HDD Virtual Reality Training Simulator

User's Manual



HDD Virtual Reality Training Simulator



User Manual V004.2



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1 HORIZONTAL DIRECTIONAL DRILL SIMULATOR

For a complete and effective training, the HDD VR Simulator should be used in conjunction with in-person training with qualified training personnel. The trainees should read and review the drill operator's manual to familiarize themselves with the drill's operation and controls.

This document contains information you will need to set up and run your simulator. The following sections are provided:

- Getting Started: describes the steps you need to set up the simulator
- **Running the Software:** describes how to use the simulator software, including defining user accounts, running the lessons and viewing evaluations
- General Drilling/Reaming Guidelines: provides guidelines which apply to drilling/reaming across all the training lessons
- Lessons: describes how to run each of the lessons
- Installation Guide: provides detailed step-by-step instructions for installing the software
- Troubleshooting: describes procedures for troubleshooting problems with the simulator

2 GETTING STARTED

The following sections describe how to set up the simulator prior to use.

2.1 Hardware Requirements

This section describes computer specifications and third-party installation requirements that need to be performed prior to use of the simulator.

2.1.1 Equipment, Tools, and Materials

The simulator requires the following equipment and hardware:

- VR Ready Personal Computer. Not provided with the Ditch Witch HDD VR Simulator Desktop kit and needs to be acquired separately.
- Ditch Witch HDD VR Simulator Desktop Setup
 - The Ditch Witch HDD VR Simulator is supplied with a US two-prong 12VDC LPS power supply rated for 100 240 VAC/50 60 Hz power input that must be used with the system. A plug adapter that conforms to local and international safety requirements may be required to use the Ditch Witch HDD VR Simulator in other countries. The plug adapter is not supplied with the Ditch Witch HDD VR Simulator Desktop kit and needs to be acquired separately.
 - These are the tools and materials recommended to complete the assembly of this hardware. These tools and materials are not provided with the Ditch Witch HDD VR Simulator Desktop kit and need to be acquired separately.
 - Phillips Screwdriver
 - 9 mm Socket
 - 10 mm Wrench
 - Alcohol (cleaning oculus for application of leap motion bracket and cleaning



of VR HDD Simulator Plastic Housing for application of Adhesive Backed Harness Clip under the housing)

- Measuring Tape and Pencil/Marker (used to line up leap motion bracket for installation)
- Cutting pliers (used to trim cable ties)
- Scissors (used to trim wire loom and webbing ends)
- Oculus Rift S VR System + Touch controllers Reality Headset (<u>https://www.oculus.com/rift-s/</u>). More detailed instructions are provided in Section 2.3. This equipment is not provided with the Ditch Witch HDD VR Simulator Desktop kit and needs to be acquired separately.



- Leap Motion Universal VR Dev Bundle. The Leap Motion software is included on the installation CD/DVD or USB Drive. More detailed installation instructions are provided in Section 0. This equipment is not provided with the Ditch Witch HDD VR Simulator Desktop kit and needs to be acquired separately.
 - Includes:
 - Leap Motion Controller
 - 2-piece curved VR Developer Mount for the Leap Motion Controller (compatible with the Oculus Rift Kits)
 - 15' USB extension cable
 - Custom 3M adhesive





2.1.3 VR-Ready Computer Requirements

Visit the Oculus Rift website (<u>https://support.oculus.com/</u>) for recommendations on VR-Ready computers. The simulator is designed to work on a VR-Ready desktop or laptop computer, which also meets or exceeds the following specifications.

- Processor: Intel[®] Core[™] i5, 3.4 GHz / AMD Ryzen[™] 5 1500X, 3.5 GHz
- Memory: 8 GB RAM
- Connections: 4 USB 3.0 ports and 4 USB 2.0 ports (or more)
- Graphics Card: NVIDIA GeForce[®] GTX 1060 / AMD Radeon[™] RX 480, or equivalent with DisplayPort[™] 1.2 / Mini DisplayPort
- Audio: Onboard sound
- Operating System: Windows 10 Professional
- Display: flat screen monitor supporting 1920 x 1080 resolution

2.2 Ditch Witch HDD VR Simulator Desktop Assembly

This section describes how to assemble the Ditch Witch HDD VR Simulator Desktop hardware.

2.2.1 Components List

CMW #	D	escription		QTY	Photo / Image
222-7029	VR HDD Housing	Simulator	Plastic	1	



215-3051	VR HDD Simulator License Dongle (includes "Powered by METECS" decal)	1	Powered by METECS
222-5802	Frame Assembly	1	
222-5744	Electrical Harness	1	
222-5825	1" Adhesive Backed Harness Clip	6	



215-2854	Wrench Joystick	1	
222-7121	Webbing Hook	1	
215-2852	Thrust/Rotate Joystick	1	
222-7105	10-32 Locking Flange Nut	7	



215-3104	Kvaser Leaf Light HS V2 (CAN TOOL)	1	
222-7104	10-32 x 1.75" ZP Phil Head Bolt	3	
215-3103	18 W SINGLE OUTPUT WALL MOUNT (DC Power Adapter)	1	
222-7101	Clamp Knobs	3	
222-5803	Table Clamp Plate	3	
222-5766	10-32 x.75n ZP Phil Head Bolt	4	



222-5775	Strap Mount Plate	1	
222-5767	8-32 Locking Flange Nut	8	
222-5774	1/4-20 X.75" ZP SCREW	1	
222-5768	8-32 x 1" Phillips Screw	8	E Manageman
222-5773	18-8 SS Flat Washer	3	
222-5769	Thread Cover	3	
222-5772	Webbing Slider	2	



222-5891	Black Webbing 1in x 2ft	1	
222-5771	Webbing w/Latch	1	
222-5848	4-20 ZP Locking Flange Nut	1	
270-7843	Decal VR HDD Simulator Model ID	1	HDDVR Simulator
270-6894	Decal LOGOTYPE	1	11.500" Ditch Witch"
270-5363	Decal JOYSTICK CONTROL	1	3.500" 3.500" 3.500" 3.500" 2.000" 2.000" 2.000" 2.000"



HDD VR Training Simulator User Manua

700-245	Decal RIGHT CONTROL	1	
110-248	CABLE TIE (1/16" TO 1-1/4")	6	
222-5892	Expandable Braided Sleeving 3/4" x 10'	1	



2.2.2 Assemble Electrical Harness to plastic housing.

- 1. Place the 222-7029, Plastic Housing on a table or work bench with a towel or cardboard underneath to avoid scratching the plastic. Turn the plastic housing upside down.
- 2. Use rubbing alcohol and a paper towel to clean interior of plastic housing wall in the areas where the 222-5825, 1" Adhesive Backed Harness Clip, will be installed (see picture below.)
- 3. Remove the protective strip from the 222-5825, 1" Adhesive Backed Harness Clip and evenly distribute the clips along the interior wall. The recommended placement is show in the image below. (There must be sufficient clearance between the clips to install the 215-3104, Kvaser Leaf Light HS V2 (CAN TOOL) device, as shown below.)



4. Orient the 222-5744, Electrical Harness such that the 12-pin connector lays to the right joystick side of the plastic housing (left on the image) as shown below.



- 5. Install power socket into hole on the back side of the plastic housing.
 - a. Remove the nut that comes installed on the power connector.
 - b. Insert the power connector into the hole from the interior of the housing.







- 6. Install 215-3104, Kvaser Leaf Light HS V2 (CAN TOOL) device.
 - a. Place 215-3104, Kvaser Leaf Light HS V2 (CAN TOOL) device in between harness clips near the power connector.
 - b. Clamp the wires in the harness.
 - c. Connect the 9-pin D-SUB CAN connector to the mating connector on the electrical harness.



2.2.3 Assemble the frame assembly

1. Thread two 222-7101, Clamp Knobs to the brackets on the 222-5802, Frame Assembly, and install the 222-5769, Thread Cover on the clamp knob on the inside of the clamp.





- 2. Attach ends of frame to the 222-7029, VR HDD Simulator Plastic Housing with four bolts and nuts. (222-5766, 10-32 x.75n ZP Phil Head Bolt and 222-7105, 10-32 Locking Flange Nut, see assembly diagram below.)
- Attach middle of frame to plastic housing with three bolts and nuts. (222-7104, 10-32 x 1.75in ZP Phil Head Bolt and 222-7105, 10-32 Locking Flange Nut, see assembly diagram below.)

Caution: Ensure electrical harness leads are run between the frame and the plastic housing as shown in the figure below before bolting the housing to the frame.







