



# Identification and Analysis of Safety Hazards on the Virtual Construction Worksite

## Facilitator Guide –



## Table of Contents

Introduction .....	1
Background.....	1
Usage.....	2
Acknowledgements.....	2
VR Safety Guide.....	3
Device Options.....	5
Software Demos .....	6
Quizzes .....	7
Hot Spots .....	7
Module 1: Slips, Trips and Falls.....	8
Learning Outcomes.....	8
Teacher Led Activity.....	8
Discussion Questions.....	9
Module 2: Struck By, Caught Between.....	10
Learning Outcomes.....	10
Teacher Led Activity.....	15
Discussion Questions.....	15
Module 3: Fire, Explosion, Toxicity and Asphyxiation.....	16
Learning Outcomes.....	16
Teacher Led Activity.....	17
Discussion Questions.....	18
Module 4: Ergonomics, Elements, and Noise.....	19
Learning Outcomes.....	19
Teacher Led Activity.....	20
Discussion Questions.....	22
Module 5: Electrocution.....	23
Learning Outcomes.....	23
Teacher Led Activity.....	25
Discussion Questions.....	25





## Introduction

The International Brotherhood of Electrical Workers Local Union 2085, the Piping Industry Technical College UA Local 254, and the Boilermakers Local 555 set out to change safe work practices of new entrants in construction by identifying, controlling and reporting incidents of safety hazards on the worksite. There are 5 modules developed for this hazard awareness resource that uses the latest virtual reality technology.



The Five Modules Include the Following Hazards:

1. Slips, Trips and Falls
2. Struck by, caught between
3. Fire, explosion, toxicity and asphyxiation
4. Electrocution

Learning Outcomes:

- An increased awareness of safety hazards
- Access to innovative safety tools by organizations who support youth transition to work in construction
- Improved safe work practices of youth working on construction sites

## Background

The International Brotherhood of Electrical Workers (IBEW) Local Union 2085 in partnership with the Boilermakers Local 555, the Piping Industry Technical College of Manitoba / UA Local 254 and the Construction Safety Association of Manitoba developed a series of virtual reality resources that will allow youth and new entrants in construction to spot hazards, assess risk and develop a plan to prevent injury. With the use of 360-degree imagery, youth will virtually walk through a worksite. They will look up, down and around the site using oculus lenses. They will spot hazards, assess the risks and as a result, they will be able to explain how to work more safely on a construction site.

When youth focus on the icon they will learn about each hazard and what needs to be done to avoid injury. This is an Interactive way to teach safety and one that is as close to real life situations without actually being there. It is not enough for youth to hear about the hazards on the worksite. They have to see it and experience what it looks and feels like. This will provide another tool for youth to learn about safety and one that is completely in line with the way youth learn today.

It is important for youth to see hazards from trades outside of their own scope. This is because trades work collaboratively on the same site and youth may start in one trade and switch to another trade over time. Exposure to all hazards is of greatest importance. This will not replace current safety training only serve to supplement and enhance the way safety is taught to our youth and new entrants.



*Note: This application is intended as an awareness application and does not replace safety training at local safety associations or on the job training. Content is specific to the Province of Manitoba and uses examples that may not apply to all situations.*

## Usage

This application is intended to be used in 2 ways:

1. **In classroom training** – Deployed to students in the class room using either the student’s own smart phone or supplied devices.
2. **Offsite training** – Using loaned devices or the student’s own device.

Once launched the smart phone should be placed inside a Google Cardboard capable viewer. The application does not work without a virtual reality display.

Virtual Reality may cause dizziness for approximately 30% of students. It is advised the facilitator takes time to discuss each module to allow for a break between each VR experience. In addition, the discussion time will allow for reflection and application of new learning. Guiding questions are provided for each module.

## Acknowledgements

### Advisory Committee Members:

We would like to acknowledge the contributions of the advisory committee who guided the direction of the project including:

- **Chris Taran**, International Brotherhood of Electrical Workers (IBEW) Local Union 2085 Project Lead
- **Steve Ducharme**, Piping Industry Technical College, UA Local 254
- **Craig Beauchamp**, Boilermakers, Local 555
- **Mike Jones**, Construction Safety Association of Manitoba (CSAM)
- **Doug McKay**, IBEW Local Union 2085
- **Peter Malagus**, Safe Work Manitoba

### Working Group Members:

We would like to recognize the contribution of the subject matter experts who spent countless hours compiling information, participating in shoots on the worksites and validating content.

