

LEADER'S GUIDE

SAFE HANDLING OF TOLUENE DIISOCYANATE

INTRODUCTION

SAFE HANDLING OF TOLUENE DIISOCYANATE is a training program designed to inform employees of the potential hazards associated with the handling of toluene diisocyanate, or TDI, and the recommended procedures to follow in order to minimize potential hazards. The program also discusses the recommended procedures for drum or intermediate bulk container handling, unloading TDI from tank containers (isotainers), cargo tank trailers, and rail tank cars, as well as emergency response procedures and proper disposal procedures.

It should be recognized that this video presentation is only one part of a comprehensive training program on the safe handling of TDI. For optimum results, this presentation should be a part of your hazard communication program, supplemented with hands-on exercises, and reporting procedures, along with evacuation drills in case of an accidental spill or leak.

Any company specific or facility specific policies and procedures relating to the handling of TDI should be discussed when presenting this program.

TARGET AUDIENCE

All individuals who handle TDI, and its derivatives—especially those who are involved in the handling of drum or intermediate bulk container, and the unloading of tank containers (isotainers), cargo tank trailers, and rail tank cars—and their supervisors or team leaders will benefit from viewing this program.

OBJECTIVES

At the conclusion of this training program and participation in a thorough discussion of the TOPICS FOR REVIEW, each participant should be able to:

1. Describe the physical characteristics of TDI.
2. Describe the routes of entry and potential health effects of overexposure to TDI.

3. Describe the first aid procedures that should be taken if an accidental exposure occurs.
4. Describe the proper personal protective equipment required when transferring TDI from drums or intermediate bulk containers, tank containers (isotainers), cargo tank trailers, and rail tank cars.
5. Describe the recommended procedures for safely handling drums and intermediate bulk containers of TDI, and TDI transfers from tank containers (isotainers), cargo tank trailers, and rail tank cars.
6. Describe the resources that are available in the event of a TDI spill.
7. Describe how to clean up a TDI spill.
8. Describe what to do with waste material generated during the cleanup of a TDI spill.

LEADER PREPARATION

The training session leader plays a key role in the success of the **SAFE HANDLING OF TOLUENE DIISOCYANATE** training program. The leader should manage the training experience by encouraging group discussion, relating the material to the participants' specific environments and company policies, and conducting follow-up exercises or meetings.

Prior to the training session, the leader should:

- Preview the appropriate sections of the program, and read the Leader's Guide.
- Study the suggested TOPICS FOR REVIEW.
- Obtain visual aids which would make employees aware of safety hazards.
- Obtain safety data sheets (SDS) or technical data sheets for toluene diisocyanate.
- Develop additional discussion questions, as required, to amplify the key points presented and relate them to the specific situations encountered in their environments.
- Secure a meeting room large enough to avoid overcrowding and quiet enough to minimize distractions.
- Secure the audiovisual equipment required to present the program.
- Allow sufficient time to conduct the training session. *NOTE: A typical training session should include a discussion of objectives, presentation of this program, review of the material, testing, test review and will take approximately 90 minutes.*
- After the training session, arrange to have the video training program made available for periodic review by employees, supervisors or team leaders, and managers. polyurethane.americanchemistry.com

AUDIOVISUAL PROGRAM OUTLINE

- Introduction** (2:22)
 - A. Typical Uses of TDI
 - B. Common Shipping Containers
 - C. Modes of Transportation

- I. Hazard Communication** (9:39)
 - A. Physical Characteristics
 - B. Routes of Entry
 - C. Potential Health Effects
 - D. First Aid
 - E. Personal Protective Equipment

- II. Drum and Intermediate Bulk Container Handling** (8:39)
 - A. Receiving Deliveries
 - B. Personal Protective Equipment
 - C. Discarding Empty Containers

- III. Tank Container (Isotainer) Transfers** (15:37)
 - A. Preparation for Unloading
 - B. Documentation
 - C. Regulatory Information
 - D. Pre-Unloading Procedures
 - E. Personal Protective Equipment
 - F. Connecting Procedures
 - G. Transfer Operations
 - H. Disconnecting Procedures
 - I. Preparation for Return

- IV. Cargo Tank Trailer Transfers** (16:57)
 - A. Preparation for Unloading
 - B. Documentation
 - C. Regulatory Information
 - D. Pre-Unloading Procedures
 - E. Personal Protective Equipment
 - F. Connecting Procedures
 - G. Transfer Operations
 - H. Disconnecting Procedures
 - I. Preparation for Return

V. Rail Tank Car Transfers (16:51)

- A. Preparation for Unloading
- B. Documentation
- C. Regulatory Information
- D. Pre-Unloading Procedures
- E. Personal Protective Equipment
- F. Connecting Procedures
- G. Transfer Operations
- H. Disconnecting Procedures
- I. Preparation for Return

VI. Emergency Response (7:48)

- A. Resources
- B. Spill Control, Containment and Cleanup
- C. Notification
- D. Disposal

PRESENTATION

The **SAFE HANDLING OF TOLUENE DIISOCYANATE** program has been divided into six parts so that training can be specifically targeted to the container in which TDI is received. All employees must view both Part One–Hazard Communication and Part Six–Emergency Response for their training to be complete. Choose one or more of the following parts based on how TDI is received at your facility:

Drum and Intermediate Bulk Container Handling	Part Two
Tank Container (Isotainer) Transfers	Part Three
Cargo Tank Trailer Transfers	Part Four
Rail Tank Car Transfers	Part Five

The sequence of a typical training session using this program would be as follows: The leader should...

- Welcome the group, and ask them to place name cards in front of themselves if appropriate.
- Introduce the subject area, and explain what is to be presented.
- Review the objectives for the program with the participants, and explain that these objectives will be tested by means of a written quiz at the end of the session.
NOTE: Four written quizzes that review the program's objectives are provided for use at the instructor's discretion.
- Start the video training program and watch it with the participants.
- Answer any immediate questions that the participants may have.

- Use TOPICS FOR REVIEW to relate the material presented to the participants' situation. *NOTE: The question/answer format is provided as a guide. It is best to relate this information to questions that the group considers important.*
- Briefly review the key points of the program, and facilitate a group discussion.
- Administer the quiz, and review the answers with the participants.
- Give each participant additional written information on company policies and programs (if available).
- Schedule and develop additional training, as necessary.
- Make the video presentation available for periodic review by employees.

TOPICS FOR REVIEW

Hazard Communication

1. *What are the physical characteristics of TDI?*

- Physical testing data has shown that liquid TDI may solidify at certain temperatures, depending upon its mixture. Specific information on your particular product can be obtained from the product's SDS.
- TDI has a flash point above 260°F. Thus, it is not ignited readily under most conditions. However, it will burn if exposed to an ignition source at or above the flash point temperature, and fires are possible if proper care is not taken.
- Testing has also shown that TDI is reactive with certain types of materials, including water. When TDI is mixed with other materials, heat and carbon dioxide are generated. Over time, this can create excessive pressure in closed containers. To reduce risks of unplanned reactions, it's extremely important that TDI not come in contact with moisture or water. Other reactive agents include, but are not limited to, ammonia, polyols, alcohols, amines, caustic soda, and caustic potash.
- TDI is typically a clear, water-white to pale yellow liquid. However, some polymeric and TDI prepolymer mixtures can be colorless or water-white to dark brown.
- TDI has a sharp pungent odor that can be very irritating to the respiratory system. The odor threshold for TDI is above the established exposure limits. Therefore, odor should never be relied upon to indicate the presence of TDI.
- Additional information can be obtained from the material's safety data sheet (SDS) or the technical data sheet.

2. *What are the three major "routes of entry" through which a chemical can cause health effects?*

- Inhalation or breathing
- Skin or eye contact
- Ingestion or swallowing

3. *What do you do if you are overexposed to TDI?*
 - If overexposure by any route of entry occurs, seek immediate medical attention.
4. *What is the greatest health hazard of TDI?*
 - The greatest health hazard of TDI is the potential for adverse effects on the respiratory system. At room temperature, TDI can form vapor concentrations above the permissible exposure limit.
5. *What are the health effects associated with overexposure to TDI vapors?*
 - Exposure to TDI vapor may cause irritation of the eyes, nose, throat, and lungs. Difficulty breathing, tightness in the chest, and coughing are also symptoms of overexposure. In most cases, these symptoms will disappear within a few hours after the exposure takes place.
 - Overexposure to airborne TDI may cause respiratory allergy, or sensitization. Skin contact may also be associated with respiratory allergy. If sensitized, or allergic to TDI, a person may react to extremely low airborne concentrations of TDI.
6. *What do you do for a person who exhibits symptoms of TDI sensitization?*
 - Move anyone who shows signs of irritation, or asthma-like symptoms, to fresh air and seek immediate medical attention.
 - The onset of these symptoms may occur immediately or be delayed. Therefore, medical personnel should observe potentially sensitized individuals for several hours after exposure.
7. *What are the health effects associated with overexposure to liquid TDI?*
 - Liquid TDI can be irritating to the skin or eyes. Skin contact may result in redness and may also cause skin sensitization, an allergic reaction. Symptoms such as redness, itching, and rash may occur when a sensitized person contacts TDI. If a person has become sensitized, the most prudent course of action is that individual no longer work with TDI.
 - Eye contact may result in redness, and tissue injury may occur.
 - Therefore, it is important an eyewash station and safety shower be located in the immediate area when TDI is being handled.