2.2.4 Install Joysticks

- To mount the 215-2854, Wrench Joystick, remove the plastic covering attached to the electrical leads on the joystick and set aside for later. Remove the rubber gasket from around the main body of the joystick and discard. Place the joystick in the plastic housing in the left joystick slot. Secure with four 222-5768, 8-32 Phillips Screw and four 222-5767, 8-32, Locking Flange Nuts. Attach the connector to the mating connector on the electrical harness. Install the plastic covering over the screws.
- Place the 215-2890, Thrust/Rotate Joystick in the Right Joystick slot in the plastic housing. Make sure the holes on the plastic covering and joystick align with the holes on the simulator plastic housing and secure with four 222-5768, 8-32 Phillips Screw and four 222-5767, 8-32, Locking Flange Nuts. Attach the connector to the mating connector on the electrical harness.







2.2.5 Clamp Simulator to Table

- 1. Attach the simulator to a desk or table using the clamps on the front to hold it in place.
- 2. To avoid damaging the desk or table, use the provided 222-5803, Table Clamp Plate in between the 222-7101, Clamp Knobs/222-5769, Thread Cover and table.







2.2.6 Install Decals

- 1. Install the 270-6894, Decal LOGOTYPE (Ditch Witch) and the 270-7843, Decal VR HDD Simulator Model ID as shown in the picture above. For the decals to fit correctly, the 270-6894, Decal LOGOTYPE might overlap the plastic housing round edge.
- 2. Install the "Powered by METECS" decal (bundled with 215-3051, VR HDD Simulator License Dongle) on the front of the plastics near the Thrust/Rotate joystick as shown in the picture above.
- 3. Install the 270-5363, Decal JOYSTICK CONTROL (Wrench Joystick) on the top of the plastics near the wrench joystick.



4. Install the 700-245, Decal RIGHT CONTROL (Thrust/Rotate Joystick) on the top of the plastics near the Thrust/Rotate joystick.





2.2.7 Install Optional Rear Clamp to secure set-up on Desk/Table

- 1. Assemble Strap for rear clamp mounting using the 222-5772, Webbing Slider and the 222-5891, Black Webbing 1in x 2ft.
- 2. Make a loop with the 222-5891, Black Webbing 1in x 2ft and the 222-5775, Strap Mount Plate.





3. Make a loop with the 222-5771, Webbing w/Latch and the 222-7121, Webbing Hook.



4. Attach the two sides of the 222-5891, Black Webbing 1in x 2ft together using the latch on the 222-5771, Webbing w/Latch. This allows for adjustment to different size tables.



5. Install 222-7101, Clamp Knob in to the 222-7121, Webbing Hook.





 Install Rear Strap to plastic housing (use the hole in the middle, on top of the plastic housing, in the back.) Use the 222-5774, 1/4-20 X.75" ZP SCREW, 222-5773, 18-8 SS Flat Washer, and 222-5848, ¼-20 ZP Locking Flange Nut to secure it to the plastic housing as shown on the picture below.



7. Install on the back of the desk/table. Use the 222-5803, Table Clamp Plate to prevent damaging the desk/table.



2.3 Oculus Rift S VR System

The simulator requires an Oculus Rift S VR System (<u>https://www.oculus.com/rift-s/</u>) including two hand controllers. The simulator does not use Oculus hand controllers but a controller is required to set up the Oculus system and to interact with Oculus displays within the immersive environment.

2.3.1 Oculus Rift S Software Setup

This step requires internet access. On a web browser, navigate to <u>https://www.oculus.com/setup/</u>. On this page, you will find a 'Download Oculus Software" button. Click the button and follow the manufacturer instructions for installation.



2.3.2 Connecting Oculus Rift S

Once the Oculus software is installed, it will prompt you to set up the Oculus hardware. At this point, plug in the Oculus HDMI connector to the HDMI port on your computer video card. Plug the Oculus headset USB connector into a USB 3.0 port (usually colored coded in blue) on your computer.



USB 3.0 Port



HDMI Port

Do not stand up or move around while using the VR simulator.

Once the Oculus software and device is installed, start the Oculus App and in Settings -> General make sure the setting for "Unknown Sources" is set to allow apps that have not been reviewed by Oculus to run on Rift.



2.4 Leap Motion Universal VR Dev Bundle

Install the leap motion sensor mount onto the Oculus headset as outlined in the directions included with the mount. The sensor should be centered left to right and top to bottom as in the picture below. Run the USB extension cable alongside the Oculus Rift video/USB cables. Feed the Oculus/Leap Motion Sensor wires through the wire loom, 222-5892, Expandable Braided Sleeving 3/4" x 10'. Secure the wires and the wire loom to the Oculus Rift headset and along the wire length with the zip-ties, 110-248, CABLE TIE (1/16" TO 1-1/4"). The wire loom will protect the wires and prevent tangles.



Leap Sensor Positioning

Wire Loom Installation

2.4.1 Connecting Leap Sensor

Due to possible compatibility issues between the Leap Motion and Oculus Rift hardware, it is important to note which USB ports are used for the leap motion sensor. Typically, computers have both USB 3.0 ports (indicated by a blue color in the port) and USB 2.0 ports (indicated by a black port). If possible, use the USB 3.0 ports for the Oculus Rift head mounted displa. **Connect the Leap motion cable to a USB 2.0 port on the computer (see figure below).**



USB 3.0 (left) and USB 2.0 (right)

2.4.2 Leap Motion Software Setup

The Leap Motion Universal VR Dev Bundle is included on the installation CD/DVD or USB Drive. Follow the instructions provided in Section 0 to complete the installation.



2.5 Setting Up the Simulator Software

You will need to download and install the HDD VR Similator software. This step requires internet access. On a web browser, navigate to <u>http://updates.ditchwitch.com/updates.html</u>. On this page, you will find the 'Download and Install the HDD VR Simulator Software" link. After downloading the self-extracting file, double click on the file to extract the software installer and support software. Locate and launch "hdd_vr_sim_x.x.x.exe" installer to begin the software installation process. More detailed instructions are provided in Section 6.1. After the software has been installed, an HDD VR Simulator icon will be included on the desktop.



Simulator Icon

2.6 License Dongle

After the simulator software has been installed and prior to running the simulator, plug in the provided 215-3051, VR HDD Simulator License Dongle into any available USB port on the computer. **NOTE: This dongle must be plugged in whenever the simulator is in use.**



215-3051, VR HDD Simulator License Dongle

3 RUNNING THE SOFTWARE

This section provides instructions for running the simulator software. The simulator software consists of two primary components:

- **Simulation Control:** Allows users to define and modify user accounts, start lessons, monitor system states, control lesson prompts and view evaluations through a web-based interface.
- Immersive Environment: Provides immersive display of work-site and lesson prompts.

These components are described in the following sections.

3.1 Simulation Control

To start the training simulator, double click the HDD VR Simulator icon on the desktop.



Simulator Icon



3.1.1 Logging In

To log in, enter a username and password and select Login. The default username is **guest** and the default password is **password**. See Section 3.1.4 for instructions for adding new users.



M Ditch Witch | HDD VR TRAINING SIMULATOR



3.1.2 Running a Demo

The login screen may be used to run a demonstration by selecting the **Demo** button. The demo provides an abbreviated drilling scenario primarily intended to showcase basic capabilities of the system (see Section 5.8). VR Demo will take you to the demo interface which will let you run the demo reaming lesson as well as utilize VR overlays to show users specific features in the simulator.

3.1.3 Graphical User Interface

The following items are included at the top of each screen on the Simulation Control application user interface:



Simulation Control Tabs

- Lessons Tab: Opens the Lessons Screen.
- Evaluation Tab:Opens the Evaluation Screen.
- VR Demo Tab: Opens the VR Demo Tab.
- User Tab: Opens the User Screen.
- Help Tab: Opens the Help Screen.
- Current User: Displays the user name of the user currently logged in.
- Logout: Logs the user out and returns to the Login Screen.



3.1.4 Defining User Accounts

User accounts are used to store evaluations so they may be viewed at a later time. To define a new user, select the **New User** button on the Login screen and fill in the required information on the page shown below. Select **Create New User** when finished. The following two types of users are supported:

- Student: May only view his own evaluations.
- Instructor: May view evaluations for any student.

