



AUGMENTED REALITY (AR) TRAINING USER GUIDE

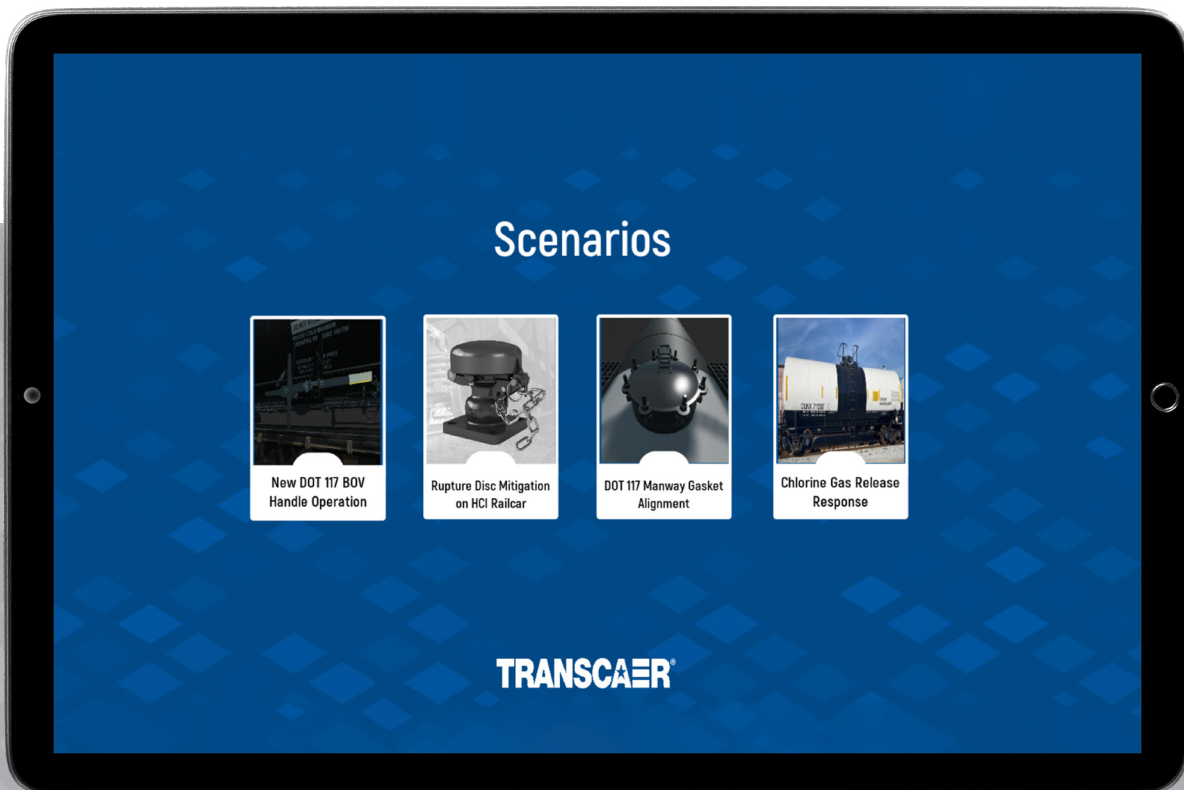


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DISCLAIMER

TRANSCAER and the American Chemistry Council assume no responsibility or liability for any errors or omissions in the content of the training application. The information contained therein is provided on an “as is” basis with no guarantees or completeness, accuracy, usefulness or timeliness.

SECTION 1: INTRODUCTION

The Purpose of the User Guide

The purpose of this User Guide to the TRANSCAER AR Training application is to provide users of the application with:

1. An overview of what the AR Training application is.
2. Instructions for how to download and install the application on an Apple device.
3. Instructions to get started with the application.
4. Describe the purpose, use, and navigation of the four existing training scenarios.
5. Answer common questions and troubleshooting support.



Figure 1: Example image for the TRANSCAER AR Training application with a computer generated, near full-scale railcar projected into the local real-world environment.

What is TRANSCAER AR Training?

TRANSCAER AR Training is an Augmented Reality (AR) application designed by GHD Limited and made specifically for Apple® mobile devices: iPads & iPhones¹ with integrated cameras. AR creates an interactive experience by combining the local real-world environment and computer-generated content within one interface on the device (see Figure 1 for an example). The AR Training application uses the camera on the user's Apple mobile device to project an interactable 3D model into the local real-world environment. The specific model projected is dependent on the training scenario that was selected - currently there are four scenarios available in the AR Training application. The user will be able to view and interact with a virtual full-scale railcar and acquire skills in operation of specific components in a mixed digital and real-world environment that has traditionally only been possible while being in the presence of the physical railcar itself. Users will be able to manipulate Department of Transport (DOT) 117 Handles, Rupture Discs, Manway Gaskets, and learn excellent practices for Chlorine Leak Mitigation.

¹ iPad and iPhone are registered trademarks of Apple Inc.

What devices work best with this application?

The application is best suited for Apple iPads with iPadOS 12.0 or later. This application will also work on Apple iPhones; however, the reduced screen size will add difficulty in the interaction with certain user interface (UI) features. **For the best experience and results, the developers suggest using the application on the Apple iPad.**



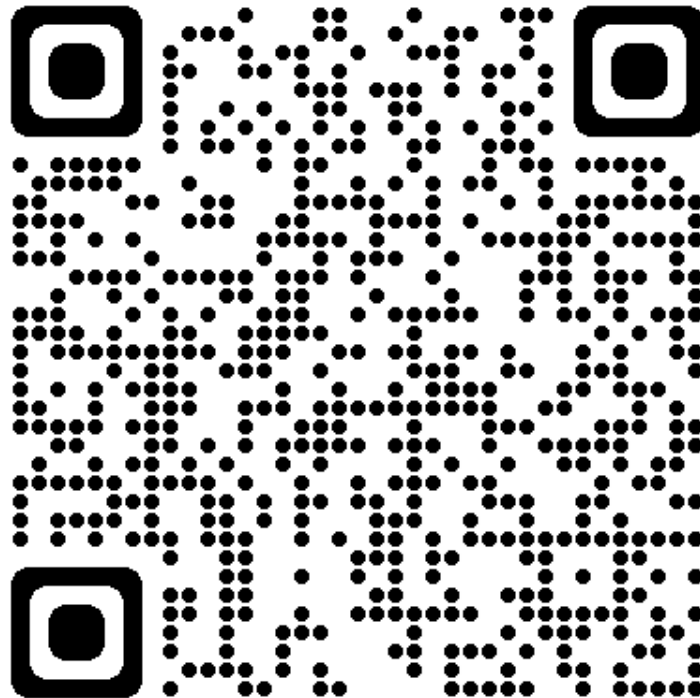
Figure 2: Example Apple iPad device that is recommended for the best user experience when using the AR Training application.

SECTION 2: DOWNLOADING AND INSTALLING

Where can this application be found?

This application is an unlisted application on the Apple App Store, so a search in the App Store will not find the application. Instead, the application can be found by using the following link on your Apple mobile device: <https://apps.apple.com/app/transcaer-ar-training/id1639934740>, which will direct the device to the TRANSCAER AR Training in the Apple App Store.

Scanning the following QR code with the device camera will also direct the device to the application on the App Store.



Downloading and Installation

Once the application has been located in the Apple App Store, you will either see a **blue GET button** or a **Cloud with an Arrow button**. Whichever button is displayed, it will be located where the red circle is indicating in Figure 3. Tapping the button, whichever is displayed on the device, will begin the download and installation process.