8. *What first aid is appropriate for skin/eye exposure to TDI?*
- For skin exposure, first wipe off the liquid then wash with a polyglycol-based skin cleanser or corn oil. Soap and water may also be used, but may be less effective. Remove any contaminated clothing.
 - For exposures requiring the use of emergency showers, remove contaminated clothing and other sources of vapor before removing respiratory protection.
 - For eye exposure, thoroughly flush the eyes with running water – many companies flush exposed eyes for at least 15 minutes, and then seek medical attention.
9. *Is ingestion of TDI toxic?*
- Although unlikely, accidental ingestion or swallowing of any chemical could occur. TDI has a low potential of toxicity by ingestion.
10. *What first aid is appropriate for ingestion of TDI?*
- For ingestion of TDI, do not induce vomiting. Seek medical attention immediately.
11. *Where would you find safe handling information for TDI?*
- As with all chemical shipments, hazard communication information is attached to all containers either by a warning label or tag.
 - If additional handling information for TDI is required, please refer to the manufacturer's safety data sheet (SDS).
12. *What personal protective equipment (PPE) is required when handling TDI?*
- Everyone involved in the handling of TDI must be equipped with the appropriate personal protective equipment. This includes appropriate impervious clothing such as chemical protective suits, chemical resistant gloves and boots, as well as an approved full-face air supplied respirator.
13. *What has been done to prevent overexposure to airborne vapors of TDI?*
- To prevent overexposure to airborne vapors, refer to applicable regulations for permissible exposure limits for TDI.
 - In the US, air concentration limits must be below the Occupational Safety and Health Administration (OSHA) permissible exposure limits (PEL).
 - The American Conference of Governmental Industrial Hygienists (ACGIH) also has established threshold limit values (TLV) for TDI which are commonly referred to.

14. *Can you use the odor of TDI as an indicator of overexposure?*
- No. The odor threshold (or point at which you can detect TDI with your sense of smell) is above the permissible exposure limit. Therefore, odor should never be used to indicate the presence of TDI.
 - TDI has poor warning properties. Monitor the workplace for TDI vapor. If you can smell TDI, you are exposed above the permissible exposure limit.
 - Harmful airborne concentrations may occur accidentally. The industry practice is to have a positive pressure self-contained breathing apparatus or a positive pressure airline respirator should be readily available in areas where TDI is handled. These are worn to prevent overexposure to airborne vapors should a release occur. Approved respiratory protection must comply with applicable requirements.
15. *What resources are available if you have additional questions about handling TDI?*
- If you have any further questions or are unsure of the actions required of you, ask your supervisor or team leader, or contact the product manufacturer.
 - For more information on the topics covered in this sections, consult the following literature developed by the Center for the Polyurethanes Industry (available at www.polyurethane.org):
 - *Guidance for Developing a Written Respiratory Protection Program*
 - *Guidance for the Selection of Protective Clothing for TDI users*
 - *Guidance for Working with TDI: Things You Should Know*
 - *Occupational Hygiene air Monitoring for TDI and TDI Guidance*

Drum and Intermediate Bulk Container Handling

1. *How is toluene diisocyanate (TDI) regulated in transportation?*
- The U.S. Department of Transportation (DOT) regulates transportation of toluene diisocyanate as a hazardous material.
 - Although there are various regulations covering the shipment of TDI, it will be classified UN2078, Toluene Diisocyanate, Class 6.1, Packing Group II.
 - The letters RQ will be entered either before or after the description of the shipment when individual packages contain 100 pounds or more of TDI, known as the “reportable quantity.”
 - The toxic placard with the UN marking 2078 displayed is the required placard for shipment of this material.
 - TDI containers must have the required labels or placards applied.
 - The storage and handling of TDI at your facility may be subject to other federal, state, and local regulations.

2. *What do you do when the truck arrives?*
 - When the truck arrives, check all paperwork for accuracy. Verify the purchase order number, and ensure the proper material and correct number of containers have been received.
 - Check the trailer hazard placards. Make sure they are correct for the product noted on the shipping documents.
 - When you have checked the security seals against the paperwork, break the seals, and open the doors of the trailer. Use caution when opening the doors as items may have shifted during transportation.
 - Assist the driver in positioning the trailer at the dock.

3. *How is the truck prepared before unloading?*
 - Make sure that the driver has set the emergency brake on the truck once it is in position.
 - Place wheel chocks under the tires of the trailer, as well as the rear tires of the truck, to prevent movement in either direction.

4. *What safety precautions are followed when unloading TDI drums?*
 - When forklifts are used to unload drums, use the proper drum handling apparatus in order to move the drums.
 - Never use the forks to pick up a drum by the chimes.
 - Never try unloading a trailer without using the proper equipment and techniques.

5. *What do you do after unloading the drums or intermediate bulk containers?*
 - Make sure that the name on the container label matches the name on the shipping documents, and confirm that no containers are leaking.

6. *What types of drums and intermediate bulk containers are appropriate for the transport of TDI?*
 - Drums used to transport TDI are typically made of metal or a variety of other composite materials with tight head construction. Open top drums are more prone to leakage of liquid contents so close head drums are most commonly used in this TDI service.
 - Intermediate bulk containers should also be made of metal. IBCs made of other composite materials are not normally used.

7. *How are drums stored?*
 - Drums can be stored on their chimes or on pallets. Drums may be stacked, check with supplier for additional guidance.
 - Drums and Intermediate Bulk Containers (IBCs) are stored in an area that protects the product from contamination due to moisture intrusion or degradation due to extreme temperature exposure

8. *What personal protective equipment (PPE) and other controls are required to avoid contact or exposure to TDI?*
- In order to avoid contact or exposure to TDI, appropriate personal protective equipment must be worn during transfer operations. For TDI, this may include chemical splash goggles or face shield and chemical resistant gloves.
 - When transferring TDI without adequate ventilation, a full-face air-supplied respirator is required. Certain activities may require additional protective equipment.
 - If local ventilation is used, leading industry practice has discharged vapors be absorbed or scrubbed free of TDI before being discharged to the atmosphere.
9. *How do you dispose of empty drums?*
- Many companies contract with an approved drum reconditioner for the disposing of empty TDI drums. If you need help in locating an approved drum reconditioner, contact the Reusable Industrial Packaging Association (301-577-3786; <http://www.reusablepackaging.org>). Follow the instructions on the IBC label for additional information on returning the container.
 - If you do not use the services of a drum reconditioner, and neutralization is necessary, contact supplier for guidance. Puncture empty drums so they cannot be reused, and remove the product label.
10. *What happens when TDI contacts water?*
- Don't forget hazards created by refilling containers with even a little moisture, water, or any foreign substance. Reaction between TDI and water will slowly emit carbon dioxide gas, and in a closed container like a drum, could cause a violent rupture.
11. *What do you do if you suspect a reaction is taking place inside a sealed container?*
- Whenever you suspect that a reaction is taking place inside a sealed container, through evidence such as a bulging drum, risk can be minimized by isolating the area immediately and contacting CHEMTREC (1-800-424-9300 (US)) for assistance.
12. *What resources are available if you have additional questions about handling TDI?*
- If you have any further questions or are unsure of the actions required of you, ask your supervisor or team leader, or contact the product manufacturer.
 - For more information on handling TDI, consult the following literature developed by the Center for the Polyurethanes Industry (available at www.polyurethane.org):
 - *Guidance for Melting Toluene Diisocyanates (TDI) in Drums*
 - *Guidelines for Receiving and Unloading TDI*

■ *Disposal of Empty Drums Containing Polyurethane Chemicals*

Tank Container (Isotainer) Transfers

1. *What do you need to be aware of before handling TDI in tank containers, or isotainers?*
 - The receiving, handling, and shipment of TDI requires compliance with all federal, state, and local regulations concerning hazardous materials. Make sure you know these regulations and follow them at all times.
 - It is recommended that a comprehensive checklist be developed and followed throughout the unloading sequence.

2. *How is the truck prepared before unloading?*
 - Make sure that the driver has set the emergency brake once the truck is in position.
 - Place wheel chocks under the tires of the trailer chassis, as well as the rear tires of the tractor, to prevent movement in either direction.
 - As an added precaution, you may wish to put barricades or warning signs around the unloading area.

3. *What do you check for on the paperwork?*
 - Check all paperwork for accuracy. Verify the driver's paperwork to validate trailer number, product identification tag, security seals, that the material being received is TDI, and that the weigh ticket shows the quantity being delivered to help ensure the volume of the delivery will fit the storage tank.
 - Review the values on the Certificate of Analysis to ensure that the product meets required specifications.