Username		
First Name	Last Name	Type Student
Password	Confirm Password	Language English ▼
Contact Number		
Update U	ser Information	Cancel

Create User Screen

A confirmation dialog will be displayed after **Create New User** is selected verifying the information has been entered. After selecting OK, you will then be returned to the login screen to log in as the new user. To update user information, select the **User** Tab to open the User Screen. **Note**: the **Language** control defines the language used on the Simulation Control and Training Simulator for the specific user. Currently installed languages are provided in a dropdown list. Additional languages may be installed separately. Contact a Ditch Witch[™] Training Specialist to find out the available translation languages.



3.1.5 Lessons Screen

The Lessons Screen is used to configure and launch training lessons.



Lessons Screen

The following displays/controls are provided. See Section 4 for a description of the effects of the Site, Rig and Fluid settings:

- Lessons: Used to select which lesson to run.
- Site
 - Soil Type: Sand, Clay or Mixed
 - Soil Condition: Wet, Normal or Dry for Sand or Clay; Hard, Normal or Soft for Mixed
- Rig
- o Drill: JT20, JT25, JT30, JT60, JT100
- o Drill Bit: Sand Bit, Tuff Bit, Tornado
- o Drill Bit Diameter (inches)
- o Reamer: Beavertail, Compact Fluted, Warthog
- Reamer Diameter (inches)
- Product Type: Cable, Plastic or Steel
- Product Diameter (inches)
- Entry Pitch (degrees) NOTE: a default bore path is included based on a 24% entry angle.
 If this value is changed, the default bore path will not be shown in the bore path view and you will be allowed to determine your own bore path.
- Fluid
 - o Bentonite
 - o Polymer
 - o Wetting Agent
 - Compound



- Training Mode
 - Practice: Allows the operator to practice as much as needed to get familiar with the training lesson. In this mode, the operator receives additional instructional cues (such as step-by-step instructions) not provided in Assessment Mode. Evaluations in Practice Mode are provided on the training simulator screen at the end for the lesson, but are not stored in the database and are not accessible on the Evaluation tab in the Simulation Control Application.
 - Assessment: Assesses the operator's ability to successfully complete the training lesson. In this mode, the operator receives fewer training cues than in Practice Mode. Assessment evaluations are stored in the database and can be viewed on the Evaluation tab in the Simulation Control Application.
- Launch Lesson: Launches the selected lesson.

To start a lesson, click on the lesson, configure the site, rig and fluid; set training mode; then, select **Launch Lesson**.

3.1.6 Evaluation Screen

The Evaluation Screen allows a user to access evaluations for a selected lesson. The number of times the lesson was run in Assessment mode is displayed next to the lesson name. Detailed evaluations are displayed by clicking on a selected lesson.

Main and the second straining simulator										
Less	ons	Evaluation	Instructor Controls	User	Help			Current User:	rlogan	Logou
		Lesson 1 - (Controls Familiarization						-	
		Lesson 2 - I	Basic Drilling: Open Field						1	
		Lesson 3 - I	Drilling: River Crossing						•	
		Lesson 4 - I	Drilling: Road Crossing						1	
	tet	Lesson 5 - I	Basic Reaming: Open Field						•	
	•	Lesson 6 - I	Reaming: River Crossing						•	
		Lesson 7 - I	Reaming: Road Crossing						-	

Evaluation Screen



Evaluation	Instructor Controls	User	Help	SIMULA	AT UK	Current User:	rlogan
Lesson 2 - Ba	sic Drilling: Open Field						1
RUN RUN_	4_20180123_151415 (2018-0	11-23 15:14:	15):			4	
Lesson 2: C - Prepar - Contin FINAL SCC	Dpen Field (Assessment) re drill and site for initial en ue Drilling: 1/1 correct SCC RE: 95%	try: 3/3 corr DRE: 4/4 (10	ect 0%) Warning	violation deduc	tion: 5		
PERFORM - Drill M - Drill B - Diame	ANCE: odel JT25 it SANDBIT ter 8.0 in						
- Produc - Diame - Reame - Diame - Soil: V	ct Type Cable ter 4.0 in er: Beavertail ter 8.0 in /et Sand						
- Additir - Time: - Bore L - Min / A - Max /	ves: None 08:24 ength: 181.6 ft Illowable Bend Radius: 205 Farget Depth: 10.0 ft / 9.8 ft	.0 ft / 123.0	ft			Ţ	
Pre	vious	Ba	ick to S	cores		Next	

Evaluation Details

Instructors can view evaluations for other users by selecting the username from a dropdown list on the Evaluation screen.



Instructor Control for Viewing Evaluations



3.1.7 Instructor Controls Screen

The Instructor Controls screen provides controls to launch both the drilling and reaming demo lessons. It also provides machine/lesson data such as pipe status (connected/disconnected), mode (drilling/reaming), number of pipes used, drilling fluid (on/off), and wrenches (open/closed). In a VR environment, these details are often hard to determine so this interface makes that determination simple.

This interface also allows you to activate visual indicators in the virtual environment. When the "On" button is selected, an arrow pops up next to the referenced item. This can be used to show users where specific controls/displays are located in the scene. The "Left Joystick Guide" will activate an overlay that labels the buttons on the left joystick.

Ditch Witch	i HDD V	R TRA	INING	SIMULATOR			
ssons Evaluation	Instructor Controls	User	Help		Current User:	rlogan	Logout
	Start HDD	Drilling					
	Start HDD F	Reaming					
State: Action:		Connected DRILLING					
Pipe #:		1					
Fluid: Wrenches:		OFF					
Remote Display	On	Off	OFF				
Pipe Mode	On	Off	OFF				
Engine RPM	On	Off	OFF				
Zoom	On	Off	OFF				
Left Joystick Guide	On	Off	OFF				

VR Demo Screen, Machine Status and VR Guides Interface

3.1.8 Help Screen

The Help Screen allows a user to open an electronic copy of this manual and to view the End User License Agreement.

essons	Evaluation	Instructor Controls	User Help	JINIOLATON	Current User:	rlogan	Logou
			View User	Guide			
		Vi	ew End User Lice	anse Agreement			
				Agreement			

Help Screen



3.2 Immersive Environment

The immersive display starts once you have launched a lesson from the Simulation Control Lessons screen.

3.2.1 User Viewing Position

IMPORTANT: The user's default head position in the 3D environment is set at the beginning of each lesson. It is important that the user looks straight ahead until you are past the initial simulator warning screen. If for some reason you need to reset the view after a lesson has started, look directly ahead and press the space bar on the keyboard.

3.2.2 Simulator Displays

The Simulator Display shows the training environment and 2D overlays (instructions, help and warnings) which provide information in support of the training.

3.2.2.1 Lesson Introduction

At the start of each lesson, introductory material is displayed showing the lesson number, name, mode and learning objectives, as shown below.



Lesson Introduction

3.2.2.2 Lesson Steps

Each lesson contains a series of steps that must be performed to complete the training. Instructions displayed in the upper left corner on the left screen guide you through the required steps.



Lesson Steps



3.2.2.3 Control Prompts

For some lesson steps, images are provided indicating the location of controls on the joysticks, as shown below.



Controls Help Prompts

- A: Icon indicates function to be controlled
- B: Arrow or highlighted button indicates control and required movement
- C: R or L indicates if control is on the right or left joystick

3.2.3 Lesson Advancement

Throughout the lessons, the right trigger button (1), as shown below, is used to acknowledge information displayed or to advance through lesson steps.



Right Thumb Button


3.2.4 Completing a Step

To successfully complete a step, perform the action displayed in the onscreen prompt. When a step is completed successfully, the lesson advances to the next step. In some cases, conditions for subsequent step(s) may already have been met due to previous actions. In this case, the system automatically advances to the next step that requires action.

3.2.5 Responding to Multiple Choice Questions

During some lessons, you will be required to respond to multiple choice questions. Virtual buttons will appear that can be selected with the index finger of left/right virtual hands.



Lesson Controls



3.2.6 Joystick Controls

Two joysticks are used to replicate the controls on the HDD, as shown on the following pages.









3.2.7 Machine Controls

As described below, virtual machine controls are used to set up the drill for initial entry.

3.2.8 Stabilizer / Frame Tilt Controls

Arrows placed near the corresponding levers on the setup control panel are used to control the stabilizers and frame tilt.



Onscreen Stabilizer/Frame Tilt Controls

- A: Front frame tilt up
- B: Rear frame tilt up
- C: Raise left stabilizer
- D: Raise right stabilizer
- E: Front frame tilt down
- G: Rear frame tilt down
- G: Lower left stabilizer
- H: Lower right stabilizer



3.2.9 Anchor Controls

To simplify the controls in the simulator, anchor thrust and rotation are controlled together. The arrows shown below indicate direction to move lever for setting anchors. The virtual hands are used to manipulate the levers aft (lower) and fore (raise).