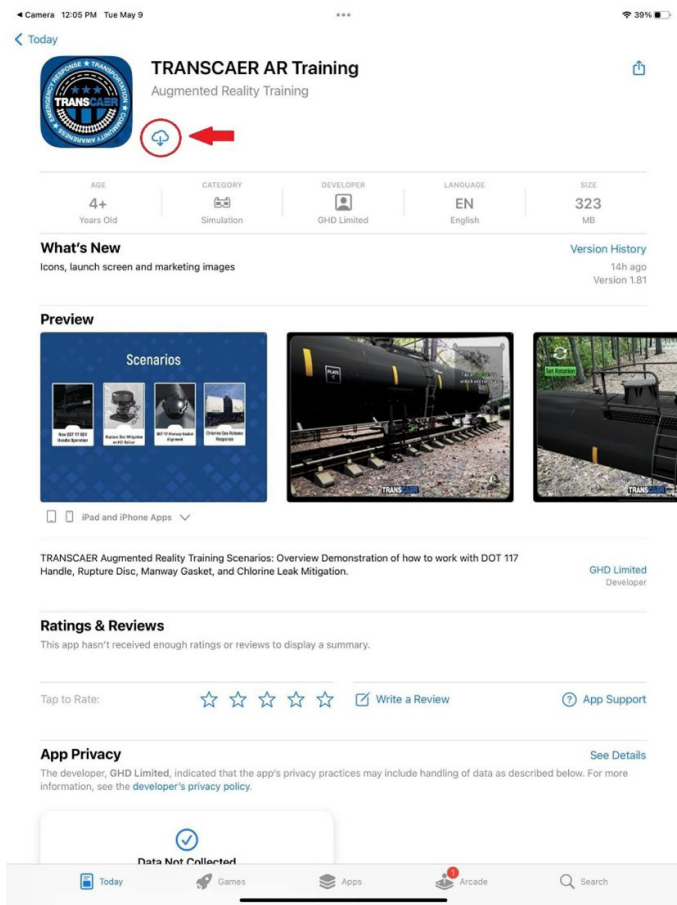


Figure 3: Screenshot of how the TRANSCAER AR Training application will appear once located in the Apple App Store. The red arrow and red circle indicate where the blue GET button, or the Cloud with Arrow button will be located.

After tapping the blue GET button or the Cloud with Arrow button, the installation will begin. While the download and installation take place, a blue progress wheel will show the current progress.

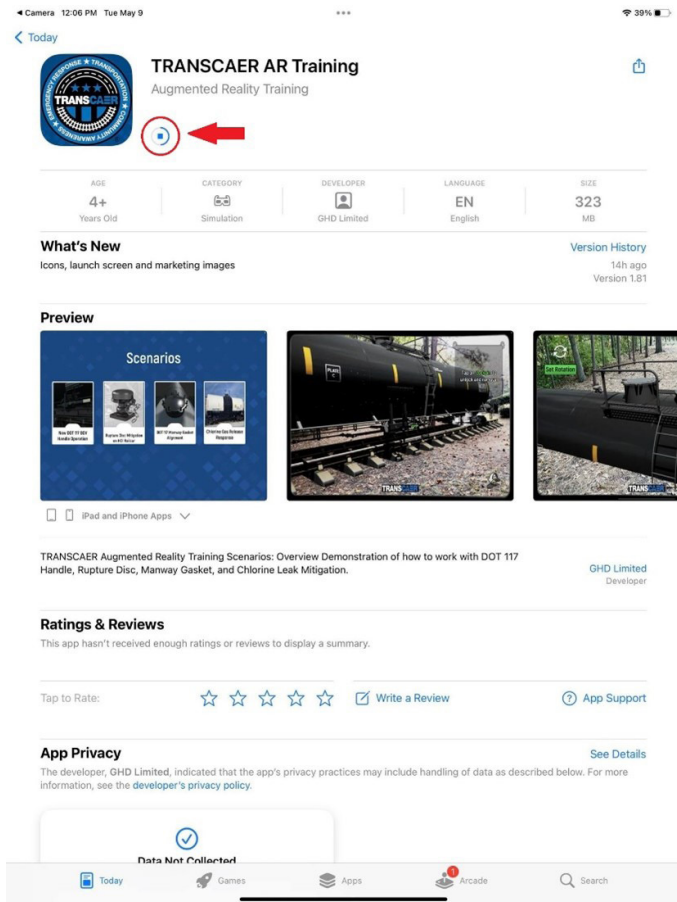


Figure 4: Screenshot showing the progress wheel as the download and installation process advances, indicated by the red arrow and red circle.

Once the application has finished downloading and installing, the application will be ready for use. The TRANSCAER AR Training application can be found on the home screen of the Apple mobile device, as seen in Figure 5.

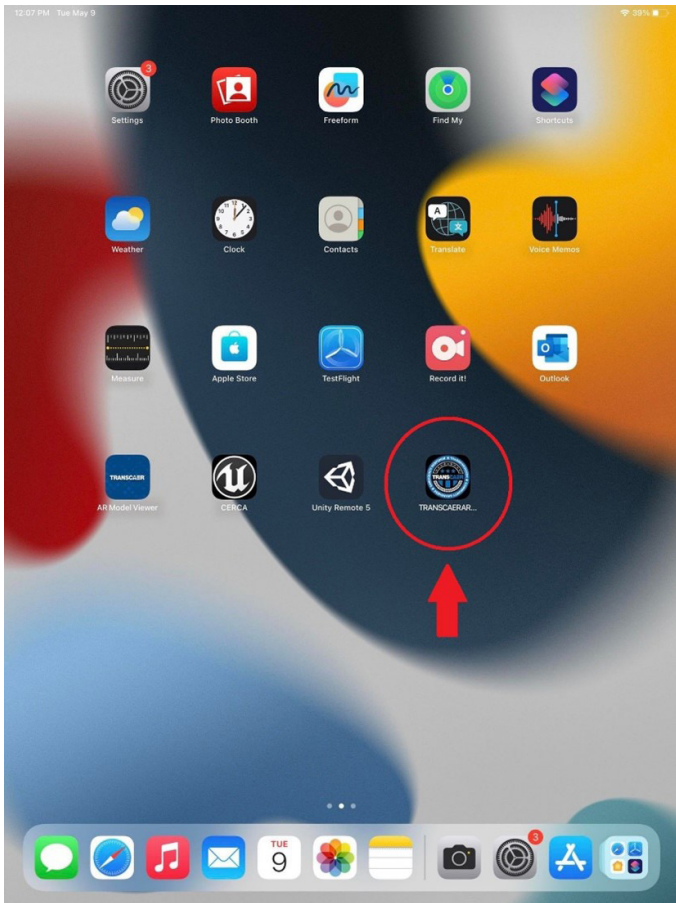


Figure 5: Once installation has finished, the TRANSCAER AR Training application can now be found on the home screen of the Apple device, as indicated by the red arrow and red circle.

SECTION 3: GETTING STARTED

Controls/UI Guides

To launch the TRANSCAER AR Training application, tap on the application icon found on the home screen of the Apple mobile device (see example in Figure 5).

When launching the application, a splash screen with the TRANSCAER logo will initially appear while the application loads (Figure 6).



Figure 6: The TRANSCAER splash screen that appears while the application loads.