- **Ted Stark**, Boilermakers, Local 555
- **Rob Fletcher**, ABCO, IBEW Local Union 2085
- **Craig Gertley**, Piping Industry Technical College, UA Local 254
- **Chad Wiebe**, Piping Industry Technical College, UA Local 254
- **Jason Rice**, McCaine Electric, IBEW Local Union 2085



- **Matt Lothian**, CSAM
- **Steve Ducharme**, Piping Industry Technical College, UA Local 254
- **Craig Beauchamp**, Boilermakers, Local 555
- **Marc Lagasse**, Boilermakers, Local 555
- **Doug McKay**, IBEW Local Union 2085

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## VR Safety Guide

VR Safety is a 360-degree photo or video driven virtual reality experience. The framework was developed by Bit Space Development Ltd. in Winnipeg Manitoba and has been used in many different experiences focused on general awareness, site-specific training, and trades promotion.

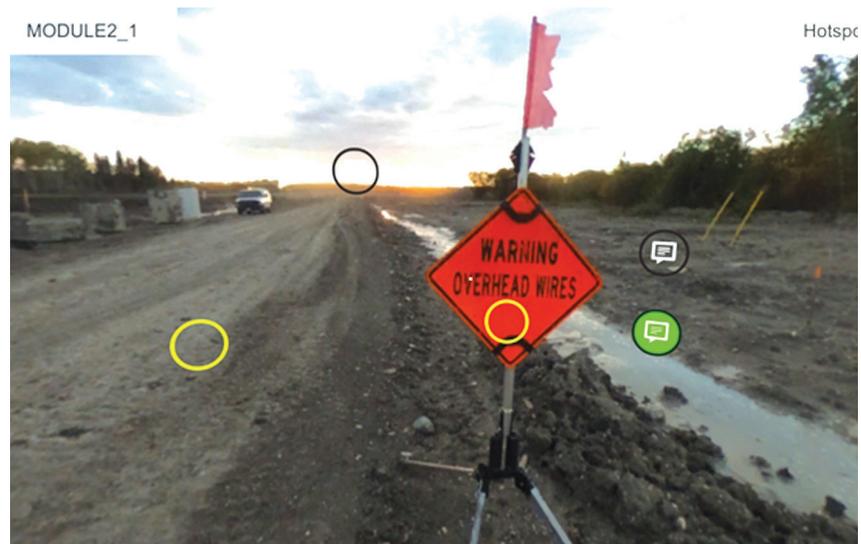
The framework can work on a wide range of devices including smart phones, tablets, computers and more. There are also various hotspot types which can be activated for embedded content.

### Running the Software:

Once the game is launched you will be put onto a job site. You can pan around using your mouse or by gazing around in VR. You do not need to press the mouse buttons to move or activate **hotspots**.

In the top left corner, you can see which module you are currently playing and in the top right corner you will see how many hotspots have been completed in the scene. Once you have completed all the hotspots you can move on to the next job site.

Modules can have 5–6 job sites showing different content.





## Device Options

There are several options for devices that can run this application. Each device has pros and cons and some may be higher quality than others.

### PC & Mac Based:



There are several computer based solutions for running VR Safety based applications.

- **Non-VR Computer Based:** VR Safety is designed to run directly on a PC based computer. We support Windows, Mac, and Linux operating systems and can be run without the need of a network connection. This is an easy out of the box solution for computer labs and institutions that do not have mobile devices handy or access to virtual reality tech.
- **VR Computer Based:** VR Safety is supported by all major VR offerings. These include:
  - **Oculus Rift:** <https://www.oculus.com/>
  - **HTC Vive:** <https://www.vive.com/eu/>
  - **Windows Mixed Reality:** <https://www.microsoft.com/en-ca/windows/windows-mixed-reality>

**Note: for higher end VR offerings you do need a VR capable PC to run the experience**

### Stand Alone VR Devices:



Stand alone VR headsets allow users to be immersed in an experience without the need for a PC or smart phone. These headsets generally are more expensive than phone based solutions but much cheaper than computer based.