Onscreen Anchor Control

- A: Lower/Rotate right anchor
- B: Left Anchor Control Lever (manipulate with virtual hands)
- C: Raise/Rotate left anchor
- D: Lower/Rotate left anchor
- E: Right Anchor Control Lever (manipulate with virtual hands)
- F: Raise/Rotate right anchor

3.2.10 Exiting a Lesson

At the end of the lesson, you will be shown the lesson launch interface. From here, you can select and launch another lesson or you can exit by pressing the right trigger button. Alternatively, the Esc key can be used to exit out of a lesson before it is complete. In this case, no evaluation is generated.

3.2.11 Physical Displays

The simulator includes a number of physical displays that are located in their actual location in the machine cab. These displays are described below.



3.2.11.1 Engine Display

The Engine Display shows the following:



Engine Display

- A: Fluid Flow Rate GPM (gallons per minute)
- B: Engine RPM
- Fuel level, battery voltage, oil temperature, pressure are all static values

3.2.11.2 ESID

The Electric Strike Indicator Display (ESID) shows information regarding strikes with underground electric utilities and includes the following:



ESID Display

- A: Strike alert: Red lights come on as values in display increase. Light in triangle represents strike warning condition that triggers alarm and strobe.
- B: Alarm interrupt button: Turns off the audible strike alarm after a strike has been detected. The strobe remains active until cleared by a self-test.
- C: Alphanumeric display: Displays current and voltage detected as a percentage of strike condition. In the simulator, V and A values will total to 100 when a strike occurs.
- D: Voltage and current problem indicators: Turn red to indicate a problem.
- E: Self-test button: Used to start a self-test.
- F: OK and power supply indicators: OK indicator turns green if the self-test detects no problems.



3.2.12 Virtual Displays

• Some machine controls are represented as virtual buttons in the environment.

3.2.12.1 VR Lesson Selection

• During the lesson, you can navigate to the Lesson Selection interface. The "home" button on the left is used to access the VR lesson selection interface.



VR Lesson Interface Button – Far Left

• The VR lesson interface can be used to launch any lesson in either practice or assessment mode. Use your index finger on your virtual hand to interact with the buttons. The home button to the left of the VR lesson interface will take you back to the cab.

A LA MA			
1.8	Lesson 1 - Controls Familiarization	Practice	Assessment
	Lesson 2 - Basic Drilling: Open Field	Practice	Assessment
	Lesson 3 - Drilling: River Crossing	Practice	Assessment
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~	Lesson 4 - Drilling: Road Crossing	Practice	Assessment
	Lesson 5 - Basic Reaming: Open Field	Practice	Assessment
	Lesson 6 - Reaming: River Crossing	Practice	Assessment
	Lesson 7 - Reaming: Road Crossing	Practice	Assessment
			Charles and a

**VR** Lesson Interface



### 3.2.12.2 Drilling Feedback

During the drilling lessons, there will be text indicating what actions to take in order to keep drill path aligned with bore plan. Below you will see an example of that display. It is located just above the right console on the virtual machine.



## 3.2.12.3 Virtual Machine Controls and Indicators

Virtual buttons are available for the following functions (clockwise from the upper left). Green is used to indicate the current functional state. Buttons can be selected using index finger of virtual hands.



**Function Indicators** 

- Pipe loading mode (add/manual/remove)
- Drilling fluid rate (low/medium/high)
- Auto Carve (enabled/disabled)
- Carve window size (small/medium/large)
- High speed carriage (on/off Indicator only, not an interactive button)
- Rotation mode (speed)
- Engine throttle (low/med/high)
- Anchor enable (on/off)



# 3.2.12.4 Right Console Indicators

The Right Console shows the following indicators (from left to right):



#### **Right Console Indicators**

- Diagnostics: not used in the simulator
- Rear stop: turns green when carriage reaches rear stop sensor at back of frame
- Rear home: turns green when carriage reaches rear home sensor
- Shuttle stop: turns green when shuttle is fully retracted
- Front home: turns green when carriage reaches front home sensor
- Operator presence: not used in simulator
- Control cycle: turns green when something is being controlled in auto pipe loading mode, flashes when control cycle is interrupted

#### 3.2.12.5 Remote Display

The Remote Display shows the following tracking information for Walk-Over and Drill-To tracking modes:



Remote Display – Walk-Over Mode

- A: Drill pitch (%)
- B: Beacon temperature (degrees Fahrenheit)
- C: Clock angle indicator/text (steering direction when thrusting without rotation)
- D: Beacon battery strength
- E: Drill depth (ft) (updated once at the end of each pipe)





Remote Display – Drill-To Mode

- A: Drill pitch (%)
- B: Horizontal distance to tracking sensor
- C: Clock angle text
- D: Clock angle indicator (steering direction when thrusting without rotation)
- E: Projected depth (horizontal cross-hair)
- F: Beacon temperature (deg F)
- G: Current depth (dashed line)
- H: Beacon battery strength



#### 3.2.12.6 Pressure Gauges

Pressure gauges are included for the following (clockwise from upper left):

**Pressure Gauges** 

- Thrust pressure
- Rotation pressure
- Fluid pressure (**NOTE**: the icon on the pressure gauge will turn green when the fluid pump is on and pumping fluid)



### 3.2.12.7 Bore Plan View

The Bore Plan view shows the following:



**Bore Plan Display** 

- A: Side view
- B: Top View
- C: Desired bore path
- D: Underground utilities: Color coded based on utility type (blue: water, red: electrical, yellow: gas).
- E: Drill head position history: Position marker added to display automatically after each pipe is drilled.

#### 3.2.12.8 Bore Plan View Buttons

The Bore Plan Buttons do the following (from left to right):



**Bore Plan Buttons** 

- VR Lesson Interface
- Drilling statistics view
- Zoom out
- Zoom in
- Perform site survey



### 3.2.12.9 Summary

Items listed below, are included in the evaluation provided during and following each lesson:

- Drill model, bit and pipe
- Product type
- Reamer
- Soil type/condition
- Time to complete lesson
- Bend radius
- Depth
- Deviation from desired bore path

# 4 GENERAL DRILLING/REAMING GUIDELINES

The simulator provides drilling and reaming training through multiple scenarios. General guidelines which apply across the lessons are outlined below.

#### 4.1 Drill Type Selection

The simulator includes options for the drill types shown in the following table. For the purpose of this simulator, the selected drill type affects only the recommended/allowable bend radii as summarized below.

Drill	Bend Radius		Max change per pipe		
туре	feet	meters	Pitch	Degrees	
JT20	107	32.6	9.40%	5.4	
JT25	123	37.5	8.00%	4.6	
JT30	123	37.5	8.00%	4.6	
JT60	170	51.8	8.80%	5.1	
JT100	205	62.5	7.20%	4.1	

#### Drill Type

## 4.2 Drill Bit Selection

The simulator supports multiple drill bits which can be used in the soil types as shown in the table below.

Soil Type	Sand Bit	Tuff Bit	Tornado
Sand	х	х	Х
Mixed	х	х	Х
Clay		Х	Х

**Drill Bit Selection** 



### 4.3 Drill Bit Diameter

The drill bit diameter should be selected based on the drill type and product size.

### 4.4 Soil Type/Conditions

Soil type and condition affect both steering and drilling resistance. In general, drilling resistance will be higher when using the MIXED soil type than when drilling in SAND or CLAY. The amount of steering will also be affected by both soil type and condition.

#### 4.5 Drilling Fluid Additives

The simulator allows the operator to select fluid additives. For the purpose of the simulation, the specific mixture does not affect drilling performance. However, if additives are not used at all, both thrust and rotation pressure will increase.

#### 4.6 Default Bore Plan/Free-Boring

Each drilling lesson includes a default bore path based on a 24% entry angle. When the default path is used, upper and lower bounds are displayed in which the path should be maintained. However; it is possible to turn off the default path to support "free-boring." This is done automatically when the entry angle on the Rig configuration tab is changed from the default value of 24% (see Section 3.1.5).

#### 4.7 Steering

Steering is controlled using drill head position and rotation. To change drilling direction, rotate the bit slowly clockwise to the clock position you intend to travel (as shown below and displayed on the remote display) then push into the ground without rotating.



To move forward without changing direction, push pipe into ground while continually rotating the bit clockwise.