The first time the application is launched on the Apple device, a message will ask for approval for the application to access the device's camera (see Figure 7). It is necessary to choose OK and allow the application access to the camera. Choosing "Don't Allow" will eliminate the functionality of the AR Training application.

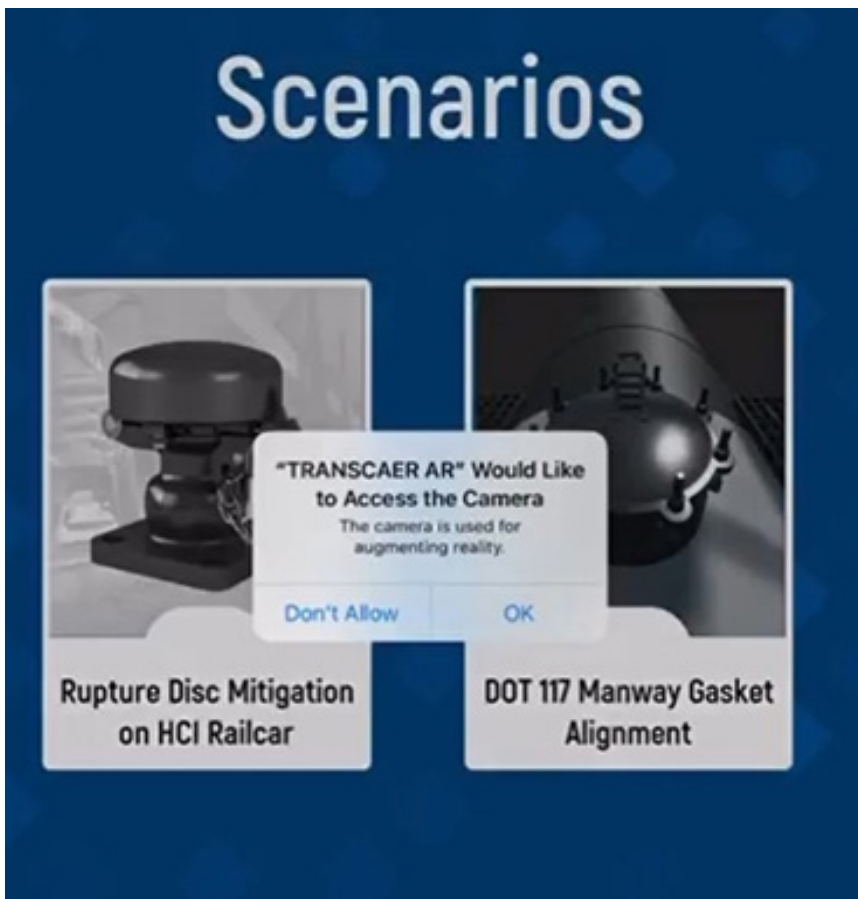


Figure 7: The message requesting approval for the application to access the Apple device's camera. Choosing OK is necessary.

On certain devices the camera message may only appear after choosing a Scenario. It is still necessary to choose OK to allow the application to access the camera.

Once the application has been granted access to your camera, the list of Scenarios menu will appear, as seen in Figure 8. The Scenarios menu is the main menu for this application and gives the user access to the four available training scenarios.



Figure 8: The menu that lists the four scenarios included in the AR Training application

Each scenario prioritizes a skillset that is meant to be learned. The four scenarios are:

- New DOT 117 BOV Handle Operation
- Rupture Disc Mitigation on HCl Railcar
- DOT 117 Manway Gasket Alignment
- Chlorine Gas Mitigation

By tapping on any of the scenarios, the learning activity for the selected scenario will begin. Once the user has completed the selected scenario, they will be redirected back to the Scenarios menu.

It is highly recommended to be in an environment with sufficient space to deploy near full-scale models of railcars. Examples could be a parking lot, an empty driveway, an empty warehouse, or a large training classroom or conference room.

SECTION 4: USE AND NAVIGATION

Scenario 1: New DOT 117 BOV Handle Operation

SCENARIO SETUP

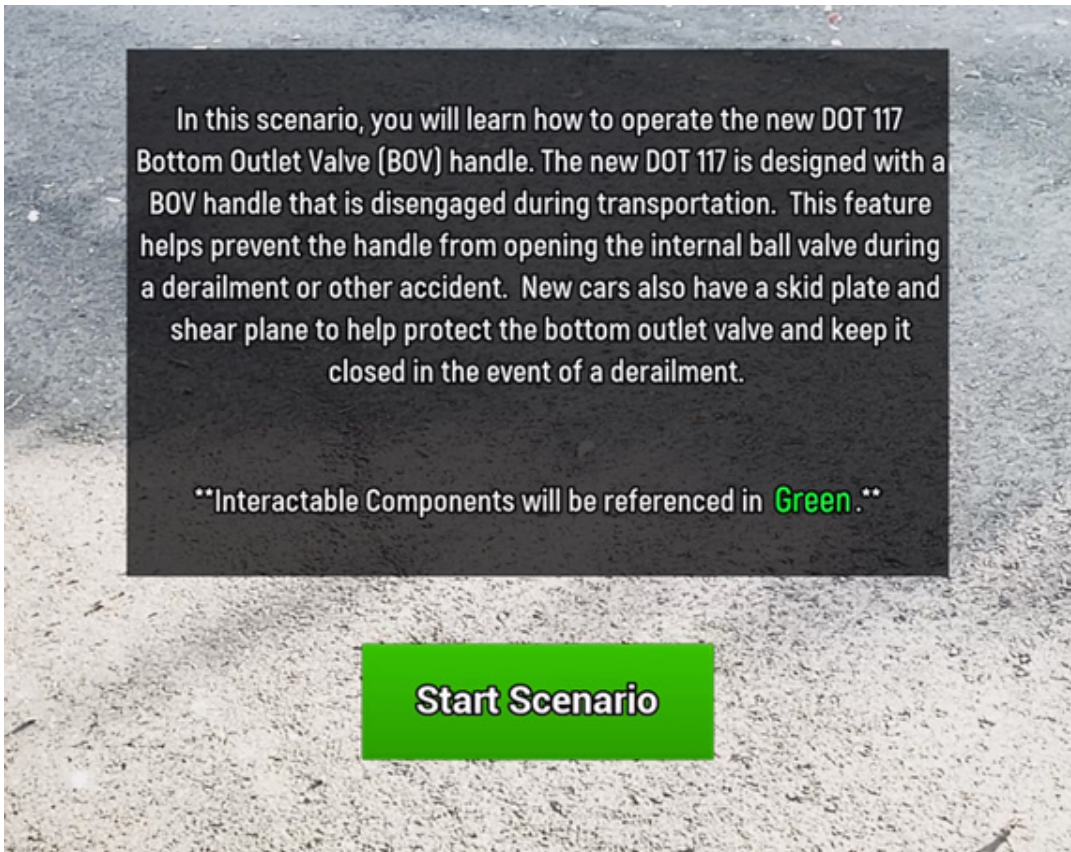


Figure 9: Introduction message that appears after selecting the New DOT 117 BOV Handle Operation scenario.

After selecting the DOT 117 Handle Scenario the Scenarios menu will fade, and the application will change to the device's camera view. An introduction screen will appear and describe the purpose of the scenario (Figure 9). Notice that Interactable Components will be referenced in Green. There are no Inventory Items in this scenario.

Tapping the Start Scenario button will cause the introduction message to fade and only the device's camera view will remain. The first step is to look around the immediate area with the device's camera. The application must detect surface planes where the AR model and all interactable components can be placed.