- **Pico Goblin:** The Pico Goblin is an Android based all in one unit that can be branded to show the client's logo and can be ordered directly through Bit Space Development Ltd.
- **Oculus Go:** A high quality experience powered by a huge brand. Any VR Safety application can be run on the Oculus Go with minimal customization.



### Smart Phone Based:



VR Safety supports all Android and iOS smart phones that have an Accelerometer and Gyroscope for VR input. All Android and iOS phones are supported for non-VR implementations.

- **Google Cardboard:** Ranging from cardboard boxes to more robust plastic headsets.
- **Google Daydream:** Day Dream is a higher quality implementation of Google's VR platform. This offering is supported by less phones, however we can take advantage of motion controllers for increased interactivity.

### Additional Devices:

More ways to run VR Safety based applications:

- iPad
- Android Tablet
- Web Based

## Software Demos

Free applications which can be downloaded and ran on your hardware.

### Confined Space Awareness:

VR:

- **Android:** <https://play.google.com/store/apps/details?id=com.bitspacedevelopment.bm555.safetyvr>
- **iOS:** <https://itunes.apple.com/us/app/boilermaker-555-safety-vr/id1287144014?ls=1&mt=8>

360:

- **Android:** <https://play.google.com/store/apps/details?id=com.bitspacedevelopment.bm555.safety360>

### RSTS (Oculus Download Link):

- <https://drive.google.com/file/d/1hkWR6O8yRSkNZ-6CPJITAWWhPEyocXrk-/view?usp=sharing>



### Videos:

- <https://www.youtube.com/watch?v=Nuzq50k2dnw&list=PL1nviu8LVDRInYckh5n4vXc2QIXemE4Qr&index=6>
- <https://www.youtube.com/watch?v=SQFdFFCT3A4&list=PL1nviu8LVDRInYckh5n4vXc2QIXemE4Qr&index=7>
- <https://www.youtube.com/watch?v=1Rx7Rnlkgul&list=PL1nviu8LVDRInYckh5n4vXc2QIXemE4Qr&index=8>
- <https://www.youtube.com/watch?v=AEOaxO-V41U&list=PL1nviu8LVDRInYckh5n4vXc2QIXemE4Qr&index=12>

### IBEW Safety VR / 360

#### Android:

- IBEW - <https://play.google.com/store/apps/details?id=com.bitspacedevelopment.ibew2085.safetyvr>
- BM - <https://play.google.com/store/apps/details?id=com.bitspacedevelopment.bm555.safetyvr>
- UA - <https://play.google.com/store/apps/details?id=com.bitspacedevelopment.pp254.safetyvr>
- CSAM - <https://play.google.com/store/apps/details?id=com.bitspacedevelopment.csam.safety360>

#### iOS:

- IBEW - <https://itunes.apple.com/us/app/ibew-2085-safety-vr/id1287143848?mt=8>
- BM - <https://itunes.apple.com/us/app/boilermaker-555-safety-vr/id1287144014?ls=1&mt=8>
- UA - <https://itunes.apple.com/us/app/united-association-safety-vr/id1287144166?mt=8>

### Non-VR (for Android and iPad):

#### Android:

- IBEW - <https://play.google.com/store/apps/details?id=com.bitspacedevelopment.ibew2085.safety360>
- BM - <https://play.google.com/store/apps/details?id=com.bitspacedevelopment.bm555.safety360>
- UA - <https://play.google.com/store/apps/details?id=com.bitspacedevelopment.pp254.safety360>
- CSAM - <https://play.google.com/store/apps/details?id=com.bitspacedevelopment.csam.safetyvr>

#### iOS:

- IBEW - <https://itunes.apple.com/us/app/ibew-2085-safety-360/id1345796126?ls=1&mt=8>
- BM - <https://itunes.apple.com/us/app/boilermaker-555-safety-360/id1348309289?mt=8>
- UA - <https://itunes.apple.com/us/app/united-association-safety-360/id1345795693?mt=8>
- CSAM - <https://itunes.apple.com/us/app/csam-safety-360/id1345795545?mt=8>



## Quizzes

Quizzes use multiple choice to assess the user on the content they have learned in the module. The questions can be answered if the user has read all the hotspots through the module. An example of a quiz below:

A screenshot of a multiple-choice quiz interface. The question is "Choose the correct way to keep a workplace clean and safe:". There are four radio button options: "Pile all materials in one location", "Proper housekeeping", "Clean the workplace weekly", and "Leave it for the supervisor to do". A blue "Submit" button is at the bottom.