### 4.8 Drilling/Steering Performance

Use the following guidelines to ensure the best performance during drilling:

- Always use drilling fluid to improve performance and to avoid overheating the beacon.
- Direction corrections should be made as gradually as possible. Overcorrecting will cause "snaking" which can damage pipe and can make drilling and pullback more difficult. Begin to straighten out of each correction as early as possible.
- Do not push an entire piece of drill pipe into ground without rotation. This can exceed bend radius and cause pipe failure.
- Monitor depth on the remote display to ensure the bore plan is being followed.
- Do not rotate spindle counterclockwise while drilling to avoid detaching pipe from the drill string downhole.
- When drilling, maintain sufficient clearance from underground utilities not only with the drill bit but also compensating for the reamer size when pulling back.

## 4.9 Reaming

Reaming is used to enlarge the pilot hole to accommodate larger product. Make sure you select the proper reamer type and diameter based on soil conditions, product diameter and the following guidelines.

- As a general rule, the reamer diameter should be 1.5 times larger than the diameter of the product being installed.
- Select a reamer based on soil type using the following table as a guide. Selecting a reamer not recommended for a specific soil type will reduce pullback performance.

	Clay	Sand	Mixed
Warthog	Х	х	х
Compact Fluted		х	
Beavertail	х	х	

#### **Reamer Selection**

- Do not rotate the reamer until it has contacted the ground.
- Always use drilling fluid to avoid getting the reamer stuck.
- Rotate the spindle clockwise while pulling back, otherwise; the reamer will not advance, and if rotating counter-clockwise, drill string may unthread.



#### 4.10 Warnings and Violations

The simulator tracks and reports numerous potentially damaging actions, such as those listed below.

- Rotating pipe counter clockwise while drilling/reaming
- Opening front wrench when spindle not attached to drill string
- Colliding with underground utilities
- Exceeding the allowable bend radius
- Exceeding maximum allowable deviation from the planned bore path

When a violation or warning is detected, a text box is displayed on the screen. When you fail to survey the site to locate underground utilities, you will hit a utility. A visual indication (e.g. water gushing from the ground) will be shown and the lesson will pause. A warning will be shown prompting you to follow emergency procedures and acknowledging the violation. The lesson will continue after automatically backing up two pipe lengths. All safety violations will be listed in the evaluation.

# 5 LESSONS

The following sections describe how to run each of the following lessons:

- Lesson 1 Controls Familiarization
- Lesson 2 Basic Drilling: Open Field
- Lesson 3 Drilling: River Crossing
- Lesson 4 Drilling: Road Crossing
- Lesson 5 Basic Reaming: Open Field
- Lesson 6 Reaming: River Crossing
- Lesson 7 Reaming: Road Crossing
- Demo Lesson Drilling: Road Crossing

## 5.1 Lesson 1 - Controls Familiarization

#### 5.1.1 Overview

Prior to using the simulator training lessons or operating the drill, you need to become familiar with the controls and displays. This lesson teaches you the location and basic functions of controls and displays included in the simulator.



## 5.1.2 Instructions

- 1. You first learn about controls used to set the stabilizers, frame tilt and anchors. In each case, you use arrows on the 3D display to move these items (see Section 3.2.9).
- 2. You then learn the location and function of basic and advanced simulator controls.
  - In Practice mode, images are displayed showing the location of controls (see Section 3.2.4). You need to engage the proper control before moving to the next prompt.
  - In Assessment mode, only the name of the specific control to engage is provided. If you engage the proper control, the lesson progresses to the next step. If you engage an incorrect control, an image is displayed indicating an incorrect response and displaying the location of the correct control. The lesson progresses when the right trigger button is pressed.
- 3. Finally, you learn about displays used in the simulator including the Engine Display, ESID, Function Indicators, Right Console Indicators, Remote Display, Pressure Gauges and Bore Plan Display. Pay attention to the information presented during Practice as you must answer multiple-choice questions regarding this information during Assessment.
- 4. After the final display is covered, the lesson ends, and an evaluation is displayed.

## 5.1.3 Evaluation

Your evaluation includes the following.

- Time to complete lesson
- Number of correct actions performed

# 5.2 Lesson 2 – Basic Drilling: Open Field

## 5.2.1 Overview

During this lesson, you complete a basic bore in an open field. The jobsite layout is shown below. **NOTE:** there are no underground utilities included for this lesson.



Open Field Layout (Note: each grid section is 10 ft x 10 ft)



## 5.2.2 Instructions

After configuring the site, rig and fluid (see Section 3.1.5), you must complete the following steps. In Practice mode, you are provided step-by-step instructions. In Assessment mode, you are expected to complete the necessary steps without guidance.

1. Reviewing the jobsite: You are prompted to view a fly over of the jobsite and then prompted to perform a survey for underground utilities. The survey is conducted by pressing the highlighted button on the bore plan display. If you choose not to perform the survey, you run the risk of hitting an unmarked underground utility.



Survey Button

2. Setting up/testing the ESID system: In Practice mode, a video is provided regarding the set-up and test of the ESID system. Following this, you are prompted to start the self-test by clicking on the "?" button on the ESID display. You move to the next step after the ESID completes its test cycle.



**ESID Self-test Button** 

- 3. Setting up for initial entry: You prepare for initial entry by setting the stabilizers, frame tilt and anchors. In each case, you use your hands to manipulate virtual levers on the side of the machine.
  - Ensure both stabilizers are grounded, the target entry angle (shown in the Summary display) is achieved without lifting the tracks off the ground, and both anchors are fully driven into the ground before continuing.



Stabilizer, Tilt and Anchor Controls



- 4. Drilling the first pipe: When drilling the first pipe, you must turn on the drilling fluid, rotate the bit, engage high throttle, fill the pipe with fluid and push the pipe into the ground.
- Adding pipe: After drilling the first pipe, you must complete steps needed to add pipe to the drill string. In Practice, you are guided first through automated pipe loading and then manual loading. In Assessment, you add pipe using automation, but are not prompted through the specific steps. When adding pipe:
  - Ensure pipe grippers are closed prior to extending shuttles with a pipe to keep it from falling off the shuttles.
  - Always set the shuttle stop/row select control to the row where all rows higher in number are filled and all rows lower are empty. Selecting any other row will result in pipes falling out of the pipe box.
  - Do not open the front wrench until the new pipe has been threaded to the spindle.
- 6. Drilling/Steering: You then continue drilling/steering until the exit area is reached. To ensure the best performance, remember to follow the guidelines in Section 4.8.
- 7. Once the exit point is reached, the lesson ends and an evaluation is displayed.

## 5.2.3 Warnings and Violations

During the lesson, several warnings and violations are tracked.

- Exceeding the recommended/allowable bend radius.
- Dropping pipe from the shuttles: if the shuttles are extended with a pipe loaded and the grippers not closed, the pipe falls off the shuttle and you must close the grippers to reload the pipe.
- Dropping pipe from the pipe box: if the shuttle stop is moved beyond a slot loaded with pipe, the pipe drops out.

#### 5.2.4 Evaluation

- Time to complete lesson
- Bore Length
- Max Deviation
- Bend Radius
- Depth
- Warnings and Violations



### 5.3 Lesson 3 – Drilling: River Crossing

#### 5.3.1 Overview

During this lesson, you complete a bore underneath a water crossing using both walk-over and drill-to tracking. The jobsite layout is shown below.



River Crossing Field Layout (Note: each grid section is 10 ft x 10 ft)

#### 5.3.2 Instructions

After configuring the site, rig and fluid (see Section 3.1.5), you must complete the following steps. In Practice mode, you are provided step-by-step instructions. In Assessment mode, you are expected to complete the necessary steps without guidance.

1. Reviewing the jobsite: You are prompted to view a fly over of the jobsite and then prompted to perform a survey for underground utilities. The survey is conducted by pressing the highlighted button on the bore plan display. If you choose not to perform the survey, you run the risk of hitting an unmarked underground utility.



**Survey Button** 

2. Setting up/testing the ESID system: In Practice mode, a video is provided regarding the set-up and test of the ESID system. Following this, you are prompted to start the self-test by clicking on the "?" button on the ESID display. You move to the next step after the ESID completes its test cycle.