4. *What regulations apply to the shipment of TDI?*
 - Outside the U.S., different regulations may apply. In the U.S., the Department of Transportation (DOT) regulates the transportation of toluene diisocyanate.
 - Although there are various regulations covering the shipment of TDI, it will be classified UN2078, Toluene Diisocyanate, Class 6.1, Packing Group II.
 - The letters RQ will be entered either before or after the description of the shipment when individual packages contain 100 pounds or more of TDI, known as the "reportable quantity."
 - The toxic placard with the UN marking 2078 displayed is the normal placard for shipments of this material.
 - TDI containers must have the required labels or placards applied.
 - The storage and handling of TDI at your facility may be subject to other federal, state, and local regulations, so adapt the process as required.

5. *What do you check on the tank container itself?*

- Check the tank container to make sure the numbers on the security seals match the numbers shown on the paperwork. Also confirm that the seals are not broken and have not been tampered with in any manner.
 - Verify that the pad pressure and temperature are within the required parameters. If they are not, contact the shipper for further instructions.
 - Check the hazard placards. Make sure that they are correct for the product noted on the shipping documents.
 - Walk around the isotainer and look for signs of damage. Also, check that the emergency shut off activator is not damaged.
6. *What personal protective equipment (PPE) is required during transfer operations?*
- In order to avoid contact or exposure to TDI, wear personal protective equipment during hook-up and disconnect activities. This includes appropriate impervious clothing such as a chemical protective suit, chemical resistant gloves and boots, as well as an approved full-face air-supplied respirator.
 - Both the unloading operator and the truck driver wear personal protective equipment.
7. *What checks of your own equipment do you make before unloading begins?*
- If the content of the tank container is to be off loaded into a receiving tank, make sure that the tank is the correct one for the product and that there is enough room in the tank to hold this shipment.
 - Clearly identify the unloading connection on the receiving line.
 - The unloading operator will show the driver the location of the nearest eye wash station and safety shower.
 - The driver will show the operator where the container's remote emergency shut off is located.
 - Transfer hoses for TDI products are typically 2-inch in diameter to differentiate them from the 3-inch diameter hoses and fittings generally used for polyol or resin products. Hoses may also be color coded and/or labeled to assist in eliminating transfer errors.
 - Because TDI reacts with moisture, it's extremely important that the hoses are dry. If there is any possibility of a problem with a hose, set the hose aside, tag it, and get another hose to complete the transfer.
8. *Why are all of these checks necessary?*
- All these checks may seem unnecessary because the operation is routine, but taking these precautions every time will prevent product contamination and a potential overflow.
9. *How are tank containers unloaded?*
- Tank containers are usually unloaded with nitrogen or dry air pressure.
 - An alternative method would be off loading using a pump, while adding nitrogen or dry air to maintain a dry atmosphere within the tank container.

- When unloading with either of these methods, leading industry practice has discharge vapors absorbed or scrubbed free of TDI.
 - If dry air is used for unloading, it is extremely important to check for signs of moisture. Many companies recommend a dew point of -40°F .
 - A “closed loop vapor exchange” system using a product pump is another means for unloading TDI. “Closed loop” means that no vapors escape from the system into the atmosphere and no moisture from the atmosphere enters the system.
10. *What is the role of the truck driver and unloading operator during transfer operations?*
- The driver will make connections to the tank container, and operate the tank container valves and all other tank container equipment.
 - The unloading operator takes responsibility for connecting the unloading hose to the receiving line and operating the valves in the receiving system.
11. *What connection procedures do you follow?*
- Check the nitrogen or dry air source. Make sure the gauge is working properly and that the hose is attached securely.
 - Remove the dust cap from the nitrogen inlet on the tank container, and install the required adapter. Check the hose gasket for splits or cracks that could prevent a good seal.
 - Before connecting the product discharge hose, inspect the fitting on the receiving line. Verify it is in good working condition. If it is a female fitting, inspect the gasket for splits or cracks that could cause a leak or spill. Replace the gasket, if necessary, and make sure you dispose of the old one properly.
 - Inspect the unloading hose, and make sure the quick disconnect fittings and gaskets are in good working order so that the connection will be secure. If everything is OK with the hoses, gaskets, and fittings, connect the hose to the receiving line, and secure it.
 - The next step is to cut the security seal, and connect the unloading hose to the tank container.
 - Remove the closure cap or blank flange from the product discharge outlet, and install the fitting with bleed valve.
 - Connect the nitrogen or dry air supply hose to the nitrogen inlet on the tank container, and secure it.
 - Now, attach the unloading hose to the product discharge outlet, and secure it.
12. *What do you do after all connections have been properly secured and the checklist completed?*
- Sign the driver’s paperwork indicating a good hook-up has been made.
13. *What steps do you follow to begin the transfer operation?*
- Open the tank container’s internal valve, and then carefully open the external valve.

- Open the receiving line valve.
 - Open the nitrogen inlet valve on the tank container, and then open the valve on the nitrogen or dry air source.
 - Introduce nitrogen gas or dry air into the top of the tank container up to about 5-10 psig.
 - The product should now be flowing through the unloading line.
 - Once you have verified there are no leaks in the system, the nitrogen or dry air pressure will need to be increased to an acceptable pressure, usually between 10 to 20 psig, depending on the desired rate of unloading. The pressure should remain constant within the tank container until unloading is complete. Do not exceed the working pressure of the tank container. Refer to the tank containers nameplate for the rated pressure if you are not sure.
14. *What are the attendance requirements during the unloading process?*
- During the unloading process, operators should stay in the area to monitor the transfer of product. The U.S. Department of Transportation (DOT) requires that a qualified person attend the unloading operation.
 - “Attend” means that the person in attendance is alert, has an unobstructed view of the unloading operation, and stays within 25 feet during the entire process.
 - According to DOT, to be “qualified” the person must understand the potential hazards of TDI, know the procedures to follow in an emergency, and have the authority and means to move the tank container.
15. *What are additional safety precautions to follow?*
- No smoking, vaping, or use of other tobacco products, no eating, and no drinking during the transfer process.
16. *The amount of product being transferred is monitored at all times. How can this be accomplished?*
- Monitoring the amount of product being transferred can be accomplished using an in-line flow meter, by watching the tank container weight (if there is a truck scale at the unloading station), and by monitoring the level rise in the storage tank.
 - Using two methods of level measurement adds a layer of safety and reduces risks of overflow.
17. *Can you rely on automatic shut-off systems to stop the unloading process?*
- Don't rely on automatic shut-off systems to stop the unloading process. Such systems are not foolproof! There is absolutely no substitute for an "attentive" operator.
18. *In addition to monitoring the amount of product being transferred, what else does the unloading operator need to monitor?*
- Monitor the operation to ensure that the pad of nitrogen or dry air is maintained in the tank container.

19. *What are the steps to disconnect the tank container from the system?*

- Close the nitrogen or dry air inlet valve on the tank container, and shut off the nitrogen or dry air source.
- Close the internal valve on the tank container. Wait a suitable time to allow completion of the closure/shutoff process (e.g., usually about a minute), then open the internal valve to blow the hose clear to the storage tank. Repeat as necessary to ensure tank container and hose are empty. Be careful not to over pressurize the receiving tank during the hose clearing operation.
- After the hose is cleared, close the internal valve on the tank container and the valve on the receiving line.
- Close tank and receiving line simultaneously to avoid back flow of product into the hose.
- Open the bleed valve to depressurize the unloading hose. Make sure you collect any excess product in a catch container that contains a neutralizing solution.
- Close the bleed valve and the external valve on the tank container.
- Carefully disconnect the unloading hose from the tank container and the receiving line. Use a catch container under the ends of the hose to capture any product drippage.
- Cap and plug the ends of the hose immediately after disconnection. Remove any required bleed valve. Then apply the closure cap to the tank container's discharge outlet and the closure cap or plug to the fitting on the receiving line.
- Recheck to see that the tank container is still pressurized with 5 to 10 psig of nitrogen or dry air. This will help ensure that moisture will not enter the tank container and react with the residual TDI on the return trip.
- Depressurize and carefully disconnect the dry air or nitrogen hose from the tank container's inlet valve, remove the bleed valve, and replace the dust cap.

17. *What do you do to get the tank container ready for return?*

- Sign the delivery report, and note any unusual problems or delays that might have occurred.
- Remove the barricades and wheel chocks.

