)</b>	The average position of the operator neutral pedal during the exercise, expressed as a percentage.
<b>Throttle Pedal Position</b>	The position of the operator throttle pedal in real time, expressed as a percentage.
<b>Throttle Pedal Position Average (%)</b>	The average pedal position (expressed as a percentage) over the time elapsed during the exercise.
<b>Wheel Slip Count</b>	The number of times the wheels slipped during the exercise.
<b>Wheel Slip Time</b>	The total amount of time wheels spent slipping (spinning) during the exercise.

Metric	Description
<b>Electric Pole or Cable Contact</b>	The number of times the equipment came into contact with an electric pole or cable during the exercise.
<b>Human Contact</b>	The number of times the equipment came into contact with a human avatar in the work site during the exercise.
<b>Safe Parking Position</b>	The number of times the operator turned off the engine without ensuring the blade touched the ground during the exercise.
<b>Vehicle Flip Over</b>	The number of times the operator flipped over the vehicle during the exercise.

# Graphing Performance Metrics

Plotting performance metrics which the system records for each a training session on a graph can offer insights into whether a student is improving certain skills through practice. You can plot up to two performance metrics over the time elapsed since the training exercise began, or the past 120 seconds, on a graph in the **Chart** pane of the **Dashboard** page.

To view a graph of a performance metric over time during a training exercise, on the **Dashboard** page of the instructor console, do the following:

1. In the **Metrics** section, click the metric you want to plot. For example, in the section for **Collisions** metrics, click **Critical**.

The **Chart** pane displays a graph of the **Collisions Critical** metric over the time elapsed since the training exercise began appears.

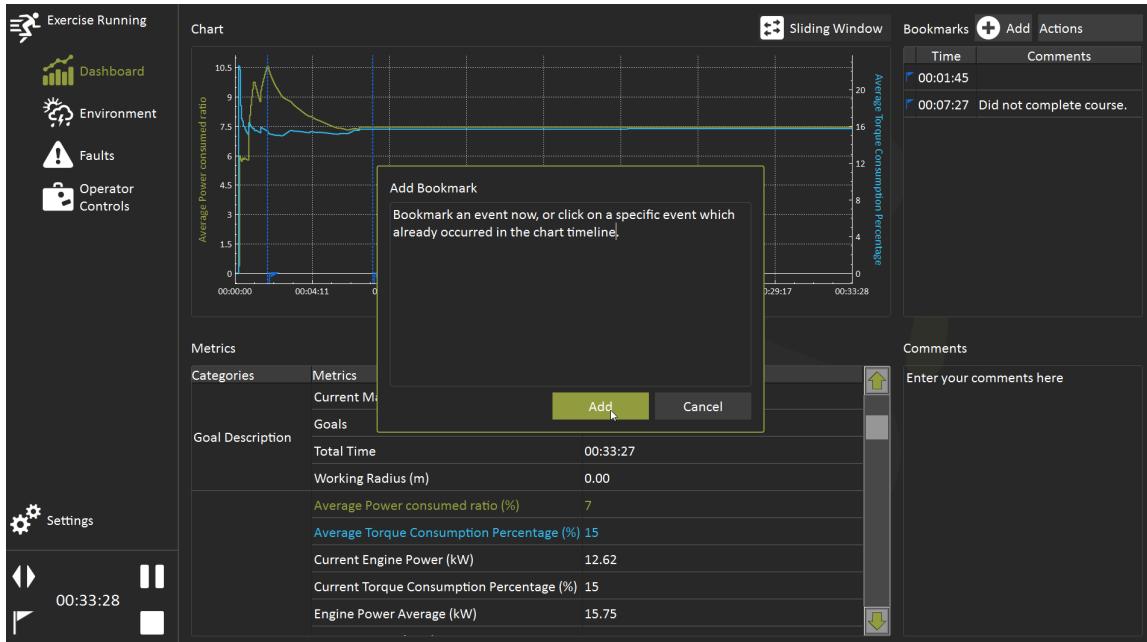
2. To plot another metric over time in the same graph, click the metric you want to view. For example, in the section for **Performance**, click **Containers moved**.

The **Chart** pane displays a graph of the **Performance Containers Moved** metric over the time elapsed since the training exercise began appears.

3. To plot the metrics over the past 120 seconds, click the **Sliding Window** button.

# Bookmarking Events for Review

As you observe the operator completing exercises, there may be events for which you want to provide targeted, timely feedback. You can *bookmark*, or flag timestamps in the training exercise to review with the operator and provide commentary.



For example, if you notice the operator ignore a pedestrian in the work area but don't want to stop the exercise to discuss the event, you can bookmark the event on the **Bookmarks** pane, add a comment, and review the incident with the operator at the end session.

The system lets you bookmark an event which is occurring now, or an event that occurred previously in the session.

All bookmarks and comments appear in the reports you generate for this training session.