Choose the correct way to keep a workplace clean and safe:

Pile all materials in one location

Proper housekeeping

Clean the workplace weekly

Leave it for the supervisor to do

## Hot Spots

This is an explanation of the symbols used for each type of hot spot.

### 1. Text

These hotspots have text or sometimes multiple pages which can be read. You will see at the top of the hotspot which page you are on.





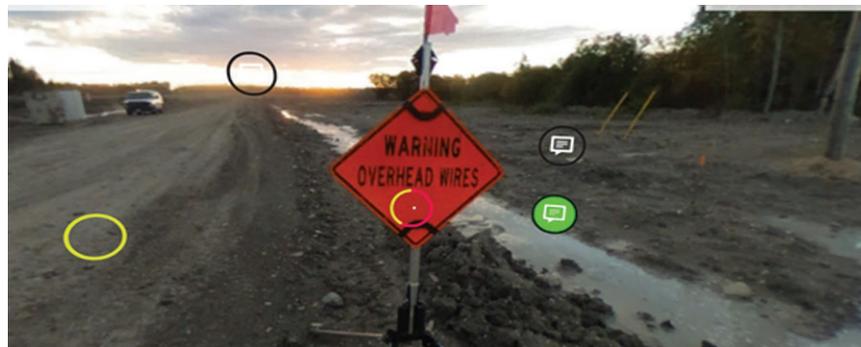
## 2. Image

This hotspot will launch an image which will show you a complementary image to the course content.



## 3. Progression

These yellow hotspots allow you to move forward and backward.



## 4. Quiz

These blue popups launch a quiz for the user to complete.





## Module 1: Slips, Trips and Falls

### Learning Outcomes

Students will be able to:

- Identify, control and report incidents relating to slips, trips and falls safety hazards.

### Virtual Reality Content

- There will be a variety of different signage on site. It is important that you are aware of the signs, what they mean. If you don't understand the sign, ask your supervisor for direction.
- Safety is a language we can all speak.
- On this spring morning the water on the surface can be frozen in the morning, and melt throughout the day; controlling this can be a difficult task.
- You must control transition of uneven floors; for example, the entrance to a building.
- You want a mechanical means of moving materials whenever possible. For example, use a pallet jack to move this material.
- Avoid working in poorly lit areas by using either temporary or task lighting.
- Cell phones are a major distraction on a busy job site; leave it behind or off during working hours.
- When training a new person with any type of language barrier make sure they repeat the directions back to you. It is important that everybody understands the risks.
- The potential for slips, trips, and falls is significantly higher in poor lighting conditions.
- When you are carrying materials, make sure you know the path first. There is always the potential for other material, cords, and debris in the way.
- Working at heights can be extremely dangerous. Whether you are working at 10 feet or 1000 feet, make sure you are tied off, wearing your PPE, and are aware of your surroundings.
- Poor lighting can make it difficult to work in a cluttered space.
- Ensure you always have sand on site to control freeze-thaw situations with water on the job site.

### Teacher Led Activity

Brainstorm as a group some of the slips, trips and falls you and others you know have experienced. What were their injuries and how could these have been prevented. Leave the column to the right empty at this time. Report your findings back to the larger group.



Identify the Slip, Trip or Fall	Name the injury that resulted	How could this have been prevented?	Identify the Hazard Control to be used

How do you control a hazard?

1. Eliminate the hazard
2. Reduce the risk of the hazard by substituting chemicals, equipment or work materials
3. Implement engineering controls to change the way workers do their jobs (ie. rearranging work stations to reduce risks of injury)
4. Implement administrative controls (ie. rotating workers to reduce risk of injury from repetitive movement)
5. Wear personal protective equipment (PPE)

Go back to your chart and insert the hazard control number that best matches each situation. Discuss as a group what you do to reduce risk in each situation.