Remember, there must be plenty of space to deploy the AR model. The DOT 117 Handle Scenario requires an area that is at least 20 ft x 20 ft free of obstruction to avoid clipping and occlusion problems that can occur from not having enough navigable room.

Once a plane has been registered by the application, a PLN number will appear to indicate that the plane has been recognized and registered by the application (see example in Figure 10). A color-tinted polygon may also appear once the plane is registered; there is no need to change the process whether the tinted polygon is present or not.



Figure 10: Camera view with PLN number to indicate that the application has recognized and registered the alley road as a surface plane where the AR model can be placed.

Tapping on the plane will place the AR model and all interactable components onto the plane.

Once the railcar is placed, you should adjust the rotation of railcar to best fit the space. Each tap of the rotate button (circle with arrows in Figure 11) will cause the railcar to rotate 15° clockwise. Tap the Set Rotation button to lock the position of the railcar once the desired rotation has been achieved. Rotating the railcar so that the DOT 117 Handle is close to the user and easy to access is recommended. Once the Set Rotation button is tapped, it is normal to see effects such as smoke, steam, ambient dust, etc. These are included to enhance the experience.

Note that each scenario begins with the process of placing the AR model onto a surface plane and setting the rotation



Figure 11: The AR model railcar after being placed on the plane. Now it is necessary to rotate the model to best fit the area and then Set Rotation to lock the orientation of the AR model.

SCENARIO WALKTHROUGH

After the Set Rotation button has been tapped, the scenario begins, and new user interface elements will appear on the screen. See Figure 12 for examples.

The Directions Panel is in the upper right corner of the screen. The Directions Panel:

- Provides the scenario instructions.
- Describes the interactable components of the AR models with green highlighted text.

The Hints Panel is in the lower left corner of the screen. The Hints Panel:

- Appears to provide appropriate hints related to the status of the scenario.
- Disappears as the status changes or after the current interactive step is finished.

The Scenarios Menu button is in the lower right corner of the screen. The Scenarios Menu button will:

- End the current Scenario and return the application to the Scenarios Menu.
- Cancel any progress on the current scenario.

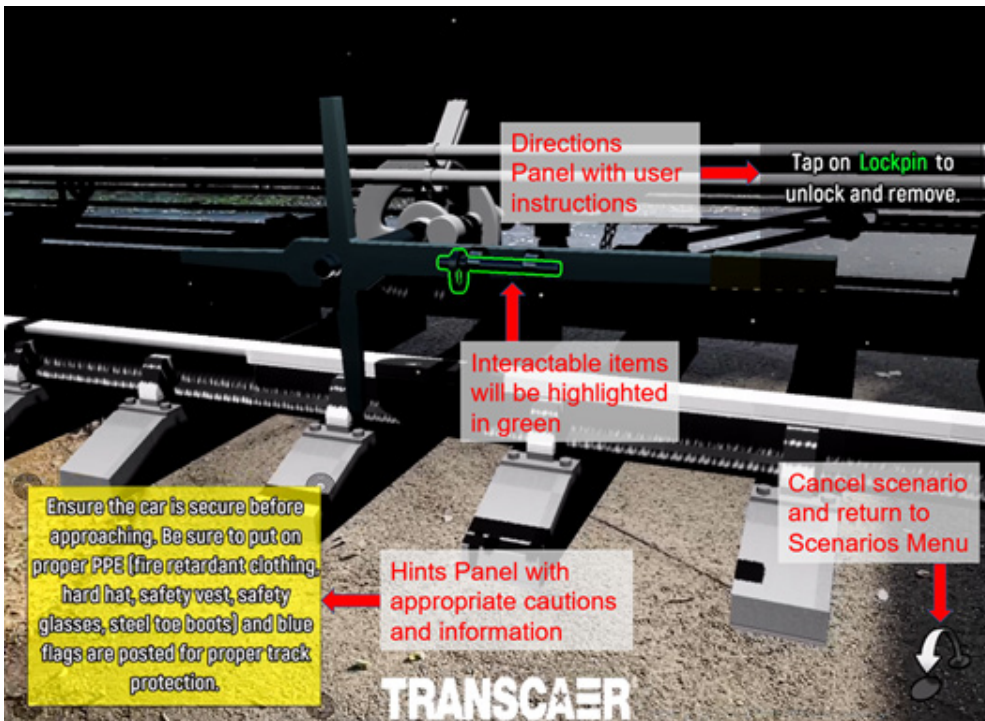


Figure 12: Examples of the user interface elements that are available once the AR model rotation has been set.

To complete the scenario, follow the instructions in the Directions Panel. Remember to walk close enough to the AR model of the DOT 117 BOV Handle. The Interactable Components will be outlined in green.

The scenario will proceed through the process of unlocking and opening the DOT 117 BOV Handle. A congratulatory text will appear on the screen to indicate a successful operation.

After a slight delay, the scenario will proceed through the process of closing and locking the DOT 117 BOV Handle. Once all the steps are complete, a congratulatory text will pop up to advise the user that they have completed the scenario and the user will automatically be returned to the Scenarios menu.

If nothing happens when tapping the interactable components highlighted in green, try to step closer or touch the component on a different spot/angle.