# Changing Environmental Conditions

Learning to operate equipment in various weather conditions is an important part of training. By default, each training exercise begins with ideal weather conditions. From the instructor page, you can modify weather settings during any training exercise. Operators learn to recognize and react safely to hazardous weather conditions.



# To Change the Weather in the Simulated Environment

To modify weather conditions in the environment during a training exercise, from the instructor station, do the following:

1. On the side menu, click **Exercise Running** and then click **Environment**. The **Weather** page appears.
2. Use controls to change weather conditions in the environment. You can observe changes you make to the weather from any Instructor views of the environment.

## To Increase Cloud Cover

In the **Clouds** section, do one of the following:

- To increase cloud cover in the sky, move the slider toward **Overcast**.
- To decrease cloud cover in the sky, move the slider toward **Clear**.

## To Increase Fog Density

In the **Fog** section, do one of the following:

- Press the button corresponding to the fog density you want to introduce in the simulated environment.
- To adjust the fog density using a slider, press the tool button .

## To Modify Wind Speed and Heading

In the **Wind** section, do any of the following:

- To increase wind speed, move the slider toward **130 km/s** (the maximum wind speed that the system supports)
- To change the wind heading, move the slider around the compass rose to the correct angle.
- To introduce a gust of wind, in the **Gust** section, use the slider and compass rose to choose a speed and heading, and then press the **Gust** button. The wind gust temporarily overrides wind settings.

## To Make it Rain

1. In the **Precipitation** section, click **Rain**.
2. Do one of the following:
  - For heavier rain, move the slider toward **High**.
  - For lighter rain, move the slider toward **Low**.
  - To adjust rain settings using graphical buttons, press the tool button .

## To Make it Snow

1. In the **Precipitation** section, click **Snow**.
2. Do one of the following:
  - For heavier snow, move the slider toward **High**.
  - For lighter snow, move the slider toward **Low**.
  - To adjust snow settings using graphical buttons, press the tool button .

## To Adjust Lighting

In the **Lighting** section, do one of the following:

- To adjust light in the simulated environment for the time of day, in the row for time  use the arrow buttons to set the time.
- To adjust light in the simulated environment for the time of year, in the row for month , use the arrow buttons to set the month.

# Ending and Evaluating an Exercise

Once the student completes all the tasks in an exercise and you have reviewed any segments of interest, you must end the session and evaluate operator performance. You can also generate a performance report for the session.

## Example of an Exercise Report



Any time you end a training exercise, the system prompts you to evaluate whether or not the operator completed the exercise successfully. You can choose from the following options:

Option	Description
<b>Pass</b>	Any reports that the system generates for this exercise will show that the operator passed this exercise.
<b>Fail</b>	Any reports the system generates about this exercise will show that the operator did not pass this exercise.
<b>Don't record</b>	The system will not store any performance metrics for this training exercise, and no record of it will appear under the list of exercises the operator completed. This is useful if something outside the operator's control prevents him from completing the exercise.

## To End an Exercise and Evaluate the Session

When the operator is done, from the instructor station, do the following:

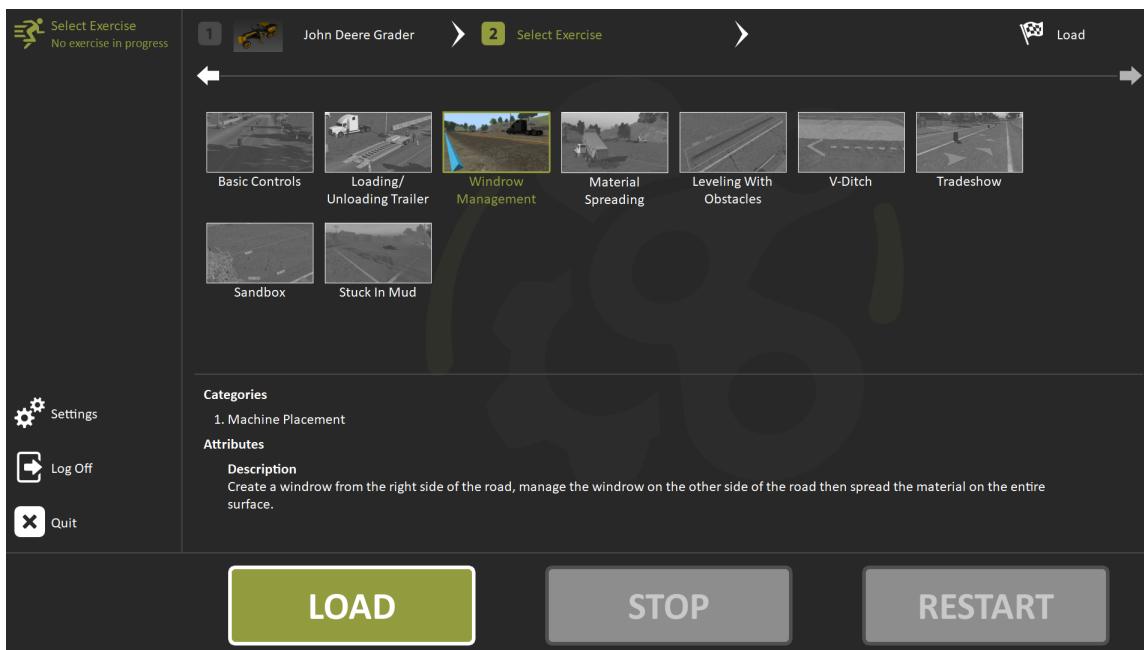
1. In the lower left of the application, click the **Stop** button .
2. In the window that appears, do one of the following:
  - To indicate that the operator successfully completed the exercise, click **Pass**.
  - To indicate that the operator did not successfully complete the exercise, click **Fail**.
  - To discard the session and leave the record of it in the system, click **Don't Record**.
3. In the **Comments** text box, type any feedback you would like the operator to review. The feedback will appear in any reports that you generate for the session.
4. (Optional) To generate a performance report for this session, on the **Action** menu, click **Generate exercise report**.  
The system generates a PDF report detailing performance statistics for the exercise.
5. (Optional) To return to the exercise after generating the report, click the **Back** button.
6. To end the exercise, click **Stop**. The exercise closes.