- 3. Setting up for initial entry: You prepare for initial entry by setting the stabilizers, frame tilt and anchors. In each case, you use arrows on the 3D display to move these items (see Section 3.2.9).
  - Ensure both stabilizers are grounded, the target entry angle (shown in the Summary display) is achieved without lifting the tracks off the ground, and both anchors are fully driven into the ground before continuing.
- 4. Drilling the first pipe: When drilling the first pipe, you must turn on the drilling fluid, rotate the bit, engage high throttle, fill the pipe with fluid and push the pipe into the ground.
- 5. Adding pipe: After drilling the first pipe, you must complete steps needed to add pipe to the drill string. In both Practice and Assessment mode you are expected to add pipe using automation, but are not prompted through the specific steps. When adding pipe:
  - Ensure pipe grippers are closed prior to extending shuttles with a pipe to keep it from falling off the shuttles.
  - Always set the shuttle stop/row select control to the row where all rows higher in number are filled and all rows lower are empty. Selecting any other row will result in pipes falling out of the pipe box.
  - Do not open the front wrench until the new pipe has been threaded.
- 6. Drilling/Steering: You then continue drilling/steering until the exit area is reached. To ensure the best performance, remember to follow the guidelines in Section 4.8. During the initial portion of the lesson, you use walk-over tracking. Once the bit reaches the river bank, you are switched to drill-to tracking. During practice, you are provided information regarding the use of drill-to tracking. Once the bit reaches the far bank, you are switched back to walk-over tracking.
- 7. Once the exit point is reached, the lesson ends and an evaluation is displayed.

## 5.3.3 Warnings and Violations

During the lesson, several warnings and violations will be tracked.

- Exceeding the recommended/allowable bend radius.
- Dropping pipe from the shuttles: if the shuttles are extended with a pipe loaded and the grippers not closed, the pipe falls off the shuttle and you must close the grippers to reload the pipe.
- Dropping pipe from the pipe box: if the shuttle stop is moved beyond a slot loaded with pipe, the pipe drops out.

## 5.3.4 Evaluation

- Time to complete lesson
- Bore Length
- Max Deviation
- Bend Radius
- Depth
- Warnings and Violations



### 5.4 Lesson 4 – Drilling: Road Crossing

#### 5.4.1 Overview

During this lesson, you complete a bore underneath a road crossing. The jobsite layout is shown below.



Road Crossing Field Layout (Note: each grid section is 10 ft x 10 ft)

#### 5.4.2 Instructions

After configuring the site, rig and fluid (see Section 3.1.5), you must complete the following steps. In Practice mode, you are provided step-by-step instructions. In Assessment mode, you are expected to complete the necessary steps without guidance.

1. Reviewing the jobsite: You are prompted to view a fly over of the jobsite. However, in this lesson you are not specifically prompted to perform a survey for underground utilities. If you choose not to perform the survey, you run the risk of hitting an unmarked underground utility.



#### **Survey Button**

- Setting up/testing the ESID system: In Practice mode, a video is provided regarding the set-up and test of the ESID system. Following this, you are prompted to start the self-test by clicking on the "?" button on the ESID display. You move to the next step after the ESID completes its test cycle.
- 3. Setting up for initial entry: You prepare for initial entry by setting the stabilizers, frame tilt and anchors. In each case, you use arrows on the 3D display to move these items (see Section 3.2.9).
  - Ensure both stabilizers are grounded, the target entry angle (shown in the Summary display) is achieved without lifting the tracks off the ground, and both anchors are fully driven into the ground before continuing.



- 4. Drilling the first pipe: When drilling the first pipe, you must turn on the drilling fluid, rotate the bit, engage high throttle, fill the pipe with fluid and push the pipe into the ground.
- 5. Adding pipe: After drilling the first pipe, you must complete steps needed to add pipe to the drill string. In both Practice and Assessment mode you are expected to add pipe using automation, but are not prompted through the specific steps. When adding pipe:
  - Ensure pipe grippers are closed prior to extending shuttles with a pipe to keep it from falling off the shuttles.
  - Always set the shuttle stop/row select control to the row where all rows higher in number are filled and all rows lower are empty. Selecting any other row will result in pipes falling out of the pipe box.
  - Do not open the front wrench until the new pipe has been threaded.
- 6. Drilling/Steering: You then continue drilling/steering until the exit pit is reached. To ensure the best performance, remember to follow the guidelines in Section 4.8.
  - During drilling, you encounter an area, which requires the use of AutoCarve to steer. Follow the onscreen prompts to engage and adjust the system.
  - During drilling, you may encounter a rocky area, which will cause a deflection of the drill bit. Be sure to compensate by steering as needed to get back onto the desired bore plan.
  - Once the exit point is reached, the lesson ends and an evaluation is displayed.

# 5.4.3 Warnings and Violations

During the lesson, several warnings and violations will be tracked.

- Exceeding the recommended/allowable bend radius.
- Dropping pipe from the shuttles: if the shuttles are extended with a pipe loaded and the grippers not closed, the pipe falls off the shuttle and you must close the grippers to reload the pipe.

## 5.4.4 Evaluation

- Time to complete lesson
- Bore Length
- Max Deviation
- Bend Radius
- Depth
- Warnings and Violations



### 5.5 Lesson 5 – Basic Reaming: Open Field

#### 5.5.1 Overview

In this lesson, you learn and practice basic reaming techniques in an open field. At the start of the lesson, the pilot bore is already in place based on the last time you completed a bore in the open field, and a reamer is attached based on your selections in the Simulator Control user interface. **NOTE**: beacon tracking is not used during reaming in this lesson.

#### 5.5.2 Instructions

After starting the lesson, you must complete the following steps. In Practice mode, you are provided stepby-step instructions. In Assessment mode, you are expected to complete the necessary steps without guidance.

- 1. Pulling back until the reamer initially contacts the exit point.
  - Do not rotate the reamer until it has contacted the ground.
- 2. Pulling back and breaking out pipe. In Practice mode, you are first stepped through the automated pipe removal mode and then the manual mode. For Assessment mode, you are expected to use automation for pipe removal, but you are not specifically guided through the required steps.
- 3. Continue reaming until the entry location is reached. To ensure the best performance:
  - Always use drilling fluid to avoid getting the reamer stuck.
  - Rotate the spindle clockwise while pulling back. Otherwise, the reamer will not advance; and, if rotated counter-clockwise it may unthread the drill string down hole.
- 4. Once the initial entry point is reached, the lesson ends and an evaluation is displayed.

#### 5.5.3 Evaluation

- Time to complete lesson
- Reaming Length
- Warnings and Violations



### 5.6 Lesson 6 – Reaming: River Crossing

#### 5.6.1 Overview

In this lesson, you learn and practice techniques while reaming under a water crossing. At the start of the lesson, the pilot bore is already in place based on the last time you completed a bore in the river crossing field, and a reamer is attached based on your selections in the Simulator Control user interface. **NOTE**: beacon tracking is not used during reaming in this lesson.

#### 5.6.2 Instructions

After starting the lesson, you must complete the following steps. In Practice mode, you are provided stepby-step instructions. In Assessment mode, you are expected to complete the necessary steps without guidance.

- 1. Pulling back until the reamer initially contacts the exit point.
  - Do not rotate the reamer until it has contacted the ground.
- 2. Pulling back and breaking out pipe. In Practice and Assessment, you are expected to use automation for pipe removal, but you are not specifically guided through the required steps.
- 3. Continue reaming until the entry location is reached. To ensure the best performance:
  - Always use drilling fluid to avoid getting the reamer stuck.
  - Rotate the spindle clockwise while pulling back. Otherwise, the reamer will not advance; and, if rotated counter-clockwise it may unthread the drill string down hole.
- 4. Once the initial entry point is reached, the lesson ends and an evaluation is displayed.

#### 5.6.3 Evaluation

- Time to complete lesson
- Reaming Length
- Warnings and Violations



## 5.7 Lesson 7 – Reaming: Road Crossing

### 5.7.1 Overview

In this lesson, you learn and practice techniques while reaming under a road crossing. At the start of the lesson, the pilot bore is already in place based on the last time you completed a bore in the road crossing field, and a reamer is attached based on your selections in the Simulator Control user interface. **NOTE**: beacon tracking is not used during reaming in this lesson.

### 5.7.2 Instructions

After starting the lesson, you must complete the following steps. In Practice mode, you are provided stepby-step instructions. In Assessment mode, you are expected to complete the necessary steps without guidance.

- 1. Pulling back until the reamer initially contacts the exit point.
  - Do not rotate the reamer until it has contacted the ground.
- 2. Pulling back and breaking out pipe. In Practice and Assessment, you are expected to use automation for pipe removal, but you are not specifically guided through the required steps.
- 3. Continue reaming until the entry location is reached. To ensure the best performance:
  - Always use drilling fluid to avoid getting the reamer stuck.
  - Rotate the spindle clockwise while pulling back. Otherwise, the reamer will not advance; and, if rotated counter-clockwise it may unthread the drill string down hole.
- 4. Once the initial entry point is reached, the lesson ends and an evaluation is displayed.