Scenario 2: Rupture Disc Mitigation on HCl Railcar

SCENARIO SETUP

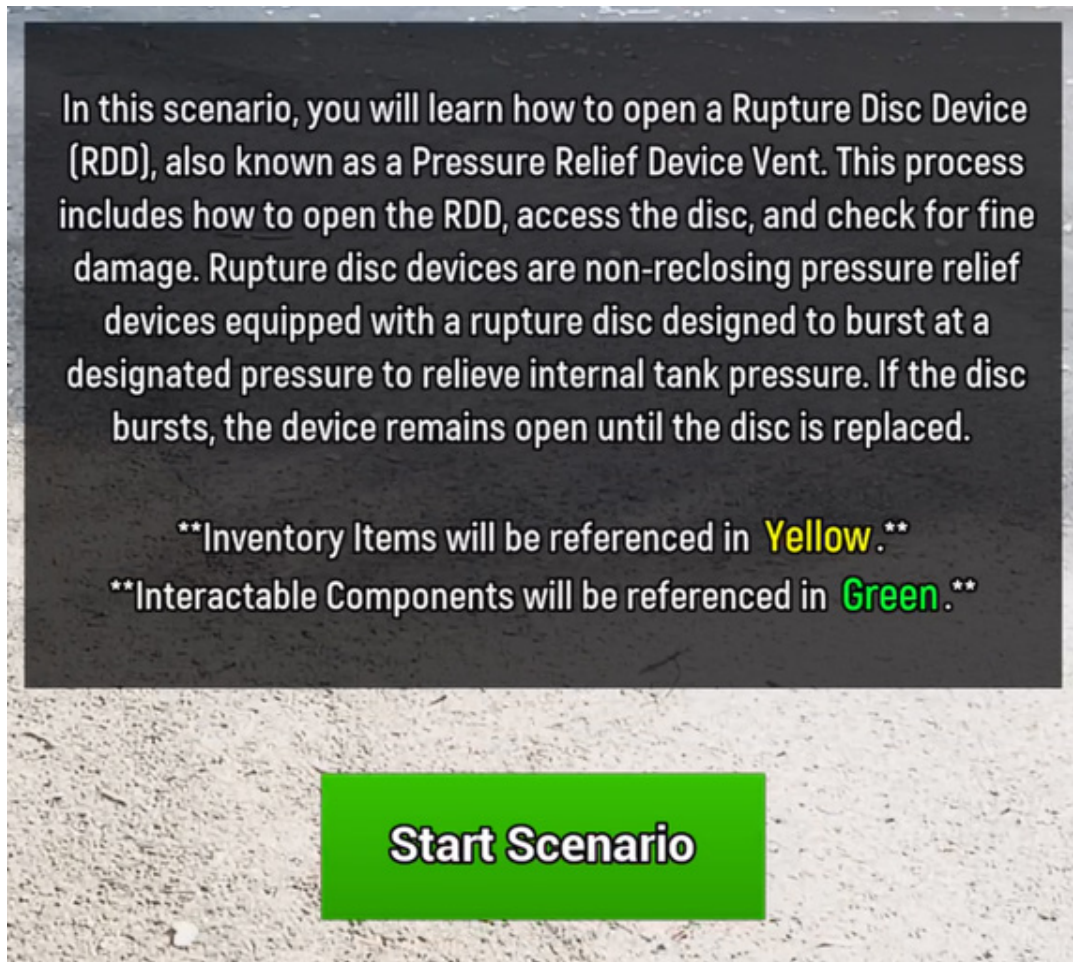


Figure 13: Introduction message that appears after selecting the Rupture Disc Mitigation on HCl Railcar scenario.

After selecting Rupture Disc Mitigation on HCl Railcar scenario, the Scenarios menu will fade, and the application will change to the device's camera view. An introduction screen will appear and describe the purpose of the scenario (Figure 13). Notice that Interactable Components will be referenced in Green and Inventory Items will be referenced in Yellow.

Tapping the Start Scenario button will cause the introduction message to fade and only the device's camera view will remain. The first step is to look around the immediate area with the device's camera. The application must detect surface planes where the AR model and all interactable components can be placed.

Remember, there must be plenty of space to deploy the AR model. Rupture Disc Mitigation on HCl Railcar scenario requires an area that is at least 20 ft x 20 ft free of obstruction to avoid clipping and occlusion problems that can occur from not having enough navigable room.

Once a plane has been registered by the application, a PLN number will appear to indicate that the plane has been recognized and registered by the application (see example in Figure 14). A color-tinted polygon may also appear once the plane is registered; there is no need to change the process whether the tinted polygon is present or not.



Figure 14: Camera view with PLN number to indicate that the application has recognized and registered the alley road as a surface plane where the AR model can be placed.

Tapping on the plane will place the AR model and all interactable components onto the plane.

Once the railcar is placed, you should adjust the rotation of railcar to best fit the space. Each tap of the rotate button (circle with arrows in Figure 15) will cause the railcar to rotate 15° clockwise. Tap the Set Rotation button to lock the position of the railcar once the desired rotation has been achieved. Rotating the railcar so that the pressure relief device is close to the user and easy to access is recommended. Once the Set Rotation button is tapped, it is normal to see effects such as smoke, steam, ambient dust, etc. These are included to enhance the experience.

Note that each scenario begins with the process of placing the AR model onto a surface plane and setting the rotation

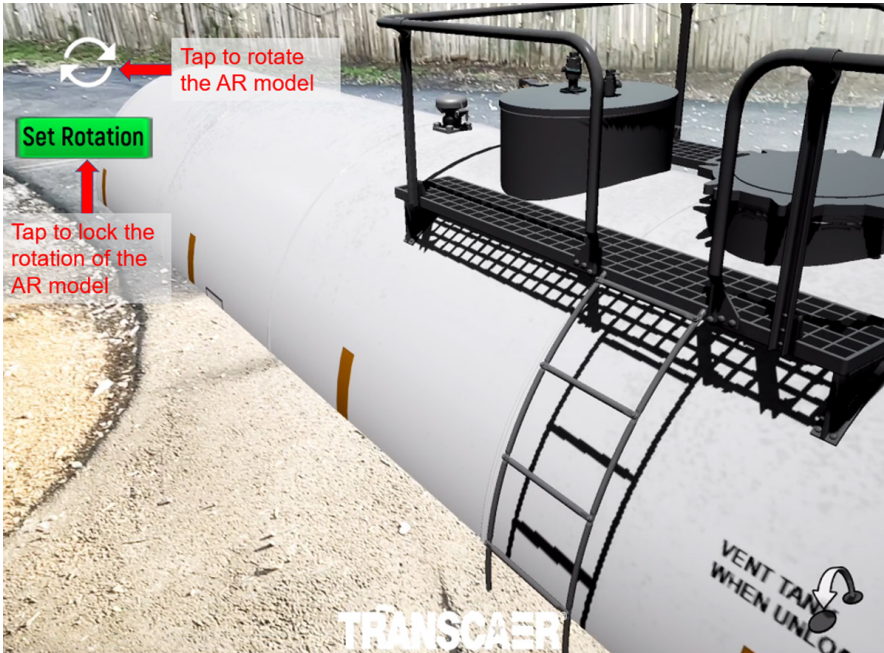


Figure 15: The AR model railcar after being placed on the plane. Now it is necessary to rotate the model to best fit the area and then Set Rotation to lock the orientation of the AR model.

INVENTORY SYSTEM

Within the Rupture Disc scenario, the user will have access to an Inventory System of tools to help them interact with the rupture disc. The Inventory System is in the top left of the screen and looks like a toolbox (see Figure 16 for example). Tapping the toolbox will present the available tools on the screen. Tapping the toolbox again will cause the tool inventory to disappear.

The inventory items utilized in the Rupture Disc scenario are:

- Wire Cutter
- Wire Crimper
- Wrench
- Screwdriver

SCENARIO WALKTHROUGH

After the Set Rotation button has been tapped, the scenario begins, and new user interface elements will appear on the screen. See Figure 12 for examples.

The Directions Panel is in the upper right corner of the screen. The Directions Panel:

- Provides the scenario instructions.
- Describes the interactable components of the AR models with green highlighted text.

The Hints Panel is in the lower left corner of the screen. The Hints Panel:

- Appears to provide appropriate hints related to the status of the scenario.
- Disappears as the status changes or after the current interactive step is finished.

The Scenarios Menu button is in the lower right corner of the screen. The Scenarios Menu button will:

- End the current Scenario and return the application to the Scenarios Menu.
- Cancel any progress on the current scenario.

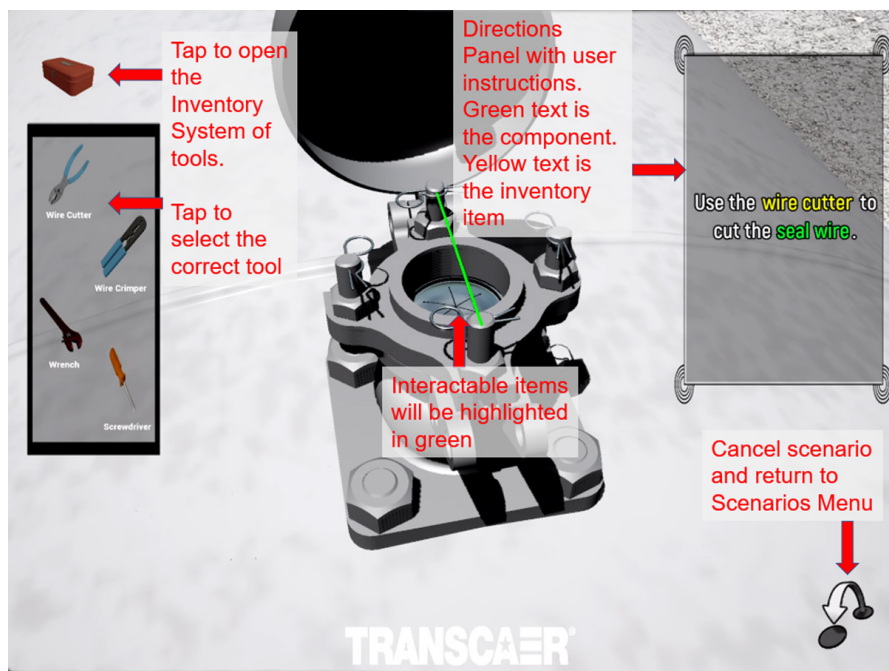


Figure 16: Example of using the Inventory System to access the Wire Cutter needed to cut the Seal Wire on the rupture disc assembly.