# Training Exercises

Each training exercise is designed to teach operators specific skills. For each skill the system focuses on, the user interface offers tips and assessment methods which instructors and operators can use to track progress. For example, during material management exercises, an on screen display measures the quality of the grade the operator produces. In other exercises, the system measures blade efficiency and operator productivity.

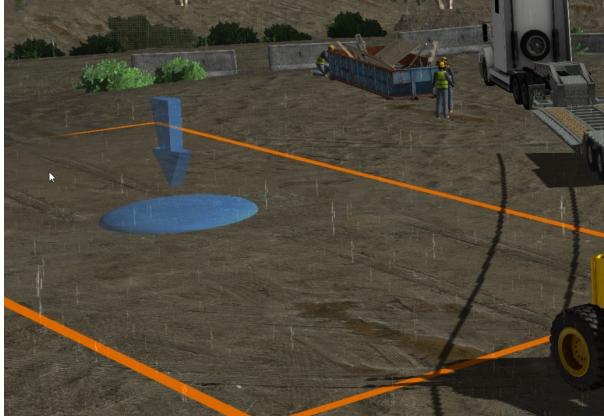
The system features the following training exercises:

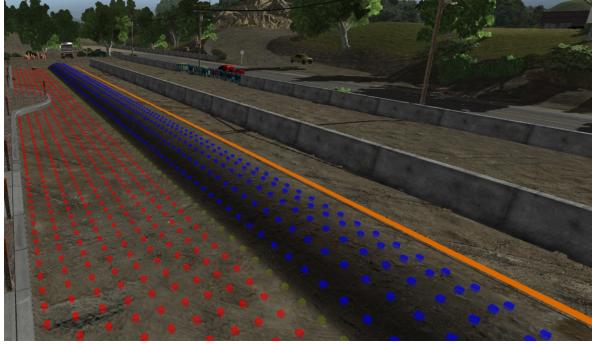


<b>Exercise</b>	<b>Description</b>
<b>Basic Controls</b> , on page 93	Learn the basics of moving and operating the motor grader.
<b>Loading and Unloading a Trailer</b> , on page 97	Safely load and unload the motor grader from a lowboy trailer.
<b>Windrow Management</b> , on page 100	Create and move a windrow from one side of the road to the other, then spread the material evenly.
<b>Material Spreading</b> , on page 104	Learn to spread material on a flat surface to match a defined grade, and coordinate with a dump truck.
<b>Leveling with Obstacles</b> , on page 108	Level material close to obstacles.
<b>Stuck in Mud</b> , on page 112	Get the grader stuck on a muddy road and dislodge it.
<b>V-ditch</b> , on page 115	Create a V-ditch and produce a crown with the excavated material
<b>Tradeshow</b> , on page 119	A mixed skill exercise meant to present the motor grader at trade shows.
<b>Sandbox</b> , on page 121	Free-form exercise where the operator can independently improve skills.

# Learning Aids in Training Exercises

During exercises, visual indicators appear in the simulation to help operators complete each goal. For motor grader training exercises, the system uses visual cues and targets to indicate where and how to move the blade and vehicle.

Indicator	Example	Description
Target Location		Transparent blue targets indicate the next position of the blade or wheels.
Machine Positioning		Orange lines and an arrow show the intended parking position for the vehicle.
Windrow Location		Blue lines show the intended location for a windrow.