#### 5.7.3 Evaluation

- Time to complete lesson
- Reaming Length
- Warnings and Violations



### 5.8 Demo – Drilling: Road Crossing

#### 5.8.1 Overview

During the demo, you have 5 minutes to complete a partial bore underneath a road crossing. The jobsite layout is shown below. **NOTE**: for this demo, the underground survey has already been performed.



Demo Road Crossing Field Layout (Note: each grid section is 10 ft x 10 ft)

#### 5.8.2 Instructions

The machine is ready for drilling at the start of the lesson (the stabilizers, frame tilt, and anchors are already set and the ESID tested). You must complete the following steps.

- 1. Drilling the first pipe: When drilling the first pipe, you must turn on the drilling fluid, rotate the bit, engage high throttle, fill the pipe with fluid and push the pipe into the ground.
- 2. Adding pipe: After drilling the first pipe, you are prompted to use automation to add the next pipe. You repeat the same process without prompts for the remaining pipe.
- 3. Drilling/Steering: You continue drilling/steering until the time limit is reached. To ensure the best performance, remember to follow the guidelines in Section 4.8.
  - During drilling, you may encounter a rocky area which will cause a deflection of the drill bit. Be sure to compensate by steering as needed to get back onto the desired bore plan.
  - Once the exit point is reached, the demo ends and an evaluation is displayed.



#### 5.8.3 Warnings and Violations

During the lesson, several warnings and violations will be tracked.

- Exceeding the recommended/allowable bend radius.
- Dropping pipe from the shuttles: if the shuttles are extended with a pipe loaded and the grippers not closed, the pipe falls off the shuttle and you must close the grippers to reload the pipe.

#### 5.8.4 Evaluation

Your evaluation includes the following.

- Time to complete lesson
- Bore Length
- Max Deviation
- Bend Radius
- Depth
- Warnings and Violations

# 6 INSTALLATION GUIDE

The HDD Training Simulator installer walks you through the process needed to set up the simulator software. During this process, the required components including the HDD VR Simulator, mREST, Bonjour SDK, PHP, Microsoft Visual C++ Redistributable, Chrome, Keylok driver will be installed. Additionally, you will have to install the Leap Motion Software to complete the installation process. **NOTE:** each of these components must be in place for the simulator to function properly.

#### 6.1 HDD VR Simulator and Components Installation

You will need to download and install the HDD VR Similator software. This step requires internet access. On a web browser, navigate to <u>http://updates.ditchwitch.com/updates.html</u>. On this page, you will find the 'Download and Install the HDD VR Simulator Software" link. After downloading the self-extracting file, double click on the file to extract the software installer and support software. Locate and launch "hdd_vr_sim_x.x.x.exe" installer to begin the software installation process. When the following screen is displayed, carefully read the full license and click on the check box to verify you agree to all of the license terms and conditions. To continue select **Install**.





After the installer is started, a dialog may be displayed asking if you want to allow the program (hdd_vr_sim-bundle-x.x.x.x.exe) to make changes to the computer. If this dialog is displayed, select **Yes** to continue. A progress dialog will be displayed while the various components are being installed.

₩ Horizontal Directional Drill Simulator v1.0.0 Full Installati – 🛛 🗙
Horizontal Directional Drill Simulator vI.0.0 Full Installation
Setup Progress
Processing: mREST v3.7.2
<u>C</u> ancel

If the additional required software components have not been previously installed, you will be guided through the required installation process for each. The following dialog will be shown if Microsoft Visual C++ Redistributable needs to be installed. Carefully read the full license and click the "I agree..." option to verify you agree to all of the license terms and conditions. To continue select **Install**.

🛃 Microsoft Visual C++ 2013 Redistributable (x86) - 12.0.21005 Set 💷 💷 💌
Microsoft Visual C++ 2013 Redistributable (x86) - 12.0.21005
MICROSOFT SOFTWARE LICENSE TERMS
MICROSOFT VISUAL C++ REDISTRIBUTABLE FOR VISUAL STUDIO 2013
These license terms are an agreement between Microsoft Corporation (or hased on where you live, one of its affiliates) and you. Please read them
✓ I agree to the license terms and conditions
Install Close

A progress dialog will be displayed while the software is being installed.





The following dialog will be displayed once the installation is complete. Select **Close** to continue.



The following dialog will be displayed if the Bonjour SDK needs to be installed. Select **Next** when the following screen is displayed.



Carefully read the full license and click the "I accept..." option to verify you agree to all of the license terms and conditions. To continue select **Next**.

😸 Bonjour SDK				Х		
License Agreement						
Please read the following license agreen	nent carefully.					
[						
APPLE INC.			^			
AGREEMENT	SUN SUP IW	AND LICENSE				
BONJOUR FOR WINDOWS						
		CDEEMENT ("L	CENCE			
BEFORE USING THE SOFTWAR	RE. BY USING	THE SOFTWAR	E. YOU			
ARE AGREEING TO BE BOUND	BY THE TERM	IS OF THIS LIC	ENSE. IF			
YOU DO NOT AGREE TO THE T	ERMS OF THE	ELICENSE, DO	NOT			
USE THE SOFTWARE. IF YOU	ARE ACCESSI	NG THE SOFTW	ARE V			
$\bigcirc$ I <u>d</u> o not accept the terms in the licen	se agreement					
I accept the terms in the license agreement:						
	< Back	Next >	Cancel			
	< Back	<u>Heat</u>	Cancer	_		



Read the information in the following dialog, and then select Next to continue.



The following dialog shows the destination folder for the Bonjour SDK. Do not change this location. Select **Install** to continue.



A progress dialog will be displayed while Bonjour is being installed.

闄 Bonjour	SDK	_		×
Installing	Bonjour SDK			
The prog	ram features you selected are being installed.			
12	Please wait while Bonjour SDK installs. This may take several	l minutes	3.	
	Status: Writing system registry values			
	Key: \Software\Classes\Bonjour.DNSSDService: Bonjour.I	DNSSDS	ervice.1	
	< <u>B</u> ack <u>N</u> ext >		Cano	el





The following dialog will be displayed once the installation is complete. Select **Finish** to continue.

If Chrome was not previously installed, it will be installed next. The following dialog will be displayed while Chrome is installing.



The following dialog will be displayed if the Kvaser Leaf Light drivers need to be installed. Select **Next** when the following screen is displayed.





The following dialog gives you the option to read the Kvaser Leaf Light software release notes. Select **Next** to continue.

🛛 Kvaser CAN Drivers W	HCP Setup		-		×
KVASER	Release Notes Before installation	n, you should re	ad the release	e notes car	efully.
Press any one of the bu	ttons to display the ind	icated documer	it.		
Display Rele	ase Notes				
Jullsoft Install System v2.4	6				
		< Back	Next >	G	ancel

The following dialog shows optional components to be installed for Kvaser Leaf Light software. Leave settings as is and select **Next** to continue.

🗾 Kvaser CAN Drivers WHC	P Setup	- 🗆 🗙				
KVASER	Choose Components Choose which features of Kvaser CAN Drivers WHCP you want to install.					
Check the components you install. Click Next to continu	want to install and uncheck the comp je.	ponents you don't want to				
Select components to insta	II: Drivers (32/64-bit x86) V Start Menu Shortcuts V GUI tools J2534 driver	Description Position your mouse over a component to see its description.				
Space required: 70.4MB						
Nullsoft Install System v2.46 -	< Back	Next > Cancel				

The following dialog shows the destination folder for the Kvaser Leaf Light drivers. Do not change this location. Select **Instal** to continue.

	Choose Install Loc	ation			
AVASER,	Choose the folder in	which to install Kyas	er CAN D	viverc WH	CP.
	Choose the rolder in			111013 1111	
Setup will install Kva	ser CAN Drivers WHCP in the I	ollowing folder. To in	istall in a	different	
folder, click Browse	and select another folder. Clic	< Install to start the i	nstallatio	n.	
Destination Folder					
Destination Folder			-		
Destination Folder	s\Kvaser\Drivers		Bro	wse	]
Destination Folder	s\Kvaser\Drivers		Bro	wse	]
Destination Folder	s\Kvaser\Drivers		Bro	wse	]
Destination Folder	s <mark>)Kvaser\Drivers</mark> 4MB 2GB		Bro	wse	]
Destination Folder	S <u> Kvaser Orivers</u> 4MB 2GB		Bro	wse	]
Destination Folder	S <mark>Kvaser(Drivers)</mark> 4MB 2GB v2.46		Bro	wse	]
Destination Folder	SIVvaser(Drivers 4MB 2GB v2.46	]	Bro	wse	]



The following dialog will be displayed while the Kvaser Leaf Light drivers and software are installing.