18. *What resources are available if you have additional questions about handling TDI?*

- If you have any further questions or are unsure of the actions required of you, ask your supervisor or team leader, or contact the product manufacturer.
- For more information about handling TDI, consult the following literature developed by the Center for the Polyurethanes Industry (available at www.polyurethane.org):
 - *Guidelines for Diisocyanate Storage Tank Systems*
 - *Guidelines for Receiving and Unloading TDI*

Cargo Tank Trailer Transfers

1. *What do you need to be aware of before handling TDI in cargo tank trailers?*

- The receiving, handling, and shipment of TDI require compliance with federal, state, and local regulations concerning hazardous materials. Make sure you know these regulations and follow them at all times.
 - It is recommended that a comprehensive checklist be developed and followed throughout the unloading sequence.
2. *How is the truck prepared before unloading?*
- Make sure that the driver has set the emergency brake once the truck is in position.
 - Place wheel chocks under the tires of the tank truck, as well as the rear tires of the tractor, to prevent movement in either direction.
 - As an added precaution, you may wish to put barricades or warning signs around the unloading area.
3. *What do you check for on the paperwork?*
- Check all paperwork for accuracy. Verify the driver's paperwork to validate trailer number, product identification tag, security seal, that the material being received is TDI, and that the weigh ticket shows the quantity being delivered, to help ensure the volume of the delivery will fit the storage tank.
 - Review the values on the Certificate of Analysis to determine whether the product meets required specifications.
4. *What regulations apply to the shipment of TDI?*
- The U.S. Department of Transportation (DOT) regulates the transportation of toluene diisocyanate.
 - Although there are various regulations covering the shipment of TDI, it will be classified UN2078, Toluene Diisocyanate, Class 6.1, Packing Group II.
 - The letters RQ will be entered either before or after the description of the shipment when individual packages contain 100 pounds or more of TDI, known as the "reportable quantity."
 - The toxic placard with the UN marking 2078 displayed is the required placard for shipment of this material.
 - TDI containers must have the required labels or placards applied.
 - The storage and handling of TDI at your facility may be subject to other federal, state, and local regulations.
5. *What do you check on the cargo tank trailer itself?*
- Check the tank truck to make sure the numbers on the security seals match the numbers shown on the paperwork. Also confirm that the seals are not broken and have not been tampered with in any manner.
 - Verify that the pad pressure and temperature are within the required parameters. If they are not, contact the shipper for further instructions.
 - Check the hazard placards. Make sure that they are correct for the product noted on the shipping documents to avoid cross contamination.

6. *What personal protective equipment (PPE) is required during transfer operations?*
 - In order to avoid contact or exposure to TDI, wear personal protective equipment during hook-up and disconnect activities. This includes appropriate impervious clothing such as a chemical protective suit, chemical resistant gloves and boots, as well as an approved full-face air-supplied respirator.
 - Evaluate if there is a need for fall protection based on your unloading method.
 - Both the unloading operator and the truck driver wear personal protective equipment.

7. *What checks of your own equipment do you make before unloading begins?*
 - If the content of the tank truck is to be off loaded into a receiving tank, make sure that the tank is the correct one for the product and that there is enough room in the tank to hold this shipment.
 - Clearly identify the unloading connection on the receiving line.
 - The unloading operator shows the driver the location of the nearest eye wash station and safety shower.
 - The driver shows the operator where the tank truck's remote emergency shut off is located.

8. *What special precautions do you take regarding the unloading hoses?*
 - Transfer hoses for TDI products are typically 2-inch in diameter to differentiate them from the 3-inch diameter hoses and fittings generally used for polyol products. Hoses may also be color coded and/or labeled to assist in eliminating transfer errors.
 - Because TDI reacts with moisture, it's extremely important that the hoses are dry. If there is any possibility of a problem with a hose, set the hose aside, tag it, and get another hose to complete the transfer.

9. *Why are all of these checks necessary?*
 - All these checks may seem unnecessary because the operation is routine, but taking these precautions every time will prevent product contamination and a potential overflow.

10. *How are cargo tank trailers unloaded?*
 - Cargo tank trailers are usually unloaded with nitrogen or dry air pressure.
 - An alternative method would be off loading using a pump, while adding nitrogen or dry air to maintain a dry atmosphere within the tank truck.
 - When unloading with either of these methods, leading industry practice is that all discharge vapors be absorbed or scrubbed free of TDI.
 - If dry air is used for unloading, it is extremely important to check for signs of moisture. Many companies recommend a dew point of -40°F .

- A “closed loop vapor exchange” system using a product pump is another means for unloading TDI. “Closed loop” means that no vapors escape from the system into the atmosphere and no moisture from the atmosphere enters the system.
11. *What special precautions do you keep in mind when the tractor’s compressor is used to generate the air pressure?*
- If the tractor’s compressor is used to generate the air pressure, it is extremely important to check the sight glass on the air dryer for signs of moisture. If a color-indicating type of dryer is used, the pellets should be blue.
 - If there is moisture in the sight glass or if the pellets are pink, contact your supplier for assistance.
 - If the tractor’s air compressor is used, the driver will start the compressor and maintain suitable pressure at the unloading operator’s direction.
12. *What is the role of the truck driver and unloading operator during transfer operations?*
- The driver will make connections to the tank truck, and operate the tank truck valves and all other tank truck equipment.
 - The unloading operator is responsible for connecting the unloading hose to the receiving line and operating the valves in the receiving system.
13. *What connection procedures do you follow?*
- Check the nitrogen or dry air source. Make sure the gauge is working properly and that the hose is attached securely.
 - Check the hose gasket for splits or cracks that could prevent a good seal. Remove the dust cap from the nitrogen inlet on the cargo tank trailer.
 - Before connecting the product discharge hose, inspect the fitting on the receiving line. Verify it is in good working condition. If it is a female fitting, inspect the gasket for splits or cracks that could cause a leak or spill. Replace the gasket, if necessary, and make sure you dispose of the old one properly.
 - Inspect the unloading hose, and make sure the quick disconnect fittings and gaskets are in good working order so that the connection will be secure. If everything is OK with the hoses, gaskets, and fittings, connect the hose to the receiving line, and secure it.
 - Cut the seal and connect the unloading hose to the tank truck. Remove the closure cap or blank flange from the product discharge outlet, and install a fitting with a bleed valve.
 - Connect the nitrogen or dry air supply hose to the nitrogen inlet on the tank truck, and secure it.
14. *What do you do after all connections have been properly secured and the checklist completed?*
- Sign the driver’s paperwork indicating a good hook-up has been made.
15. *What steps do you follow to begin the transfer operation?*

- Open the tank truck's internal valve, and then carefully open the external valve.
 - Open the receiving line valve.
 - Open the nitrogen inlet valve on the tank truck, and then open the valve on the nitrogen or dry air source.
 - Introduce nitrogen gas or dry air into the tank truck up to about 5-10 psig.
 - The product should now be flowing through the unloading line.
 - Once you have verified there are no leaks in the system, the nitrogen or dry air pressure will need to be increased to an acceptable pressure, usually between 10 to 20 psig, depending on the desired rate of unloading. Maintain a constant pressure in the tank truck until unloading is complete. Control the nitrogen or dry air pressure to prevent the tank truck's pressure relief valve from opening. Many companies use 25 psig as a maximum pressure.
16. *What are the attendance requirements during the unloading process?*
- During the unloading process, operators stay in the area to monitor the transfer of product. The U.S. Department of Transportation (DOT) requires that a qualified person attend the unloading operation.
 - "Attend" means that the person in attendance is alert, has an unobstructed view of the unloading operation, and stays within 25 feet during the entire process.
 - According to DOT, to be "qualified" the person must understand the potential hazards of TDI, know the procedures to follow in an emergency, and have the authority and means to move the tank truck.
17. *What additional safety precautions do you follow?*
- No smoking, vaping, or use of other tobacco products, no eating, and no drinking in the area during the transfer process.
18. *The amount of product being transferred is monitored at all times. How can this be accomplished?*
- Monitoring the amount of product being transferred can be accomplished using an in-line flow meter, by watching the tank truck weight (if there is a truck scale at the unloading station), or by monitoring the level rise in the storage tank.
 - Using two methods of level measurement increases the level of safety and reduces risk of overflow.
19. *Can you rely on automatic shut-off systems to stop the unloading process?*
- Don't rely on automatic shut-off systems to stop the unloading process. Such systems are not foolproof! There is absolutely no substitute for an "attentive" operator.
20. *In addition to monitoring the amount of product being transferred, what else does the unloading operator need to monitor?*
- Monitor the operation to ensure that the pad of nitrogen or dry air is maintained in the tank truck.

21. *What are the steps to disconnect the tank container from the system?*

- Close the nitrogen or dry air inlet valve on the tank truck, and shut off the nitrogen or dry air source.
- Close the internal valve on the tank truck. Wait a suitable time to allow completion of closure/shutoff process, (e.g., about a minute in most cases), then open the internal valve to blow the hose clear to the storage tank. Be careful not to over pressurize the receiving tank during the hose clearing operation.
- After the hose is cleared, close the internal valve on the tank truck and the valve on the receiving line. Close the tank and receiving line simultaneously to avoid back flow of product into the hose.
- Open the bleed valve to depressurize the unloading hose. Make sure you collect any excess product in a catch container that contains a neutralizing solution.
- Close the bleed valve and the external valve on the tank truck.
- Carefully disconnect the unloading hose from the tank truck and the receiving line. Use a catch container under the ends of the hose to capture any product drippage.
- Apply caps and plugs to ends of the hose immediately after disconnection.
- Remove the bleed valve fitting. Then apply the closure cap to the tank truck's discharge outlet and the closure cap or plug to the fitting on the receiving line.
- Recheck to see that the tank truck is still pressurized, usually with minimum 5 to 10 psig of nitrogen or dry air. This will help ensure that moisture will not enter the tank truck and react with the residual TDI on the return trip.
- Depressurize and carefully disconnect the dry air or nitrogen hose from the tank truck's inlet valve, and replace the dust cap.