Indicator	Example	Description
<b>Grade Quality Indicators</b>		<p>Colored dots show which material in the area is too deep or too shallow, and which material is the correct height.</p> <ul style="list-style-type: none"> <li>■ Blue dots show material which is too low or shallow.</li> <li>■ Red dots show material which is too high or thick.</li> <li>■ Green dots show material which is the correct grade.</li> </ul>

# Basic Controls

This exercise is designed to help operators learn basic motor grader controls and functions:

1. On-screen indicators show the operator how to lift, lower, rotate, side-shift, and pitch the blade.
2. The operator moves the blade to the driving position and drives across a course. The course includes a slalom course, speed bumps, and a three-point turn.
3. The operator goes back to the start position and turns in a confined area on uneven ground.
4. The operator parks the motor grader.



# Learning Outcomes

Operators can develop the following abilities by completing this exercise:

Goal	Methodology
Set up the motor grader.	The operator must start the engine and set up the motor grader to start blade operations.
Position the blade with precision and accuracy using the following motions: <ul style="list-style-type: none"><li>■ Blade Lower</li><li>■ Blade Lift</li><li>■ Circle Rotate</li><li>■ Circle Side-Shift</li><li>■ Blade Side-Shift</li><li>■ Blade Pitch</li></ul>	On-screen indicators show the operator where to move the blade next. A heads-up display (HUD) shows the distance the blade must move to achieve the next goal.  Once the operator puts the blade in the correct position, the indicator turns green and a new target for the blade appears.
Drive the vehicle to a target destination.	On-screen instructions show the operator how to raise the blade so that the blade heel points toward oncoming traffic.  Reports show measurements for how long the operator spends in each gear, traveling speed, and any collisions.
Do a 3-point turn.	On-screen instructions show the movements the motor grader must use to do the turn correctly.  Reports show measurements for wheel lean angle and traction.
Become familiar with controls and equipment.	The operator must use controls in precise, controlled ways to complete every task.

# Key Performance Indicators

To complete the exercise, operators must:

- Complete each goal as quickly as possible.
- Use controlled precise movements to put the blade on each target.
- Use the correct gear and speed.
- Change direction and gears with ease. (The vehicle should never slide.)
- Use the correct wheel lean and articulation during turns. Maintain a safe distance from nearby objects.
- Do a 3-point turn.
- Do not contact obstacles such as barrels and cones.

If the motor grader contacts any personnel, the exercise ends immediately and the operator must restart.

## Metrics

Category	Metric
Goal Description	Time
	Current Blade Height
Machine	Idle Time
	Blade Contacts
	Average Speed
	Fuel Consumption
	Throttle Pedal Position
	Brake Pedal Position
	Neutral Pedal Position
	Engine Power
	Engine Torque
	Axle Load (Front and Tandem)
	Wheel Reaction Force
	Articulation Angle
	Front Wheel Lean Angle
	Wheel Traction

<b>Category</b>	<b>Metric</b>
	Gear Time
	Wheel Slip
	Lock Differential Turning
<b>Environment</b>	Collisions
	Barrels Touched
	Barrels Knocked Over
	Cones Touched
	Cones Knocked Over
<b>Performance</b>	Blade Capacity
	Blade Efficiency
	Grade Sensor
<b>Safety Violation</b>	Vehicle Flip Over
	Human Contact
	Safe Parking Position

# Moving the Motor Grader onto a Trailer

This exercise is designed to help the operator practice safely moving the motor grader on and off a lowboy trailer. Workers around the trailer encourage the operator to be careful and develop situational awareness.

1. The operator starts the motor grader and puts the blade in the correct position to move forward.
2. The operator moves the motor grader so that the vehicle mass over the trailer is centered.
3. The operator puts the motor grader in the correct position for travel. The blade heel must point in the direction oncoming traffic.
4. The operator moves off of the trailer and puts the motor grader in the correct position for driving.



# Learning Outcomes

This exercise is designed to teach operators these skills:

Goal	Methodology
Safely move the motor grader onto and off of a lowboy trailer.	On-screen tips help the operator learn to position the motor grader so that the vehicle mass is centered over the trailer. The exercise ends automatically if the operator flips the motor grader over.
Put the blade in the correct position for travel, moving on and off of the trailer, and parking.	Targets show the operator how to position the blade safely, so that the heel faces oncoming traffic.

## Key Performance Indicators

To successfully complete the exercise, operators must:

- Keep the motor grader stable while it moves onto the trailer.
- Put the blade in the correct position for travel (with the heel pointing toward oncoming traffic.)
- Complete the exercise as quickly as possible.

## Metrics

Category	Metric
Goal Description	Time
	Goals
	Current Blade Height
Machine	Idle Time
	Blade Contacts
	Average Speed
	Fuel Consumption
	Throttle Pedal Position
	Brake Pedal Position
	Neutral Pedal Position

Category	Metric
	Engine Power
	Engine Torque
	Axle Load (Front and Tandem)
	Wheel Reaction Force
	Articulation Angle
	Front Wheel Lean Angle
	Wheel Traction
	Gear Time
	Wheel Slip
	Lock Differential Turning
<b>Environment</b>	Collisions (Minor, Major, Critical)
<b>Performance</b>	Blade Capacity
	Blade Efficiency
	Grade Sensor
<b>Safety Violation</b>	Vehicle Flip Over
	Human Contact
	Safe Parking Position

# Windrow Management

This exercise is designed to teach operators to create a windrow and use correct methods to manage material. The training area is a flat field with space to drive the motor grader and create the windrow.