To complete the scenario, follow the instructions in the Directions Panel. Remember to walk close enough to the AR model of the Interactable Components. The Interactable Components will be outlined in green. Open the Inventory System and tap the correct tool when prompted (see example in Figure 16).

The scenario will proceed through the process of disassembling and removing the rupture disc. A congratulatory text will appear on the screen to indicate a successful operation.

After a slight delay, the scenario will proceed through the process of replacing and reassembling the rupture disc. Once all the steps are complete, a congratulatory text will pop up to advise the user that they have completed the scenario and the user will automatically be returned to the Scenarios menu.

If nothing happens when tapping the interactable components highlighted in green, try to step closer or touch the component on a different spot/angle.

Scenario 3: DOT 117 Manway Gasket Alignment

SCENARIO SETUP

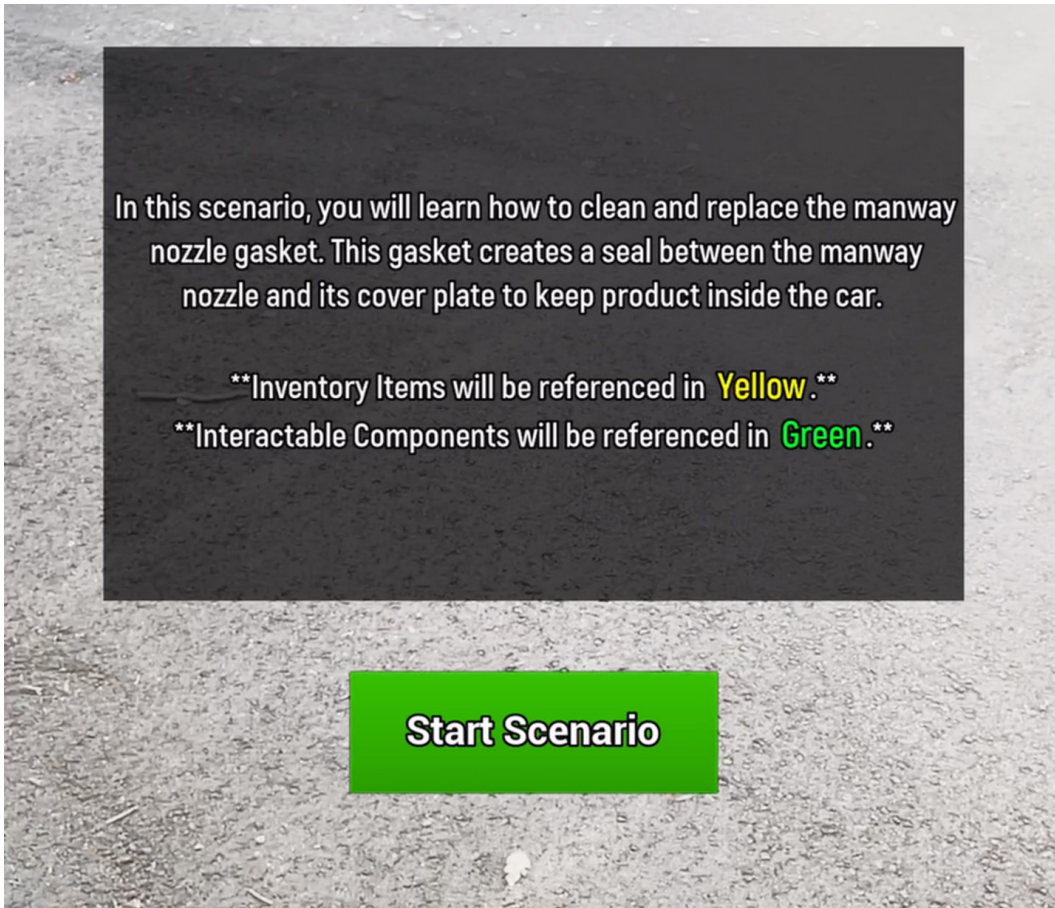


Figure 17: Introduction message that appears after selecting the DOT 117 Manway Gasket Alignment scenario.

After selecting DOT 117 Manway Gasket Alignment scenario, the Scenarios menu will fade, and the application will change to the device's camera view. An introduction screen will appear and describe the purpose of the scenario (Figure 17). Notice that Interactable Components will be referenced in Green and Inventory Items will be referenced in Yellow.

Tapping the Start Scenario button will cause the introduction message to fade and only the device's camera view will remain. The first step is to look around the immediate area with the device's camera. The application must detect surface planes where the AR model and all Interactable Components can be placed.

Remember, there must be plenty of space to deploy the AR model. The DOT 117 Manway Gasket Alignment scenario requires an area that is at least 20 ft x 20 ft free of obstruction to avoid clipping and occlusion problems that can occur from not having enough navigable room.

Once a plane has been registered by the application, a PLN number will appear to indicate that the plane has been recognized and registered by the application (see example in Figure 18). A color-tinted polygon may also appear once the plane is registered; there is no need to change the process whether the tinted polygon is present or not.



Figure 18: Camera view with PLN number to indicate that the application has recognized and registered the alley road as a surface plane where the AR model can be placed.

Tapping on the plane will place the AR model and all interactable components onto the plane.

Once the railcar is placed, you should adjust the rotation of railcar to best fit the space. Each tap of the rotate button (circle with arrows in Figure 19) will cause the railcar to rotate 15° clockwise. Tap the Set Rotation button to lock the position of the railcar once the desired rotation has been achieved. Rotating the railcar so that the manway is close to the user and easy to access is recommended. Once the Set Rotation button is tapped, it is normal to see effects such as smoke, steam, ambient dust, etc. These are included to enhance the experience.