22. *What is done to get the tank truck ready for return?*

- Sign the delivery report, and note any unusual problems or delays that might have occurred.
- Remove the barricades and wheel chocks.

23. *What resources are available if you have additional questions about handling TDI?*

- If you have any further questions or are unsure of the actions required of you, ask your supervisor or team leader, or contact the product manufacturer.
- For more information on handling TDI, consult the following literature developed by the Center for the Polyurethanes Industry (available at www.polyurethane.org):
 - *Guidelines for Diisocyanate Storage Tank Systems*
 - *Guidelines for Receiving and Unloading TDI*
 - *Unloading Toluene Diisocyanate (TDI) Tank Trucks (poster)*

Rail Tank Car Transfers

1. *What do you need to be aware of before handling TDI in rail tank cars?*
 - The receiving, handling, and shipment of TDI require compliance with federal, state, and local regulations concerning hazardous materials. Make sure you know these regulations and follow them at all times.
 - It is recommended that a comprehensive checklist be developed and followed throughout the unloading sequence.

2. *How is the rail tank car prepared before unloading?*
 - Set the brakes on the rail tank car, chock the wheels properly to prevent roll in either direction, and use blue flags as a warning to prevent access to the unloading area. Using derails will also provide additional access prevention.

3. *What do you check for on the paperwork?*
 - In most cases, the shipping documents and the Certificate of Analysis will have been sent to your company's receiving office ahead of the rail tank car delivery.
 - Verify the paperwork to validate rail car number, product identification tag, security seal and that the identity of the material being received is the correct TDI product
 - Review the values on the Certificate of Analysis to ensure that the product meets required specifications.

4. *What regulations apply to the shipment of TDI?*
 - The U.S. Department of Transportation (DOT) regulates the transportation of toluene diisocyanate as a hazardous material. .
 - Although there are various regulations covering the shipment of TDI, it will be classified UN2078, Toluene Diisocyanate, Class 6.1, Packing Group II.
 - The letters RQ will be entered either before or after the description of the shipment when individual packages contain 100 pounds or more of TDI, known as the "reportable quantity."
 - The toxic placard with the UN marking 2078 displayed is the normal placard for shipment of this material.
 - TDI rail cars must have the required labels or placards applied.
 - The storage and handling of TDI at your facility may be subject to other federal, state, and local regulations.
 - The shipping paper must include an emergency contact telephone number that is manned twenty-four hours a day and appropriate emergency response information.

5. *How should you begin to check the tank car?*
 - Check the hazard placards. Make sure that they are correct for the product noted on the shipping documents.
 - Compare the tank car number against the number identified on the shipping documents.
 - Check the tank car to make sure the numbers on the security seals match the

numbers shown on the paperwork. Also confirm that the seals are not broken and have not been tampered with in any manner.

- Break the seal on the valve cover hatch, remove the securement pin, and open the hatch to verify product temperature and pad pressure.
- Carefully remove the closure cap from the thermowell tube. If the car is equipped with a valve on the thermowell tube, carefully open the valve. Insert an appropriate thermometer into the thermowell to determine that the car is at the proper temperature for unloading.

6. *What personal protective equipment (PPE) is required during transfer operations?*

- In order to avoid contact or exposure to TDI, personal protective equipment is worn during transfer operations. This includes appropriate impervious clothing such as a chemical protective suit, chemical resistant gloves and boots, as well as an approved full-face air-supplied respirator. Use fall protection when accessing the top of rail car.
- Unloading operators should always wear personal protective equipment whenever there is a chance of TDI exposure.

7. *What are the final steps to check on the tank car before unloading begins?*

- Verify that the air inlet valve on the rail car is closed, then carefully remove the plug, and install a fitting that is equipped with a pressure gauge.
- Ensure the air inlet valve on the bleed valve fitting is closed, then carefully open the air inlet valve on the rail car to verify the pad pressure on the rail car.

8. *What checks of your own equipment do you make before unloading begins?*

- Verify the location and operation of the nearest eyewash station and safety shower.
- If the content of the tank car is to be off loaded into a receiving tank, make sure that the tank is the correct one for the product and that there is enough room in the tank to hold this shipment.
- Clearly identify the unloading connection on the receiving line

9. *What special precautions do you take regarding the unloading hoses?*

- Transfer hoses for TDI products are typically 2-inch in diameter to differentiate them from the 3-inch diameter hoses and fittings generally used for polyol products. Hoses may also be color coded and/or labeled to assist in eliminating transfer errors.
- Because TDI reacts with moisture, it's extremely important that the hoses are dry. If there is any possibility of a problem with a hose, set the hose aside, tag it, and get another hose to complete the transfer.
- Ensure the quick disconnect fittings and gaskets of the hose are in good working order so that the hose can be securely locked onto the discharge valve of the tank car and the receiving line. Replace the gasket, if

necessary, and make sure you dispose of the old one properly.

10. *Why are all of these checks necessary?*

- All these checks may seem unnecessary because the operation is routine, but taking these precautions every time will prevent product contamination and a potential overflow.

11. *How are tank cars unloaded?*

- Tank cars are usually unloaded with nitrogen or dry air pressure.
- An alternative method would be off loading using a pump, while adding nitrogen or dry air to maintain a dry atmosphere within the tank car.
- When unloading with either of these methods, leading industry practice has that all discharge vapors be absorbed or scrubbed free of TDI.
- If dry air is used, it is extremely important to check for signs of moisture. Many companies recommend a dew point of -40°F .
- A “closed loop vapor exchange” system using a product pump is another means for unloading TDI. “Closed loop” means that no vapors escape from the system into the atmosphere and no moisture from the atmosphere enters the system.

12. *What connection procedures do you follow?*

- Check the nitrogen or dry air source. Make sure the gauge is working properly and that the hose is attached securely.
- Check the hose gasket for splits or cracks that could prevent a good seal.
- Verify that the rail tank car discharge valve is closed, and carefully remove the plug from this valve. Install the necessary bleed valve fitting into the discharge valve.
- Connect the 2-inch product hose to the fitting installed in the rail car’s discharge valve.
- Connect the nitrogen or dry air supply hose to the fitting installed in the air inlet valve, and secure it.

13. *What steps do you follow to begin the transfer operation?*

- Open the discharge valve on the rail car.
- Open the receiving line valve.
- Open the air inlet valve on the adapter fitting, and then open the valve on the nitrogen or dry air source.
- The product should now be flowing through the unloading line.
- Once you have verified there are no leaks in the system, the nitrogen or dry air pressure will need to be increased to a typical pressure, usually between 10 to 20 psig, depending on the desired rate of unloading.
- Check the pressure to ensure constant pressure is maintained within the rail car until unloading is complete.

14. *What are the attendance requirements during the unloading process?*

- The US DOT requires a qualified person attend the unloading operation when the carrier is in attendance. If the carrier leaves the premises, the industry practice still recommends a qualified person attend the unloading operation.
 - “Attend” means that the person in attendance is alert and has an unobstructed view of the unloading operation during the entire process.
 - A qualified person should be properly instructed in unloading procedures, be responsible for compliance with all applicable regulations, be familiar with the nature and properties of the material involved, be instructed in proper emergency procedures and, in the event of an emergency, have the authority and ability to immediately halt the flow of the product.
15. *Can a signaling system be used during transfer operations?*
- Signaling systems that include surveillance equipment, such as cameras, may be used to notify people within the facility that a problem may exist so that product flow may be halted.
16. *What are additional safety precautions to follow?*
- No smoking, vaping, or use of other tobacco products, no eating, and no drinking should be permitted during the transfer process.
17. *The amount of product being transferred is monitored at all times. How can this be accomplished?*
- Monitoring the amount of product being transferred can be accomplished using an in-line flow meter, by watching the rail car weight (if there is a scale at the unloading station), or by monitoring the level rise in the storage tank. Use of two methods of level measurement provides an additional layer of safety and reduces risk of overflow.
18. *Can you rely on automatic shut-off systems to stop the unloading process?*
- Don't rely on automatic shut-off systems to stop the unloading process. Such systems are not foolproof! There is absolutely no substitute for an "attentive" operator.
19. *In addition to monitoring the amount of product being transferred, what else does the unloading operator need to monitor?*
- Monitor the operation to ensure that the pad of nitrogen or dry air is maintained in the tank car.
20. *What are the steps to disconnect the rail tank car from the system?*
- Close the nitrogen or dry air inlet valve on the tank car, and shut off the nitrogen or dry air source.
 - Close the product discharge valve on the tank car. Wait for a suitable time to allow completion of the closure/shutoff process, (e.g., about a minute in most

cases), then open the product discharge valve to blow the hose clear to the storage tank. Be careful not to over pressurize the receiving tank during the hose clearing operation.