To complete the exercise, operators must do these things:

1. Create a windrow on one side of the road and then move it to the other side.
2. Spread material equally over the entire surface until it is level again.
3. Put the motor grader in a parked position, with the machine in the correct area of the work site.



# Learning Outcomes

This exercise is designed to help operators develop these skills:

Goal	Methodology
Analyze the work area, estimate and plan work.	On-screen tips show the operator how to control the blade and machine to complete each task.
Set up the motor grader in the correct position to begin work on the windrow.	On-screen tips and images show the operator how to position the machine and blade before taking a cut.
Take a cut from the ground and control the direction from which material exits the blade.	System measurements and reports show the impact of incorrectly positioning the machine on blade efficiency and engine capacity.
Correctly position the blade in relation to machine capacity and load.	When the operator overloads the machine and supplies insufficient power (lugging), the transmission automatically returns to Neutral.
Control the relationship between the load applied to the blade and the available machine power and traction.	Operators can see wheels slip if when they apply too much throttle while controlling a large quantity of material. The system alerts the operator when the wheels slip due to overload.
Lean wheels to counter side-thrust effect.	The motor grader realistically side shifts and does not drive in a straight line when the operator fails to lean wheels correctly.
Create and maintain a windrow.	A display on the simulator screen shows the operator where to make the windrow. The display also alerts operators when they deviate from the correct path.

Goal	Methodology
Control the driving system and transmission. Use the correct speed and change direction smoothly, moving the blade correctly at the end of each pass.	<p>Reports at the end of the exercise show:</p> <ul style="list-style-type: none"> <li>■ Average speed</li> <li>■ How long the motor grader was in each gear</li> <li>■ How long the motor grader was idle during the exercise</li> <li>■ How long the operator spent on each task</li> </ul>
Use the correct blade offset height and angle to make material as level as possible.	An on-screen display shows the pitch, roll, height, and standard deviation of the grade. Operator can improve leveling technique as they work.

## Key Performance Indicators

Instructors can use the following performance metrics to evaluate operators during the exercise:

- Engine Power, Torque Consumption, and Wheel Traction show ability to optimize available power.
- Blade Efficiency, Speed and Fuel Consumption show operator efficiency during the exercise.
- Pitch Score, Height Score, Roll Score, and Standard Deviation Score show the quality of the operator's work.
- Gear Time metrics can show how well the operator controls the load on the blade and machine capacity.
- Idle Time can show operator confidence in completing tasks.

# Metrics

Category	Metrics
Goal Description	Time Goals Current Blade Height
Machine	Idle Time Blade Contacts Average Speed Fuel Consumption Throttle Pedal Position Brake Pedal Position Neutral Pedal Position Engine Power Engine Torque Axle Load (Front and Tandem) Wheels Reaction Force Articulation Angle Front Wheel Lean Angle Wheel Traction Gear Time Wheel Slip Lock Differential Turning
Environment	Collisions (Minor-Major-Critical)
Performance	Blade Efficiency Cycle Time Grade Sensor
Safety Violations	Vehicle Flip Over Human Contact Safe Parking Position

# Spreading Material

This exercise is designed to help operators practice spreading material on a flat surface to an exact grade specification. The training environment is a flat field with space for moving the motor grader freely.



A dump truck releases material in front of the motor grader. The operator must use the Horn button to signal to the dump truck to stop.

The operator uses the blade to move material over the surface until it is level, with a crown. When material is equal and level, the operator parks the machine in the correct location in the work site.

To signal the truck to bring more material, the operator presses the horn two times. The truck appears 10 meters in front of the leveling zone. The operator must press the Horn button one time to signal the truck to stop. After the truck releases more material, the operator must press the Horn button to signal it to stop again.

# Learning Outcomes

This exercise is designed to teach operators these skills:

Goal	Methodology
Estimate the amount of work to be done and make a plan to complete all tasks.	To complete work in the exercise, operators must be able to evaluate the current grade of the terrain and say how they will move material to make the surface level.
Stop the dump truck in the correct location near the motor grader before it releases material.	To complete the task as quickly as possible, the operator must signal the dump truck to stop in the correct position.
Begin to move material in the middle of the pile and work toward the outside of the pile.	If the dump truck releases material on the side of the work area, the operator needs more time to complete the task.
Use available torque to control the load of material on the blade. Do not let the wheels spin.	The exercise ends immediately if the motor grader contacts any part of the dump truck.
Make a crown with a specific slope	On-screen tips and images show the operator how to move material from the middle of the pile and work toward the outside of the pile.
	To control material, on-screen tips instruct the operator to position the blade for cutting action, rolling action and carrying.
	While the operator makes the crown, the display shows the current height, slope, and angle.