Discussion Questions

1. What types of signage will you encounter on a construction site? Discuss the meaning of signs on the construction site.
2. What does it mean when they say "safety is a language we can all speak?"
3. What are some of the hazards associated with slips, trips and falls that we need to be aware of? How can these be controlled?
4. Are you aware of any incidents relating to slips, trips and falls? How could these incidents have been avoided?



## Module 2: Struck By, Caught Between

### Learning Outcomes

Students will be able to:

- Identify, control and report incidents relating to Struck By and Caught Between safety hazards



### Virtual Reality Content

- Welcome to Module 2: Struck by, Caught Between. This module explores a commercial job site where you will identify hazards and learn about how you can work safer on the job.
- Always know where overhead hoisting and rigging is taking place to avoid the possibility of falling objects.
- Strong winds can cause flying debris to fall off roofs like this bundle of foam; ensure materials are properly secured.
- Weather conditions will determine if roofing cranes are operable or not.
- You must be properly trained before operating any machinery on a job site.
- Be aware of overhead falling materials.
- Working around machinery can be dangerous; ensure you are wearing proper reflective gear and attempt to make eye contact with the operator whenever possible.
- Always be aware of potential pinch points when working with machinery.
- Operators may have limited visibility; pay attention to backup sirens.
- Wind can blow through job sites and cause debris, materials, and equipment to blow over.
- Be aware of trip hazards such as cords. They should be lifted off the ground to avoid trips and injuries. This eliminates a lot of problems.
- If a ladder falls on cords, there is the potential for shocks if the cord is cut.
- Be aware of unfinished ceilings during transition seasons. Frost can be on the bottom of a steel roof and ice or water can fall from the roof.
- Be aware of uneven grounds and trip points. When you are driving on uneven ground, a person could be thrown from the machine.
- This cord is laying in the water with debris over top of it, there are multiple hazards present.
- A subfloor is installed for HVAC installation.



- Be aware of red tape. Red tape is used as a warning of a hazard. Where is the hazard and why is it on the floor? Is the hazard tape still required?
- Yellow tape means caution, red tape means stay away from that area. There is a note to identify the hazard.
- Under certain weather conditions, water may freeze and cause slippage. Free standing water needs to be cleaned up.
- Metal framing beams need to be braced to prevent from rolling.
- Wheels on cabinets can roll over feet. Wheel locks should be set in place.
- Be aware of existing tile ceilings. You can find everything and anything on top of the tiles such as old chunks of concrete, pipe, old wiring, cables, and dead animals.
- Here is a reel of wire that has no chocks. If the wire reel is located on uneven ground, it may potentially roll away and strike employees or damage nearby equipment. The wire or conductor itself should never be used as the chock. The wire should always be secured after every cut to prevent coil spring back during storage or while being transported.
- When cutting above your head, you have very little control. Overhead cutting could cause a worker to be struck. What's keeping the blade from binding?
- Watch your fingers when laying down reels.
- Reels are all different sizes and some of them are full and some empty. Make sure half reels are at the top and full reels at the bottom. The full reels are more stable.
- You should never horse around on machinery. Always be aware of where your tools are because a falling tool can be dangerous.
- Stray cords on the ground can be a hazard if machinery drives over them. Keep cords up and out of the way.
- Long materials can be dangerous to carry. Be aware of your surroundings and be aware of others who are carrying materials to avoid being hurt.
- These wheels are not locked, which means this is not secure and safe!
- This machine is missing the kick plate; this can cause falling debris.
- A length of pipe is being used to lift materials which is unsafe.
- When operating a scissor lift be aware of your height; you can strike your head on objects if you are working too high up for the environment.
- Leaving tools up top on the vents, causes a future fall hazard. The cut off lengths (sheet metal) need to be removed.
- Material leaning against the wall should always be tied off.
- Here is material laying on the floor. Why is it out in the middle of everything? This is a potential hazard for the scissor lift operator.
- Watch floors when there is risk of freezing water or where snow can be blown in.
- Be aware of light materials that can blow off the roof.