- After the hose is cleared, close the product discharge valve on the tank car and the valve on the receiving line.
- Open the bleed valve to depressurize the unloading hose. Make sure you collect any excess product in a catch container that contains a neutralizing solution.
- Close the bleed valve.
- Carefully disconnect the unloading hose from the tank car and, if necessary, from the receiving line. Use a catch container under the ends of the hose to capture any product drippage.
- Apply caps and plugs to the ends of the hose immediately after disconnection.
- Remove the fitting from the tank car discharge valve, and install the closure plug.
- Recheck to see that the tank car is still pressurized, usually with a minimum 5 to 10 psig of nitrogen or dry air. This will help ensure that moisture will not enter the tank car and react with the residual TDI on the return trip.
- Depressurize and carefully disconnect the dry air or nitrogen hose from the tank car's inlet valve. Remove the fitting from the tank car's nitrogen valve, and install the closure plug.
- Remove the thermometer from the thermowell, close the valve (if one is present), and install the closure cap.
- Check all valves to verify they are fully closed, and all closure plugs to verify they are wrench tight.
- Close the valve cover hatch, install the securement pin, and apply a tamper evident seal for the return trip.

17. What do you do about any spilled material or product residue on the tank car?

- Consult state and local regulations for spilled material. The U.S. Department of Transportation (DOT) requires that any spilled material or product residue must be removed from the tank car's exterior surface prior to it being offered for return shipment.

18. What do you do to get the tank container ready for return?

- Complete the checklist to ensure the rail tank car is properly prepared for return shipment.
- If there are any defects that must be corrected before the car can be returned or before the car is loaded for the next shipment, notify the supplier.
- Remove the wheel chock, blue flag, and derail.
- Return the paperwork to the receiving office and, if there are no defects, notify appropriate personnel that the empty tank car is ready for return.

19. What resources are available if you have additional questions about handling TDI?

- If you have any further questions or are unsure of the actions required of you, ask your supervisor or team leader, or contact the product manufacturer.

- For more information on handling TDI, consult the following literature developed by the Center for the Polyurethanes Industry (available at www.polyurethane.org):
 - *Guidelines for Diisocyanate Storage Tank Systems*
 - *Guidelines for Receiving and Unloading TDI*
 - *Unloading Toluene Diisocyanate Rail Cars*

Emergency Response

1. *What resources are available in the event of a TDI spill?*
 - An emergency response plan must be in place before handling TDI.
 - The emergency response plan will give you the information you need to control a release of TDI, avoid potential cross contamination, prevent injury to yourself or your coworkers, or damage to the environment.
 - Periodic review of the plan helps ensure the plan remains current with legal requirements and leading practices.
 - Some manufacturers may supply their own in-house emergency response telephone numbers and contacts in case of an incident involving a spill, leak, or damage.
 - All TDI manufacturers in the US are registered with CHEMTREC—the Chemical Transportation Emergency Center—established by the American Chemistry Council.
2. *How can CHEMTREC help in the event of a spill?*
 - CHEMTREC is staffed twenty-four hours a day, seven days a week, toll free at 1-800-424-9300, and is available to provide emergency response information.
 - A call to CHEMTREC will provide first action advice on handling procedures for emergencies involving TDI, and operators will also make contact with the manufacturer. CHEMTREC is not a governmental reporting agency.
 - Providing accurate information to CHEMTREC is imperative in order to receive correct response information. It is important to identify the product by its trade name.
 - All producers of TDI have response capabilities and can provide assistance if requested.
3. *What do you do if you discover a leaking package?*
 - If a package arrives at your facility and is leaking, follow your company's emergency plan or call the product manufacturer for assistance.
4. *Who is permitted into the spill area?*
 - In the event of an incident, only trained and qualified individuals are permitted into the spill area.

5. *Is respiratory protection required?*
 - Never approach a spill without the appropriate personal protective equipment, including an approved air-supplied positive pressure breathing apparatus.
6. *What is the first thing that should be done when attempting to control a spill?*
 - In the event of a product spill, activate the emergency response plan and stop the flow of product from the source, if it can be accomplished safely.
 - Do not allow spilled TDI to flow into drains or sewers. TDI will react with water and could obstruct the flow, and clog the drain.
 - If you puncture a drum, leave the forks in the drum and obtain assistance to clean up the spill.
7. *What do you do to contain the spill?*
 - Do not allow spilled TDI to flow into drains or sewers. TDI will react with water and could obstruct the flow, and clog the drain.
 - To stop the spread of the spilled material use absorbent material such as vermiculite, saw dust, clay earth, sweeping compound or sand to create a barrier around the spill or the inlet to the sewer or drain.
 - Depending on the size of the incident, spill pillows or other containment materials may be used to prevent further spreading of the product.
8. *What do you do after the spill has been contained?*
 - Once the spill has been stopped, absorbed, pumped off, or removed from the receiving surface, and there is no chance of further spread of the product, the area must be decontaminated with a neutralizing agent.
 - It is important to ensure all liquid has been absorbed before attempting neutralization of remaining product.
9. *Where can you find out additional information about neutralizing solutions?*
 - Consult the product manufacturer's SDS or contact the product manufacturer for neutralizing solution recommendations.
10. *When do you prepare the neutralizing solution and absorbent material?*
 - Prepare the neutralizing solution ahead of time, as well as the absorbent material, and have them readily available if an emergency arise.
11. *How should the neutralizing solution and absorbent material be used?*
 - Apply the neutralizing solution over the entire spill area.
 - Once the neutralizing solution has been applied, cover the area with additional absorbent material.
 - Spread the absorbent material around to aid in contact between the surface and the neutralizing solution.

- Then shovel all of the absorbent material into an appropriate waste container.
 - Apply neutralizing solution again to ensure adequate decontamination.
12. *What is the recommended ratio for thorough decontamination?*
- A commonly recommended ratio for thorough decontamination is tens parts of neutralizing solution to one part spilled material.
13. *What is the disposition of the drum into which waste material from the cleanup has been placed?*
- Place the lid loosely on the drum, and move it to a well-ventilated area, in case further reaction occurs. Do not tighten the lid because dangerous pressures may result from the neutralization process.
 - Carbon dioxide gas is generated through the neutralization process so frequent monitoring of the drum can reduce potential risks. Do not secure the lid until you are sure the reaction is complete.
 - After the product has fully reacted and prior to disposal, tighten the lid on the drum securely. Always check with regulatory authorities for proper disposal guidelines.
14. *What do you do with contaminated protective equipment?*
- Properly dispose of all contaminated protective equipment.
15. *What regulations apply to waste materials generated during a TDI spill cleanup?*
- Any waste material that has been generated during spill cleanup must be disposed of in accordance with federal, state, and local regulations.
 - TDI is a hazardous waste.
 - Containers used for waste disposal must be labeled in accordance with applicable waste regulations, such as US DOT and EPA. Contact your supplier for additional information.
16. *Who needs to be notified when a spill occurs?*
- Depending upon the circumstances and the amount of the spillage, local, state, and federal agencies may have to be notified. Of course, your company's own hazardous materials team or outside contractor will be able to judge this.
17. *What resources are available if you have additional questions about handling TDI?*
- If you have any further questions or are unsure of the actions required of you, ask your supervisor or team leader, or contact the product manufacturer.
 - For more information on handling TDI, consult the following literature developed by the Center for the Polyurethanes Industry (available at www.polyurethane.org):
 - *Guidelines for Management and Disposal of Hazardous Wastes from Polyurethane Processing*

QUIZ

The purpose of these quizzes is to assure the instructor that the participants have been receptive to, and have mastered the objectives of, this training program. The test results may be retained in the participant's file as a means of demonstrating to company health and safety managers that all participants are familiar with proper work procedures and safety rules.

Five separate quizzes have been provided with this Leader's Guide. One is for employees handling drums or intermediate bulk containers, the second for employees involved in tank container (isotainer) transfers, the third for employees involved in cargo tank trailer transfers, the fourth for employees involved in rail tank car transfers and the fifth quiz is for all transport operations, with information on hazard communication and emergency response procedures. Use the quiz that is most appropriate for your work site. Each participant should be able to demonstrate mastery of the objectives by achieving an acceptable test score. A participant who scores lower than that should review the missed questions with the leader.

The quizzes included in this Leader's Guide may be reproduced without further permission.