# Key Performance Indicators

Instructors can use the following performance indicators to evaluate students:

- The Grade Level Sensor display shows green dots over the work area when material is the correct grade.
- The number of times the operator signals trucks to bring more material is an indicator of how well they move material on the surface.
- The Blade Efficiency metric measures the amount of material operators spread and fuel consumption during a specific period of time.
- The Engine Capacity metric should be between 70 to 80% while the motor grader moves material.

## Metrics

Category	Metrics
Goal Description	Time
	Current Blade Height
Machine	Idle Time
	Blade Contacts
	Average Speed
	Fuel Consumption
	Throttle Pedal Position
	Brake Pedal Position
	Neutral Pedal Position
	Engine Power
	Engine Torque
	Axle Load (Front and Tandem)
	Wheels Reaction Force
	Articulation Angle
	Front Wheel Lean Angle
	Wheel Traction
	Gear Time
	Wheel Slip
	Lock Differential Turning

<b>Category</b>	<b>Metrics</b>
<b>Environment</b>	Collisions (Minor-Major-Critical)
	Pickets
<b>Performance</b>	Blade Efficiency
	Grade Sensor
<b>Safety Violations</b>	Vehicle Flip Over
	Human Contact
	Safe Parking Position

# Leveling Material Near Obstacles

This exercise is designed to teach operators to carefully level material near curbs, driveways, sewers, and manholes. With experience from previous training exercises, operators position the blade carefully and maintain a safe distance from obstacles.

When the exercise begins, a windrow is next to a concrete curb. To complete the exercise, the operator moves material around obstacles until it is level.



# Learning Outcomes

Operators can develop the following abilities by completing this exercise:

Goal	Methodology
Plan where to move material and how to operate the motor grader around obstacles.	On-screen instructions show the activities the operator will complete. To work in the best way, the operator must make a plan.
Perform more difficult operations.	The operator must use complex and simultaneous movements to operate the motor grader around obstacles during the exercise.
Make material level and uniform using specifications for elevation and profile.	The Grade Quality Sensor display shows the current grade of material and compares it to the system specification. Operators can improve while they correct the errors which the system detects.
Make material level and even around a driveway, storm sewer, manhole, and concrete curb.	Pickets mark each obstacle. On-screen tips and images show how to position the blade. The system instructs the operator to keep away from the curb and use blade bolts as a point of reference.
Cover the entire work area with material, from one side to the other.	The operator must control the material so that there is enough to cover the work zone.
Control the load on the machine during operations and balance the amount of available power and traction.	The operator must continue to carefully balance load on the machine and traction.

# Key Performance Indicators

Instructors can use the following performance indicators to evaluate students:

- The Grade Level Sensor display shows green dots over the work area when material is the correct grade.
- The operator must not contact the concrete curb, storm sewer, manhole, or other obstacles.
- The number of times the operator repeats a pass before moving on to the next step indicate control.
- The number of times the wheels slip indicates that the operator applied too much force to the blade.
- The Engine Capacity metrics should be between 70 to 80% while the motor grader moves material.

## Metrics

Category	Metric
Goal Description	Time
	Goals
	Current Blade Height
Machine	Idle Time
	Blade Contacts
	Average Speed
	Fuel Consumption
	Throttle Pedal Position
	Brake Pedal Position
	Neutral Pedal Position
	Engine Power
	Engine Torque
	Axle Load (front and tandem)
	Wheel Reaction Force
	Articulation Angle
	Front Wheel Lean Angle

Category	Metric
	Wheel Traction
	Gear Time
	Wheel Slip
	Lock Differential Turning
<b>Environment</b>	Collisions (Minor-Major-Critical)
	Material Over Obstacle
<b>Performance</b>	Blade Efficiency
	Grade Sensor
<b>Safety Violations</b>	Vehicle Flip Over
	Human Contact
	Safe Parking Position

# Stuck in Mud

This exercise is designed to help the operator practice freeing the motor grader when it becomes stuck in mud.

To complete the exercise, the operator must drive the motor grader on a muddy road and then practice different methods to free the wheels when it becomes stuck.

A concrete barrier and sections of hard ground mark the muddy section of the practice area.



# Learning Outcomes

Operators can develop the following abilities by completing this exercise:

Goal	Methodology
Demonstrate the paddle method for freeing the motor grader from the mud.	On-screen tips and images show the operator how to control the vehicle and blade to transfer weight and friction so that the wheels can move out of the mud.
Demonstrate side-moving.	
Correctly articulate the blade throughout the exercise.	
Understand the relationship between machine components and their role in moving the motor grader out of the mud.	The operator must use all physical components of the machine as tools to free the motor grader.
Move multiple controls at the same time with ease and precision.	To successfully complete the exercise, the operator shows skills using controls to accurately move machine components.
Show knowledge of the relationship between wheel traction and the motor grader.	Operators must optimize wheel traction to dislodge the motor grader.