Note that each scenario begins with the process of placing the AR model onto a surface plane and setting the rotation

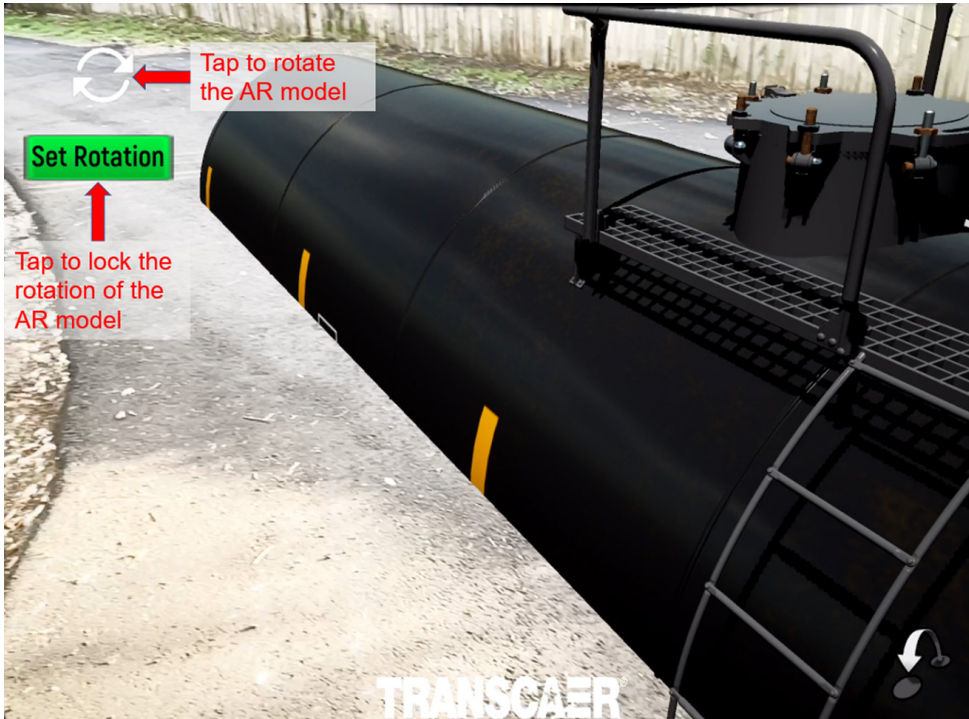


Figure 19: The AR model railcar after being placed on the plane. Now it is necessary to rotate the model to best fit the area and then Set Rotation to lock the orientation of the AR model.

INVENTORY SYSTEM

Within the Manway Gasket scenario, the user will have access to an Inventory System of tools to help them interact with the rupture disc. The Inventory System is in the top left of the screen and looks like a toolbox (see Figure 20 for example). Tapping the toolbox will present the available tools on the screen. Tapping the toolbox again will cause the tool inventory to disappear.

The inventory items utilized in the Rupture Disc scenario are:

- Wire Brush
- Wrench
- Towel
- Prying Tool
- Lubricant

SCENARIO WALKTHROUGH

After the Set Rotation button has been tapped, the scenario begins, and new user interface elements will appear on the screen. See Figure 12 for examples.

The Directions Panel is in the upper right corner of the screen. The Directions Panel:

- Provides the scenario instructions.
- Describes the interactable components of the AR models with green highlighted text.

The Hints Panel is in the lower left corner of the screen. The Hints Panel:

- Appears to provide appropriate hints related to the status of the scenario.
- Disappears as the status changes or after the current interactive step is finished.

The Scenarios Menu button is in the lower right corner of the screen. The Scenarios Menu button will:

- End the current Scenario and return the application to the Scenarios Menu.
- Cancel any progress on the current scenario.

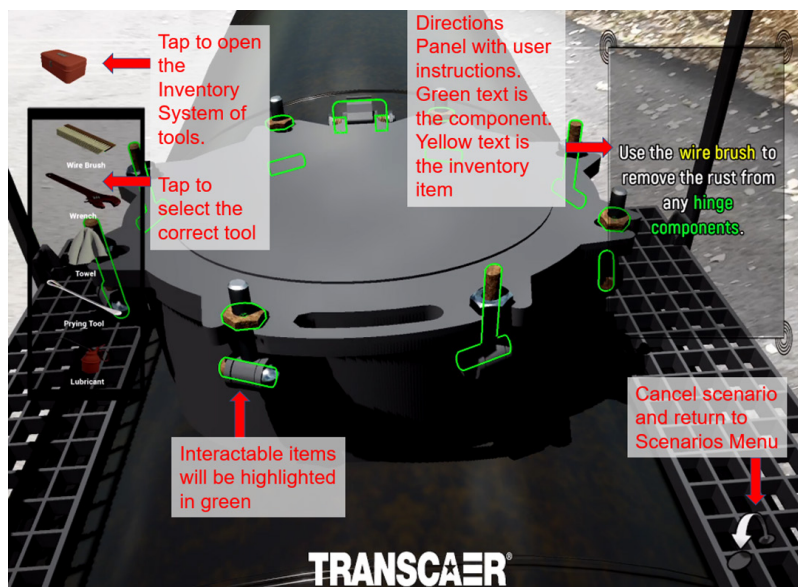


Figure 20: Example of using the Inventory System to access the Wire Brush needed to remove rust from the Hinge Components.

To complete the scenario, follow the instructions in the Directions Panel. Remember to walk close enough to the AR model and the Interactable Components. The Interactable Components will be outlined in green. Open the Inventory System and tap the correct tool when prompted (see example in Figure 20).

The scenario will proceed through the process of opening the manway and removing the manway gasket. A congratulatory text will appear on the screen to indicate a successful operation.

After a slight delay, the scenario will proceed through the process of replacing the manway gasket and closing the manway. Once all the steps are complete, a congratulatory text will pop up to advise the user that they have completed the scenario and the user will automatically be returned to the Scenarios menu.

If nothing happens when tapping the interactable components highlighted in green, try to step closer or touch the component on a different spot/angle.

Scenario 4: Chlorine Gas Release Response

SCENARIO SETUP

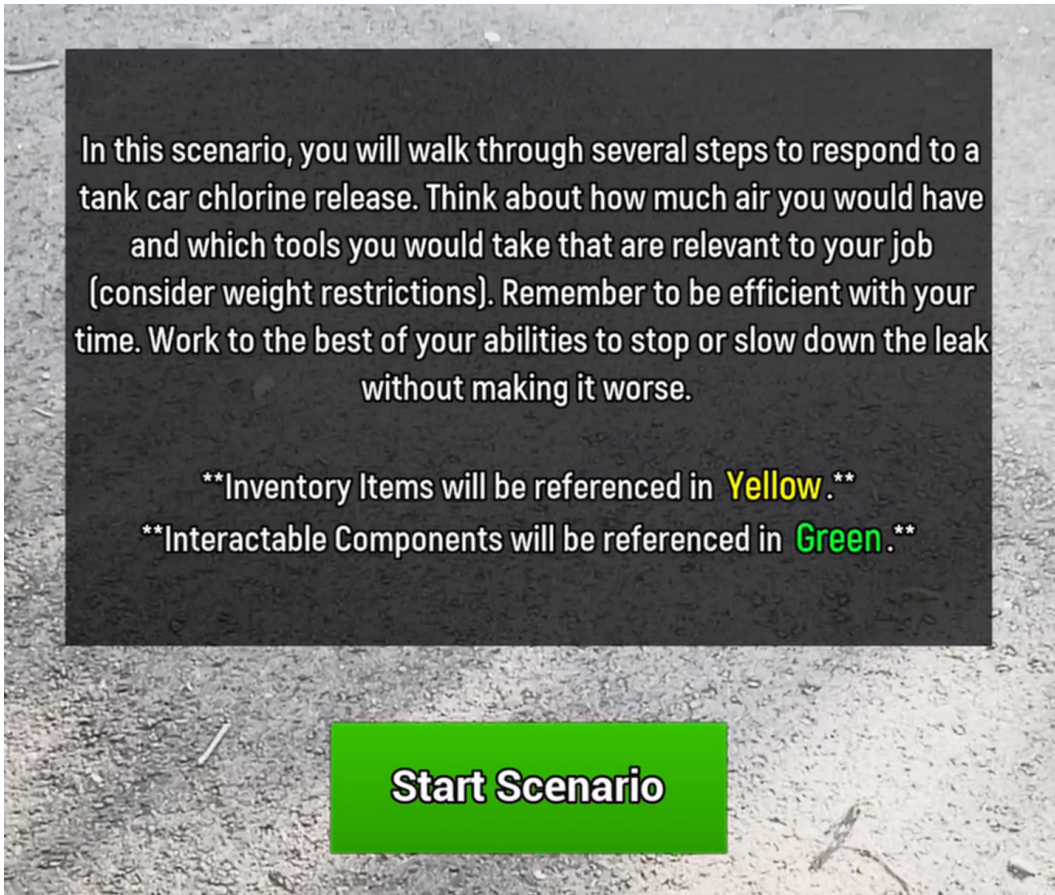


Figure 21: Introduction message that appears after selecting the Chlorine Gas Release Response scenario.