Answers to the quiz questions follow:

DRUM AND INTERMEDIATE BULK CONTAINER HANDLING QUIZ

1. A
2. D
3. B
4. D
5. A
6. C
7. A
8. B

TANK CONTAINER TRANSFERS QUIZ

1. B
2. A
3. D
4. A
5. C
6. D
7. B
8. A
9. C
10. A
11. B

CARGO TANK TRAILER TRANSFERS QUIZ

1. B
2. A

3. D
4. A
5. B
6. C
7. D
8. A
9. B
10. C
11. A
12. B

RAIL TANK CAR TRANSFERS QUIZ

1. B
2. A
3. D
4. A
5. C
6. D
7. A
8. A
9. C
10. A
11. B

HAZARD COMMUNICATION AND EMERGENCY RESPONSE QUIZ

1. B
2. A
3. D
4. A
5. C
6. D
7. B
8. A
9. C
10. A
11. A
12. D
13. B
14. B
15. C
16. B

NAME: _____

DEPT.: _____

DATE: _____

Drum and Intermediate Bulk Container Handling Quiz

SAFE HANDLING OF TOLUENE DIISOCYANATE

MULTIPLE CHOICE: *Circle the correct statement.*

1. Prior to unloading, follow these checks for shipment accuracy: verify that the purchase order number matches the shipment, check that the product description on the paperwork matches what was ordered, _____ and _____.
 - a. verify the seal numbers on the paperwork match the seal number on the container; verify the container number matches the paperwork
 - b. verify the seal number is listed on the paperwork; check the driver's ID
 - c. verify the placard on the container matches the hazard listed on the paperwork; verify the material labels on the drums or IBCs are the correct TDI product
 - d. verify that the paperwork lists the Emergency Contact number; check that the container has been sealed
2. Which statement is true about drums?
 - a. Drums can be stored on their chimes or on pallets.
 - b. Never move drums by picking them up on their chimes.
 - c. Drums should not be stored outside where they can be exposed to the elements.
 - d. All of the above.
3. Before opening the doors to begin unloading drums or IBCs, it is important to _____ and _____ on the tractor and trailer.
 - a. take the driver's keys; inspect the drums or IBCs
 - b. set the emergency brake; chock the wheels
 - c. secure the doors; close the air brake
 - d. Inspect the trailer floor; remove any freight securement equipment
4. The preferred way to dispose of empty drums is to:
 - a. place on pallets and place in an approved pick up location.
 - b. drain residual material and place drums with the bungs down.
 - c. contact local scrap metal dealer for instruction.
 - d. contract with an approved drum reconditioner.
5. Drums or IBCs with even a little _____ have the potential to react with TDI to form carbon dioxide and, in closed containers, potentially cause a violent rupture.
 - a. water or moisture
 - b. heat
 - c. oxygen
 - d. polyurethane foam

6. If you suspect a chemical reaction is taking place in a drum or IBC, the most appropriate action to take is to:
 - a. loosen the bung before rupture can occur.
 - b. move to a remote location and monitor.
 - c. isolate the area and contact manufacturer for assistance.
 - d. inspect the drum or IBC to ensure there are no leaks.
7. The U.S. Department of Transportation (DOT) regulates the transportation of toluene diisocyanate as
 - a. a hazardous substance.
 - b. a non-hazardous substance.
 - c. The US DOT does not regulate TDI.
 - d. a hazardous substance in single packages in quantities greater than 5,000 pounds.
8. What is the correct hazard placard for TDI?
 - a. 3082
 - b. 2078
 - c. 8230
 - d. 7820

NAME: _____

DEPT.: _____

DATE: _____

TANK CONTAINER (ISOTAINER) TRANSFERS QUIZ

SAFE HANDLING OF TOLUENE DIISOCYANATE

MULTIPLE CHOICE: *Circle the correct statement.*

1. What helps to ensure that each step of the appropriate unloading procedure is completed each and every time throughout the unloading sequence?
 - a. An on time delivery
 - b. Checking off each and every step on a documented checklist completed during the offload
 - c. Signing the paperwork
 - d. Working with a partner
2. Prior to unloading, follow these checks for shipment accuracy: verify the purchase order number matches the shipment, verify the product description on the paperwork matches what was ordered, _____ and _____.
 - a. verify the seal numbers on the paperwork match the seal number on the container; verify the container number matches the paperwork
 - b. verify the seal number is listed on the paperwork; check the driver's ID
 - c. verify the placard on the container matches the hazard listed on the paperwork; verify the material labels on the tank container are the correct TDI product
 - d. verify the paperwork lists the Emergency Contact number; check that the container has been sealed
3. Before beginning the unloading process, the receiving tank should be confirmed to _____ and _____.
 - a. have product in the storage tank; the tank content level is visible
 - b. not have an active high level alarm; has a temperature within 20°F of the product being delivered
 - c. have a pressure lower than the tank container; there is enough room in the storage to hold the amount being delivered
 - d. have an unloading connection that is clearly identified with a product name that matches the product tag on the tank container outlet; there is enough room in the storage tank to hold the amount being delivered
4. According to industry best practice, to prevent cross contamination of polyurethane raw materials, what size hoses and fitting will be needed to unload TDI?
 - a. 2" hoses and fittings
 - b. 4" hoses adapted to 3" fittings
 - c. 2" or 3", depending on what is on the cargo tank trailer

- d. 3" hoses and fittings
5. If dry air is used, it is extremely important to check for signs of moisture. It is recommended that dry air have a dew point of _____ as a minimum.
- a. 32° F
 - b. 300° F
 - c. -40° F
 - d. 0° F
6. According to industry best practice, the role of the truck driver during unloading operations is to:
- a. operate all tank container valves only after the unloading operator has made all connections to the tank container.
 - b. make all connections so that the unloading operator can operate all valves.
 - c. remain in tractor while the unloading operator completes the offload.
 - d. make all connections to the tank container and operate the valves and other equipment on the tank container.
7. According to industry best practice, for the role of the unloading operator during unloading operations is to:
- a. ensure that the driver follows the appropriate unloading procedures.
 - b. make all connections to the receiving line and operate the valves and other equipment on the receiving system.
 - c. make all tank container and receiving line connections so that the driver can operate all valves.
 - d. monitor the receiving tank while the driver completes the offload.
8. The U.S. Department of Transportation (DOT) regulates the transportation of toluene diisocyanate as
- a. a hazardous substance.
 - b. a non-hazardous substance.
 - c. The US DOT does not regulate TDI.
 - d. a hazardous substance in single packages in quantities greater than 5,000 pounds
9. What should the unloading operator do after all of the connections have been properly secured and the unloading connections checklist steps have been completed?
- a. Start the unloading process.
 - b. Leave the unloading area.
 - c. Sign the driver's paper work indicating a good hook up has been made.
 - d. Notify management that the unloading sequence is about to begin.
10. In addition to the amount of product being transferred, what else should the unloading operator monitor during the transfer?
- a. Regularly monitor the dry air or nitrogen pad throughout the unloading process to ensure it is at the proper pressure for the unloading method.
 - b. Monitor other product transfer in process in nearby tanks.
 - c. Check the temperature in the tank container.
 - d. Monitor the unloading area for unnecessary people entering the area.

11. What is the correct hazard placard for TDI?

- a. 3082
- b. 2078
- c. 8230
- d. 7820

NAME: _____

DEPT.: _____

DATE: _____

CARGO TANK TRAILER TRANSFERS QUIZ

SAFE HANDLING OF TOLUENE DIISOCYANATE

MULTIPLE CHOICE: *Circle the correct statement.*

1. What helps to ensure that each step of the appropriate unloading procedure is completed throughout the unloading process?
 - a. an on time delivery
 - b. checking off each and every step on a documented checklist completed during the offload
 - c. signing the paperwork
 - d. working with a partner
2. Prior to unloading, complete these checks for shipment accuracy: verify the purchase order number matches the shipment, verify the product description on the paperwork matches what was ordered, _____ and _____.
 - a. verify the seal numbers on the paperwork match the seal number on the cargo tank trailer; verify the cargo tank trailer number matches the paperwork
 - b. verify the seal number is listed on the paperwork; check the driver's ID
 - c. verify the placard on the container matches the hazard listed on the paperwork; verify the material labels on the cargo tank are the correct TDI product
 - d. verify the paperwork lists the Emergency Contact number; verify the container has been sealed
3. During the TDI unloading operation, who is required to wear PPE?
 - a. The truck driver
 - b. The unloading operator
 - c. PPE is not necessary during unloading operations
 - d. Both the unloading operator and truck driver
4. According to industry best practice, to prevent cross contamination of polyurethane raw materials, what size hoses and fitting will be needed to unload TDI?
 - a. 2" hoses and fittings
 - b. 4" hoses adapted to 3" fittings
 - c. 2" or 3", depending on what is on the cargo tank trailer
 - d. 3" hoses and fittings
5. What special precautions should be taken when the tractor mounted air compressor is used to pad the tank during offload?
 - a. the tractor does not overheat
 - b. check the sight glass to confirm the desiccant is blue and there are no signs of moisture
 - c. the pressure does not exceed 5 PSI

- d. the compressor has been inspected within the last 12 months
6. If dry air is used, it is extremely important to check for signs of moisture. It is recommended that dry air have a dew point of _____ as a minimum.
- a. 32° F
 - b. 300° F
 - c. -40° F
 - d. 0° F
7. According to the industry best practice, the role of the truck driver during unloading operations is to:
- a. operate all tank container valves only after the unloading operator has made all connections to the tank container.
 - b. make all connections so that the unloading operator can operate all valves.
 - c. remain in tractor while the unloading operator completes the offload.
 - d. make all connections to the cargo tank trailer and operate the valves and other equipment on the tank container.
8. The U.S. Department of Transportation (DOT) regulates the transportation of toluene diphenyl diisocyanate as
- a. a hazardous substance.
 - b. a non-hazardous substance.
 - c. The US DOT does not regulate TDI.
 - d. a hazardous substance in single packages in quantities greater than 5,000 pounds.
9. According to industry best practice, the role of the unloading operator during unloading operations is to:
- a. ensure that the driver follows the appropriate unloading procedures.
 - b. make all connections to the receiving line and operate the valves and other equipment on the receiving system.
 - c. make all tank container and receiving line connections so that the driver can operate all valves.
 - d. monitor the receiving tank while the driver completes the offload.
10. As the unloading operator, what should you do after all of the connections have been properly secured and the unloading connections checklist steps have been completed?
- a. Start the unloading process.
 - b. Leave the unloading area.
 - c. Sign the driver's paper work indicating a good hook up has been made.
 - d. Notify management that the unloading sequence is about to begin.
11. In addition to the amount of product being transferred, what else should the unloading operator monitor during the transfer?
- a. Regularly check the dry air or nitrogen pad during the unloading process to ensure it is at the proper pressure for the unloading method.
 - b. Check other product transfer in process in nearby tanks.
 - c. Verify the temperature in the tank container.
 - d. Check the unloading area for unnecessary people entering the area.