## Key Performance Indicators

The instructor can observe the following indicators when assessing operator performance:

- The amount of time it takes the operator to free the motor grader.
- The Wheel Traction metric.

## Metrics

Category	Metric
Goal Description	Time
	Goals
	Current Blade Height
Machine	Idle Time
	Blade Contacts

Category	Metric
	Average Speed
	Fuel Consumption
	Throttle Pedal Position
	Brake Pedal Position
	Neutral Pedal Position
	Engine Power
	Engine Torque
	Axle Load (Front and Tandem)
	Wheel Reaction Force
	Articulation Angle
	Front Wheel Lean Angle
	Wheel Traction
	Gear Time
	Wheel Slip
	Lock Differential Turning
Environment	Collisions (Minor-Major-Critical)
Safety Violation	Vehicle Flip Over
	Human Contact
	Safe Parking Position

# V-Ditch

This exercise is designed to help operators practice making a V-ditch.

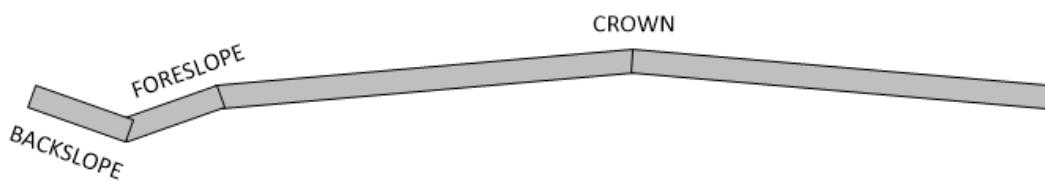
To successfully complete the exercise, operators must make a V-ditch and then create a crown with the excavated material:

1. The operator cuts the fore-slope of the V-ditch and excavates the material outside for the crown.
2. The operator cuts the back-slope material and moves the material into the ditch.
3. The operator moves the material out of the ditch to create a crown with 3% slope.

The centerline of the V-ditch is marked with onscreen targets and pickets.



**ROAD CROSS SECTION**



# Learning Outcomes

Operators can develop the following abilities by completing this exercise:

Goal	Methodology
Make a V-ditch in the work site.	On-screen instructions and targets show the operator how to make the V-ditch.
Make sure surfaces are level and meet system specifications.	The system grade sensor display helps the operator respect elevation targets in each segment of the exercise.
Use the correct method to move and pile excavated material.	To create the crown, the operator must move material from different locations in the work area. Creating the crown is easier if operators pile material correctly while they complete the V-ditch.
	The system shows System measurements for efficiency at the end of the exercise.
Use counter-movements to control side draft on the machine.	To minimize effects of side draft during the exercise, the operator must side-shift the blade, articulate, and lean the front wheels or offset the saddle locking bar.
Balance load on the machine with traction.	Moving material efficiently requires the operator to continue to be attentive to the relationship between load and traction. System reports and metrics offer real-time feedback on the ways the operator loads the engine and applies traction.

# Key Performance Indicators

The instructor can observe the following indicators when assessing operator performance:

- The Grade Level Sensor display shows green dots over the work area when material is the correct grade.

- The Cycle Time and the Number of Cycles metrics show how efficient the operator was during the exercise.
- The number of times the wheels slip indicates that the operator applied too much force to the blade.
- The Engine Capacity metrics should be between 70 to 80% while the motor grader moves material.

## Metrics

Category	Metric
Goal Description	Time
	Goals
	Current Blade Height
Machine	Idle Time
	Blade Contacts
	Average Speed
	Fuel consumption
	Throttle Pedal Position
	Brake Pedal Position
	Neutral Pedal Position
	Engine Power
	Engine Torque
	Axle Load (Front and Tandem)
	Wheels Reaction Force
	Articulation Angle
	Front Wheels Lean Angle
	Wheels Traction
	Gear Time
	Wheel Slip
	Lock Differential Turning
Environment	Collisions (Minor-Major-Critical)
Performance	Blade Efficiency
	Cycle Time

Category	Metric
	Grade Sensor
	Ground Level Sensor
Safety Violation	Vehicle Flip Over
	Human Contact
	Safe Parking Position

# Tradeshow

This exercise is designed to show simulator capabilities and let users with any level of expertise demonstrate grading skills or experience motor grading for the first time.

On-screen instructions and tips explain tasks in the exercise.



Tasks in the exercise are organized as follows:

1. The operator drives forward in a straight line, across barrels in a slalom, and over speed bumps.
2. Once operators pass the speed bumps, they must remove material near the sidewalk to create a windrow on the inner side of the road.
3. Leaving the material management area, the operator executes a 3-point turn and returns for a second pass. On the second pass, the operator moves the windrow to the middle of the road.
4. The exercise is completed when the operator leaves the material management area.