After selecting Chlorine Gas Release Response scenario, the Scenarios menu will fade, and the application will change to the device's camera view. An introduction screen will appear and describe the purpose of the scenario (Figure 21). Notice that Interactable Components will be referenced in Green and Inventory Items will be referenced in Yellow.

Tapping the Start Scenario button will cause the introduction message to fade and only the device's camera view will remain. The first step is to look around the immediate area with the device's camera. The application must detect surface planes where the AR model and all interactable components can be placed.

Remember, there must be plenty of space to deploy the AR model. The Chlorine Gas Release Response scenario requires an area that is at least 30 ft x 30 ft free of obstruction to avoid clipping and occlusion problems that can occur from not having enough navigable room.

Once a plane has been registered by the application, a PLN number will appear to indicate that the plane has been recognized and registered by the application (see example in Figure 22). A color-tinted polygon may also appear once the plane is registered; there is no need to change the process whether the tinted polygon is present or not.



Figure 22: Camera view with PLN number to indicate that the application has recognized and registered the alley road as a surface plane where the AR model can be placed.

Tapping on the plane will place the AR model and all interactable components onto the plane.

Once the railcar is placed, you should adjust the rotation AND SCALE of the railcar to best fit the space. Each tap of the rotate button (circle with arrows in Figure 23) will cause the railcar to rotate 15° clockwise. Tap the Set Rotation button to lock the position of the railcar once the desired rotation has been achieved. Once the Set Rotation button is tapped, it is normal to see effects such as smoke, steam, ambient dust, etc. These are included to enhance the experience.

Tapping the change scale button (square with arrow in Figure 23) will reduce or increase the scale of the railcar by 25%. Tap the Set Scale button once the desired scale has been achieved.

Note that each scenario begins with the process of placing the AR model onto a surface plane and setting the rotation. The Chlorine Gas Release Response scenario also includes setting the scale or the railcar



Figure 23: The AR model railcar after being placed on the plane. Now it is necessary to rotate the model to best fit the area and then Set Rotation to lock the orientation of the AR model. Once the rotation is set, change the scale of the AR model to the desired size and then Set Scale to lock the scale of the AR model.

INVENTORY SYSTEM

Within the Chlorine Gas scenario, the user will have access to an Inventory System of tools to help them interact with the release. The Inventory System is in the top left of the screen and looks like an emergency response toolbox (see Figure 20 for example). Tapping the toolbox will present the available tools on the screen. Tapping the toolbox again will cause the tool inventory to disappear.

The inventory items utilized in the Chlorine Gas scenario are:

- Wrench 110
- Wrench 218
- Wrench 200c
- Wrench 112
- Socket Wrench
- Ammonia Spray
- Hood 24/Hood 6
- Yoke Assembly

SCENARIO WALKTHROUGH

After the Set Scale and Set Rotation buttons have been tapped, the scenario begins, and new user interface elements will appear on the screen. See Figure 12 for examples.

The Directions Panel is in the upper right corner of the screen. The Directions Panel:

- Provides the scenario instructions.
- Describes the interactable components of the AR models with green highlighted text.

The Hints Panel is in the lower left corner of the screen. The Hints Panel:

- Appears to provide appropriate hints related to the status of the scenario.
- Disappears as the status changes or after the current interactive step is finished.

The Scenarios Menu button is in the lower right corner of the screen. The Scenarios Menu button will:

- End the current Scenario and return the application to the Scenarios Menu.
- Cancel any progress on the current scenario.



Figure 24: Example of using the Inventory System to access the Yoke Assembly needed to secure Hood 6.

To complete the scenario, follow the instructions in the Directions Panel. Remember to walk close enough to the AR model and the Interactable Components. The Interactable Components will be outlined in green. Open the Inventory System and tap the correct tool when prompted (see example in Figure 24).

The scenario will proceed through the process of putting on proper PPE, completing a damage inspection report, and then mitigating four separate types of leaks. A congratulatory text will appear on the screen to indicate a successful operation.

The types of leaks that will be mitigated are:

- Packing Leak
- Valve Seat Leak
- Valve Gasket Leak
- Pressure Release Valve Leak

After each step is completed, the scenario will proceed to the next step. Once all the steps are complete, a congratulatory text will pop up to advise the user that they have completed the scenario and the user will automatically be returned to the Scenarios menu.

Pay special attention to the final information in the Hints Panel at the end of the Chlorine Gas scenario.

If nothing happens when tapping the interactable components highlighted in green, try to step closer or touch the component on a different spot/angle.

Installation and General Operation

- 1. Issue:** The application will not install or does not function properly on the Apple device.
Solution: Ensure that the Apple device has the latest iOS installed. It is also recommended to use an Apple iPad rather than an iPhone. The application is best used on Apple iPads with iPadOS 12.0 or later. This application will also work on iPhones; however, the reduced screen size will add difficulty in the interaction with certain user interface (UI) features. For the best experience and results, the developers suggest only using it on iPad devices.
- 2. Issue:** The application does not show the surrounding environment on the screen after starting a scenario.
Solution: Ensure that the TRANSCAER AR application has access to the Apple device's camera. Access to the camera is an essential part of the Augmented Reality (AR) experience. From the device's home screen, tap Settings and then scroll down to find Privacy & Security (or just Privacy depending on the iOS). Tap Privacy & Security and then scroll down to find Camera and tap to see the list of applications that have access to the device's camera. Tap the toggle next to the TRANSCAER AR to make it green. The application now has access to the camera. Exit Settings and try the application again.

Scenario Use

- 1. Issue:** The interactable component does nothing when tapping on it.
Solution: First, ensure that the interactable component is highlighted in green. Only items highlighted in green can be interacted with.
Second, try walking closer to the interactable component and tapping in slightly different locations on the component. Sometimes the user may be too far from the interactable component, or the application is not registering the taps on the component.
Third, the interactable component may require the use of an inventory item to progress. If the instructions in the Directions Panel indicate the use of a tool in yellow text, tap the Inventory System toolbox in the upper left corner and then tap the appropriate tool to interact with the component highlighted in green.
Lastly, if all attempts fail, try canceling the scenario and returning to the Scenarios menu with the Scenarios Menu button in the lower right corner. Then attempt the scenario again.
- 2. Issue:** The AR model railcar does not fully display after it is placed on the surface plane.
Solution: Ensure there is adequate space free of obstruction for the railcar to be placed. The minimum spatial requirements are indicated in bold for each scenario in the SCENARIO SETUP section of each scenario. Try returning to the Scenarios menu with the Scenarios Menu button in the lower right corner, then moving to a location with a larger empty space. Be sure to look around with the camera to let the application recognize and register the space and plane before tapping to place the AR model on the surface plane.