## Video: Stolen Youth, Safe Work BC, Four Stories

- One worker is injured every hour. Does that surprise you? Why or why not?
- Why are younger workers at a higher risk than others?
- 1 out of 24 male workers are injured on the job. Why males?
- Why do companies look at improvements after an accident happens?
- One of the victims said, "the guy with the most training gets the best job." What does that mean?
- Youth work harder than most to prove themselves on the job. Youth never say no when asked. They want to impress. Is that true? What needs to change to prevent these accidents?
- If it seems unsafe do you do it? If not, what do you say? What happens if you are dismissed?
- How would you describe a new worker on the job?

A new worker is an individual who:

- Is new to the workplace.
- Has moved from one area of work to another that has different processes or hazards.
- Is relocated to a different workplace that has different process or hazards.
- Is returning to the same workplace but the process or hazards in the workplace have changed while the worker was away

*Note: The employer is responsible for providing safety and health orientation specific to that worker's workplace*

## Responsibilities

What are the responsibilities of the employers, supervisors, workers and prime contractors?

Duties of the Employer

- Provide access to the Act
- Provide access to each regulation made under the Act that applies to the workplace or the work being done.
- Provide access to each code of practice approved and issued by the employer that relates to a regulation under the Act.
- Ensure regular inspections of the workplace and of work processes and procedures to identify risk to individuals' safety and health.
- Correct unsafe conditions as soon as possible and take steps to protect the safety and health of individuals at risk.



### Duties of the Supervisor

- Take all precautions necessary to protect the safety and health of a worker under his/her supervision.
- Ensure that a worker under his/her supervision works in the manner and in accordance with the procedures and measures required by this act and regulations.
- Ensure that a worker under his/her supervision uses all the devices and wears all clothing and PPE designated or provided by the employer or required to be used or worn by this act or the regulations.
- Advise a worker under his/her supervision of all known or reasonably foreseeable risks to safety and health in the area where a worker is performing tasks.
- Cooperate with any other person exercising a duty imposed by this act or the regulations.
- Comply with this Act and the regulations.

### Duties of the Workers:

Every worker while at work will:

- Take reasonable care to protect his/her safety and health and the safety and health of other persons.
- Use all devices and wear all articles of clothing and PPE designated and provided for his/her protection by the employer or required to be used and worn by him/her in accordance with the regulations.
- Consult and cooperate with the Workplace Safety and Health Committee, where such a committee exists, regarding the duties and matters with which that committee is charged under this Act.
- Consult and cooperate with the Workplace Safety and Health Representative, where such a representative has been designated, regarding the duties and matters with which that representative is charged under this Act.

### Duties of the Prime Contractor:

- Ensure that regular inspection of the construction project site, the work processes at the site are conducted.
- When a risk is identified, ensure any unsafe condition is corrected asap and, in the interim, ensure that immediate steps are taken to protect the safety and health of any person at risk.

### Definition of Competence:

Possessing knowledge, experience and training to perform a specific duty.

### What is a Certificate of Recognition (COR™)?

Verification of an implemented safety and health program.



## Orientation

A new worker must attend an orientation.

The worker orientation includes:

- The employers and workers' rights and responsibilities.
- The name and contact information of the new workers' supervisor.
- The procedure for reporting unsafe conditions. Report all unsafe acts, unsafe conditions or near miss incidents to your supervisor so that corrective action can be taken.
- The procedure for exercising the right to refuse dangerous work.
- Contact information for the committee or the representative as applicable.
- Any policies, programs, and safe work procedures developed by the employer that are applicable to the worker.
- The hazards the worker may be exposed to and the control measures used to protect the worker.
- The location of the first aid station, how to request help and the procedures for reporting illnesses and injury. Report any injuries or accidents immediately to your supervisor.

Every worker has the right to:

- Know about hazards in the workplace and which precautions must be taken to prevent injury or illness from these hazards.
- Participate in safety and health activities at the workplace, including involvement in the joint workplace safety and health committee, or as a worker representative for example.
- Refuse work for anything that the worker believes will cause immediate and serious. Or long-term effects on their safety and health or the safety and health of others.
- Carry out duties or exercise safety and health rights as set out under the *Manitoba Workplace Safety and Health Act* without being subject to discriminatory action.