12. What is the correct hazard placard for TDI?

- a. 3082
- b. 2078
- c. 8230
- d. 7820

NAME: _____

DEPT.: _____

DATE: _____

RAIL TANK CAR TRANSFERS QUIZ

SAFE HANDLING OF TOLUENE DIISOCYANATE

MULTIPLE CHOICE: *Circle the correct statement.*

1. What helps to ensure that each step of the appropriate unloading procedure is completed throughout the unloading process?
 - a. an on time delivery
 - b. following a comprehensive checklist throughout the unloading sequence
 - c. relying on backup procedures
 - d. working with a partner
2. Prior to unloading, the items to check for shipment accuracy should include: verify the purchase order number matches the shipment, verify the product description on the paperwork matches what was ordered, _____ and _____.
 - a. verify the seal numbers on the paperwork match the seal number on the cargo tank trailer; verify the cargo tank trailer number matches the paperwork
 - b. verify the seal number is listed on the paperwork; check the driver's ID
 - c. verify the placard on the container matches the hazard listed on the paperwork; verify the material labels on the rail car are the correct TDI product
 - d. verify the paperwork lists the Emergency Contact number; check that the container has been sealed
3. What personal protective equipment (PPE) is required during transfer operations?
 - a. Work clothing and rubber gloves
 - b. Side shield eye protection, rubber boots and gloves
 - c. Impervious clothing, cotton gloves and eye protection
 - d. Chemical protective suits, chemical splash goggles or chemical face shield and chemical resistant gloves and boots as well as an approved full-face air-supplied respirator.
4. According to industry best practice, to prevent cross contamination of polyurethane raw materials, what size hoses and fitting will be needed to unload TDI?
 - a. 2" hoses and fittings
 - b. 4" hoses adapted to 3" fittings
 - c. 2" or 3", depending on what is on the cargo tank trailer
 - d. 3" hoses and fittings
5. If dry air is used, it is extremely important to check for signs of moisture. It is recommended that dry air have a dew point of _____ as a minimum.

- a. 32° F
 - b. 300° F
 - c. -40° F
 - d. 0° F
6. Who must attend the unloading operation at all times?
- a. a manager
 - b. a unloader and a witness
 - c. a third party unloader
 - d. a qualified person
7. The U.S. Department of Transportation (DOT) regulates the transportation of toluene diisocyanate as
- a. a hazardous substance.
 - b. a non-hazardous substance.
 - c. The US DOT does not regulate TDI.
 - d. a hazardous substance in single packages in quantities greater than 5,000 pounds.
8. In addition to the amount of product being transferred, what else should the unloading operator monitor during the transfer?
- a. Regularly check the dry air or nitrogen pad throughout the process to make sure it is at the proper pressure for the unloading method.
 - b. Monitor other product transfer in process in nearby tanks.
 - c. Check the temperature in the tank container.
 - d. Monitor the unloading area for unnecessary people entering the area.
9. When disconnecting hoses from the railcar what should be done to minimize the impact of any material that could spill?
- a. Open the cam and groove fitting very slowly.
 - b. Walk the hose out to ensure there is no product remaining.
 - c. Contain product drippage using a catch container.
 - d. Disconnect wearing gloves and rubber boots as the only PPE required.
10. Complete the statement. The U.S. Department of Transportation (DOT) requires that any spilled material or product residue must be removed from the tank car's exterior surface _____.
- a. prior to it being offered for return shipment
 - b. after it leaves the facility
 - c. upon return to the supplier's facility
 - d. spilled material does not need to be removed
11. What is the correct hazard placard for TDI?
- a. 3082
 - b. 2078
 - c. 8230
 - d. 7820

NAME: _____

DEPT.: _____

DATE: _____

HAZARD COMMUNICATION AND EMERGENCY RESPONSE PROCEDURES QUIZ

SAFE HANDLING OF TOLUENE DIISOCYANATE

MULTIPLE CHOICE: *Circle the correct statement.*

1. When TDI reacts with water, polyol and several other compounds, what two byproducts are a result of the reaction?
 - a. Heat and steam
 - b. Heat and carbon dioxide
 - c. Carbon dioxide and steam
 - d. Polyurea solids and oxygen
2. What are the three routes of entry through which a chemical can cause health effects?
 - a. Inhalation or Breathing, Skin or Eye Contact, Ingestion or Swallowing
 - b. Skin or Eye Contact only
 - c. Inhalation or Breathing, Absorption, Ingestion
 - d. Skin Contact, Eye Contact, Inhalation
3. What are symptoms of over exposure to TDI?
 - a. Difficulty breathing
 - b. Tightness in the chest and
 - c. Irritation of the eyes, nose throat and lungs
 - d. All of the above
4. Skin exposure or overexposure to airborne TDI may cause or trigger _____ or _____.
 - a. respiratory allergy; sensitization
 - b. headaches; dizziness
 - c. slight changes in body temperature; low grade fever
 - d. change in the taste of food; loss of appetite
5. For TDI exposure to the eyes, it is important that the eyes are:
 - a. flushed with water until the TDI reacts with the water and only seek medical attention if the eyes are irritated.
 - b. quickly wipe the TDI out with damp cloths and do not seek medical attention.
 - c. flushed with running water for at least 15 minutes and seek medical attention.
 - d. flushed with saline water only to avoid chemical reaction and seek medical attention within 48 hours.
6. Everyone involved in handling of TDI must be equipped with PPE (Personal Protective Equipment). This includes:
 - a. Work clothing and rubber gloves
 - b. Side shield eye protection, rubber boots and gloves

- c. Impervious clothing, cotton gloves and eye protection
 - d. Chemical protective suits, chemical splash goggles or chemical face shield and chemical resistant gloves and boots as well as an approved full-face air-supplied respirator.
7. TDI has a flash point greater than:
- a. 200° F
 - b. 260° F
 - c. 212° F
 - d. 100° F
8. Established TDI exposure limits and the TDI odor threshold limit would suggest that:
- a. odor should never be used to indicate the presence of TDI.
 - b. overexposure could not occur if TDI odor is detected.
 - c. odor is an effective method for determining the presence of TDI.
 - d. the TDI odor threshold does not correspond to the TDI exposure limits.
9. Personnel that will be working in an area containing spilled TDI must be _____ and _____?
- a. alert, healthy
 - b. approved, trained
 - c. trained, qualified
 - d. responsible, in charge
10. After reporting the product spill and ensuring that it is safe to take actions, the first step to take is to _____.
- a. stop the flow of product from the source
 - b. build a dike with sand in order to drain away the spilled material
 - c. determined the amount spilled
 - d. contain the spilled material in a catch container
11. Absorbent material such as clay earth and sweeping compound should be used to stop spilled TDI from flowing into _____ or _____.
- a. drains, sewers
 - b. piping, trenches
 - c. open ditches, pits
 - d. containment area, dikes
12. When cleaning up spilled TDI, once the product has been stopped, absorbed, pumped off, or removed from the receiving service, and there is no chance of further spread of the product, the area must be decontaminated with _____?
- a. appropriate solvents
 - b. saw dust
 - c. sweeping compound
 - d. neutralizing agent
13. Drums containing materials contaminated by TDI should be kept:
- a. sealed and in a cool dry area.
 - b. in a well-ventilated area and monitored frequently.
 - c. in direct sunlight.
 - d. in a hot, humid room.
14. Where can you find out additional information about neutralizing solutions?

- a. Emergency Response Guidebook
 - b. the product manufacturer's SDS
 - c. the unloading checklist
 - d. the manufacturer's product label
15. What should be documented within the facility in order to give information needed to control a release of TDI, and help prevent injury or damage to the environment?
- a. A product checklist
 - b. Membership in CHEMTREC
 - c. An emergency response plan
 - d. A chemical inventory list that contains TDI
16. All TDI producers in the United States are registered with _____, which is staffed twenty-four hours a day, seven days a week, to provide emergency response information for the US, Canada, and Mexico.
- a. OSHA
 - b. CHEMTREC
 - c. Emergency Response Network
 - d. EPA