# Metric

Category	Metrics
Goal Description	Time
	Goals
	Current Blade Height
Machine	Idle Time
	Blade Contacts
	Average Speed
	Fuel Consumption
	Throttle Pedal Position
	Brake Pedal Position
	Neutral Pedal Position
	Engine Power
	Engine Torque
	Axle Load (Front and Tandem)
	Wheel Reaction Force
	Articulation Angle
	Front Wheel Lean Angle
	Wheel Traction
	Gear Time
	Wheel Slip
	Lock Differential Turning
Environment	Collisions (Minor-Major-Critical)
Performance	Blade Efficiency
	Cycle Time
	Grade Sensor
Safety Violations	Vehicle Flip Over
	Human Contact
	Safe Parking Position

# Sandbox

This exercise is designed to let operators improve skills in a multi-purpose area without on-screen tips or a specific work flow.

An area of the work site dedicated to moving material is outlined by cones. There are also multiple objects which the operator can move and navigate around, such as a concrete ball and tennis balls on poles.



# Learning Outcomes

Operators can develop the following abilities by completing this exercise:

Goal	Methodology
Refine operating skills, such as precision, manipulation, machine control, and material management.	The exercise is free-form with no pre-defined workflow. Specialized sections of the simulated work site give operators the opportunity to practice creating windrows, loading and unloading the motor grader from a trailer, and maneuvering a concrete ball through a slalom course.

# Metrics

Category	Metric
Goal Description	Time
Machine	Current Blade Height
	Idle Time
	Blade Contacts
	Average Speed
	Fuel Consumption
	Throttle Pedal Position
	Brake Pedal Position
	Neutral Pedal Position
	Engine Power
	Engine Torque
	Axle Load (Front and Tandem)
	Wheel Reaction Force
	Articulation Angle
	Front Wheel Lean Angle
	Wheel Traction
	Gear Time
	Wheel Slip

<b>Category</b>	<b>Metric</b>
<b>Environment</b>	Lock Differential Turning
	Collisions
	Barrels Touched
	Barrels Knocked Over
	Cones Touched
	Cones Knocked Over
<b>Performance</b>	Pickets
	Blade Capacity
	Blade Efficiency
	Grade Sensor
<b>Safety Violation</b>	Vehicle Flip Over
	Human Contact
	Safe Parking Position



# System Maintenance

Any problems you encounter when starting the simulator may be related either to the license or the start-up process itself.

## License Issues

If you encounter a problem with your license, do the following:

1. Make a note of any details in the license message that appears on the simulator display.
2. Contact CM Labs Support at [support@cm-labs.com](mailto:support@cm-labs.com).

## Start-Up Issues

If you notice that the simulator or the instructor system is not functioning properly, turn off the system and then restart the simulator. If the problem is not resolved, contact CM Labs Support at [support@cm-labs.com](mailto:support@cm-labs.com).

## Backing Up the Vortex Database

To prevent data loss, we strongly recommend that you regularly back up the database for your Vortex Training Solution. You can back up the Vortex database to an external drive or other storage location using the command line for the computer which stores your Vortex data. You can typically access the Vortex database from the instructor station.

Attention: The default database directory is located in D:\Program Files\MonogoDB.

Before backing up the database, you must know how much data is currently stored in the database. You must also know the file path of the external storage location where you will back up your data.

Once you back up your data, you can restore the database from the command line at any time.

## To Back Up the Vortex Database

Backing up the database involves identifying the external storage location where you want to store your back-up files and issuing a back-up command from the database command line interface (CLI)

Before you can back up the Vortex database, you must do the following:

- Ensure that your permanent storage location is large enough to store your backed up data.
- Know the file path of the permanent storage location where you will store your backed up data.

From the computer where the database is stored, do the following:

1. Open the command prompt.
2. Change the current directory to the path of the database using the following command:

```
cd C:\Program Files\MongoDB\bin.
```

3. Back up the database to your permanent storage location using the following command:

```
mongodump [FILEPATH_STORAGE_LOCATION].
```

You must specify the file path of your permanent storage location in the command.

The system backs up data to the permanent storage device. This may take several moments.

## To Restore the Vortex Database

After a data loss event, you may want to restore the Vortex database from a backup file stored on a permanent storage location. Restoring the database involves identifying the path of the external drive where the backed up data is stored, and using commands on the command line interface to restore the database.

From the computer where the Vortex database is located, do the following:

1. Open the command prompt.
2. Change the current directory to the path of the database using the following command: `cd C:\Program Files\MongoDB\bin`.
3. Restore the database from your permanent storage location using the following command: `mongorestore [FILEPATH_OF_STORAGE_LOCATION]`.

You must specify the file path of your permanent storage location in the command.

The system restores data to the permanent storage device to the Vortex database. This may take several moments.