🔟 Kvaser CAN Drivers WHCP Setup —					
KMASER	Installing Please wait while	Kvaser CAN Drive	ers WHCP is bei	ng installed	d.
Output folder: D:\Progr	am Files\Kvaser\Driver	s			_
Show details					
Nulleoft Techall Sustance 2	6				
nuisure ansedil bystem v2,4		< Back	Close	Cano	:el

The following dialog confirms installation of Kvaser Leaf Light drivers. Select **Close** to continue.

😈 Kvaser CAN Drivers WHCP Setup 🦳 🗌			$\times$	
KVASER	Installation Complete Setup was completed successfully.			
Completed				
Show details				
Nullsoft Install System v2,46	a Bask	1	Car	un l
	< Back C	lose	Cano	:el

The following dialog will be displayed once all components have been successfully installed. Select **Close** to close the installer.



An HDD VR Simulator icon will be added to the desktop for starting the simulator. Refer to Section 3 for instructions on running the simulator.



Simulator Icon



## 6.2 Leap Motion Software Installation (Required)

The HDD VR Training Simulator installation software includes the Leap Motion software installer. Locate and launch "Leap_Motion_Orion_Setup_win_x.x.x.exe" to begin the Leap Software installation process.

The following dialog will be shown at the beginning of the Leap software installation. Select **Next** to continue.



The following dialog will be displayed once the installation is complete. Select **Finish** to complete the installation process. **NOTE:** make sure to deselect the check box "Launch Browser for VR setup" as this step is not needed.

Leap Motion Controller Setu	p ·	-		×	
	Installation completed	eted			
	Your Leap Motion Controller is ready for u	use!			
LEAP	Launch Browser for VR Setup				
-					
	Visit us at: www.leapmotion.com				
	< Back Finish		Can	cel	



#### 6.3 Optional TeamViewer Software Installation

The HDD VR Training Simulator installation CD/DVD or USB drive includes an optional software package that can be used to assist in troubleshooting your simulator by allowing simulator support personnel to remotely log into the computer. For more information on TeamViewer see www.teamviewer.com.

If you choose to install the software, follow the steps below.

Double click on TeamViewer_Setup.exe in the Support folder on the CD/DVD or USB drive. Select **Run** on the following dialog to continue.



Set the options as shown below and select **Accept – finish**.




## **HDD VR Training Simulator User Manual**

The following dialog will be displayed once all components have been successfully installed. Select **Close** to close the installer.

TeamViewer 10 Setup		l	
<b>Installing</b> Please wait while TeamViewer 10 is bein	ng installed.		
Rename: C:\Program Files (x86)\Team\	/iewer\x64\teamvie	ewervpn.sy>C:\Pr	ogram Files (x86
Show details			
	< <u>B</u> ack	Close	Cancel

The following dialog will be displayed once TeamViewer have been successfully installed. Take note of the information displayed, then select **Close** to close the installer. As needed, support personnel will work with you to use TeamViewer to provide technical support.

Check out w	hat's possible	e with Team	√iewer - Re	mote Contro
This is your ID. Share it for connections to this computer.	You're in Remote Control Switch to Meeting mode Premate Control Allow Remote Control 223 456 7870	Control Rende Co	The second secon	Always have your omputers with you. Connect easily without remembering numbers and passwords.
		••		



# **HDD VR Training Simulator User Manual**

# 7 TROUBLESHOOTING GUIDE

This section contains information you will need to troubleshoot potential simulator issues.

## 7.1 Simulator Not Responding

Potential Cause: Simulator display window does not have focus.

Solution: Use the mouse to move the cursor into the simulation window and left click.

## 7.2 Joysticks Not Responding

Potential Cause: Joysticks not plugged into USB ports or power supply.

*Solution:* Ensure the joysticks are plugged into a USB port and the power supply is properly connected to the electrical harness and a wall power outlet prior to starting the simulator software.

### 7.3 Simulator Will Not Start – Keylok Error Displayed

*Potential Cause:* Dongle not plugged into the simulation computer.

Software License Error		
	Error: Keylok USB Dongle Not Present or drivers not installed	
	ОК	

*Solution:* Ensure the dongle is plugged into a USB port on the simulation computer.



215-3051, VR HDD Simulator License Dongle



# **HDD VR Training Simulator User Manual**

#### 7.4 HDD VR Simulator became Unresponsive or shows Objects out of Place.

Potential Cause: One of the interacting software application became unresponsive.

**Solution:** Close all the software applications running (i.e. mREST, Chrome, Oculs, etc.). Allow a few minutes for the computer to complete the closing of the applications. Try restarting the simulator to verify if the issue was corrected.

If the issue continues, close all the software applications running again (i.e. mREST, Chrome, Oculs, etc.). Allow a few minutes for the computer to complete the closing of the applications. Next, "Restart" the computer or "Shutdown" the computer and restart it. Once the computer has restarted or rebooted, try restarting the simulator to verify if the issue was corrected.

### 7.5 Virtual Hands Show Up Inverted in the Simulator or the Hands are Unresponsive

Potential Cause: Leap Motion sensor or software became unresponsive.

**Solution:** Disconnect the Leap Motion sensor cable at the headset and reconnect. Allow a few minutes for the computer and software to reestablish the connection with the sensor.

### 7.6 Images Not Arranged Correctly

Potential Cause: Display configuration needs to be updated.

Solution: Open the Windows Control Panel and set the View by option to Large icons or Small icons.



**Control Panel** 

Select Display.



**Control Panel** 



Select Change display settings.

4	🌀 🕞 🗢 📮 🕨 Control Panel 🕨	All Control Panel Items 🔸 Display	👻 🍫 Search Control Panel 🔎
	Control Panel Home Adjust resolution 😵 Calibrate color	Make it easier to read what's o You can change the size of text and othe temporarily enlarge just part of the scree	I your screen I your screen by choosing one of these options. To n, use the <u>Magnifier</u> tool.
	Change display settings Adjust ClearType text	Smaller - 100% (default)	Preview
	Set custom text size (DPI)	<u>M</u> edium - 125%	
		© <u>L</u> arger - 150%	
			Apply
	See also		
1	Personalization		
1	Devices and Printers		

Desktop Pop-Up Menu

Use the interface to rearrange the displays to match the setup. Select **Identify** to help see how monitors are numbered. If needed, click and drag the display icons so the one corresponding to the 3D display is on the left. Check **Make this my main display** for the 3D display. Select **Apply** when done.

**NOTE:** Both displays must be set to 1920 x 1080.

Change the ap	pearance of your displays	
	2 1	Detect Identify
Di <u>s</u> play:	2. SyncMaster 🔻	
Resolution:	1920 × 1080 (recommended)	
Orientation:	Landscape 🔻	
<u>M</u> ultiple displays:	Extend these displays	
This is currently yo	ur main display.	Advanced settin
Make text and othe	r items larger or smaller	
	as should Lishooso?	

**Display Configuration Controls** 



# 8 ACKNOWLEDGEMENTS

The Simulation Software incorporates mREST software: Copyright (c) 2013 METECS (http://www.metecs.com). mREST was developed at NASA's Johnson Space Center (JSC) under NASA Contract NNJ09HB89Z and the U.S. Government retains certain rights.

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Kvaser Leaf Light[®] is registered trademarks of Kvaser AB in the United States and/or other countries.



# 9 REGULATORY COMPLIANCE

#### 9.1 Federal Communications Commission (FCC)

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesirable operation.

#### 9.2 Canada

This Class "A" device complies with CAN ICES-3(A)/NMB-3(A).

#### 9.3 European Union (EU)

This device is in conformity with the directives and standards listed herein:

Low Voltage Directive (LVD)	2014/35/EU
Electromagnetic Compatibility (EMC) Directive	2014/30/EU
Health & Safety	EN 60950-1:2006 + A1:2010 + A11:2009 + A12:2011 + A2:2013
EMC	EN 55032:2012/AC:2013 EN 61000-3-2:2014 EN 61000-3-3:2013 EN 55024:2010