## Teacher Led Activity

Create a poster to inform new entrants about the responsibilities and rights of the worker.

Discussion Questions:

- Identify situations where a worker could be struck by or caught between something on a worksite.
- When is red and yellow tape used on a job site?
- What incidents are you aware of that resulted in a worker being struck by or caught between? How could these incidents have been avoided?



## Module 3: Fire, Explosion, Toxicity and Asphyxiation

### Learning Outcomes

Students will be able to:

- Identify, control and report incidents relating to explosion, toxicity and asphyxiation safety hazards.



### Virtual Reality Content

#### Fire:

- Be trained in the use of a fire extinguisher.
- Fire extinguishers should be properly rated for the work being performed:
  - A. Combustibles (paper)
  - B. Flammable liquids (gasoline)
  - C. Electrical
  - D. Chemicals
- You should be able to identify what started the fire.
- If you remove ignition, fuel source (combustible material), or oxygen there is no fire.
- Do not fight fires if you're not properly trained.
- If a fire cannot be put out in the first 30 seconds, vacate (evacuate) and report.

#### Explosion:

- Compressed gasses should be stored according to the fire code. (ie. spray paints, oxygen, spray foams)
- You should always be aware of location of fuel sources.
- Explosive areas can cause a fire. Flammable gasses, somebody walking by with flammable clothing, or something in the air or vicinity could cause an explosion or fire.

#### Toxicity:

- When dealing with controlled products, reference the appropriate MSDS sections for exposures.
- An employer must provide emergency washing facilities at a workplace where hazardous, irritating or corrosive substances are used.



- An employer must ensure that a worker who may be required to use emergency washing equipment is trained in the use of the equipment in accordance with the requirements of ANSI Standard Z358.1–04, American National Standard for Emergency Eyewash and Shower Equipment; and the equipment manufacturer’s specifications.
- Know the density of the gas at your work location. Some gasses (like propane) are heavier than air.
- Appropriate PPE may include a dust mask, respirator, goggles/glasses, shields, gloves, hazmat suit, and/or an air monitoring system.
- Carbon monoxide is heavier than air.

#### Asphyxiation:

- Make sure you have proper ventilation and air movement.
- Nitrogen is used for purging lines for eliminating excess gas.
- Make sure you have proper ventilation and air movement.
- Asphyxiation can happen gradually, you may not know that you are running out of oxygen.
- Welding or cutting (galvanized steel) can cause toxic smoke. Wear respirators and have proper ventilation.
- Cad welding creates toxicity and possible asphyxiation and if there is not proper ventilation, there is potential for fire.
- Suffocation is the state or process of being deprived of oxygen, which can result in unconsciousness or death.

## Teacher Led Activity

*Note: Need copies of MSDS for use in the classroom.*

#### Material Safety Data Sheets (MSDS):

What are material safety data sheets and how are they used?

- MSDS provide critical information about potentially hazardous products/materials. These sheets outline possible health effects, accidental exposure, product ingredients, first aid measures, personal protection, proper handling and storage, manufacturer emergency telephone number, as well as other vital information.

#### Activity:

Students will work in pairs to extract information from a material safety data sheet and answer the questions below.

1. What is the product name?
2. What are the uses of this substance or mixture and uses advised against?
3. What are the identified hazards of this product?
4. Describe the first aid measures of this product.



5. What are the general fire hazards associated with this product?
6. What are the accidental release measures or precautions associated with this product?
7. What are the handling and storage practices recommended?
8. How can the hazards be controlled?
9. How should the product be disposed?
10. How is the product to be transported safely?

Discussion Questions:

- Name some controlled products used on a construction site. What are the potential hazards?
- What are the 3 required elements for a fire?
- What is the appropriate PPE for an environment with controlled products?
- What do you do in the case of a fire?



## Module 4: Ergonomics, Elements, and Noise

### Learning Outcomes

Students will be able to:

- Identify, control and report incidents relating to ergonomics, elements and noise safety hazards.



## Virtual Reality Content

### Ergonomics:

- Ergonomics is the study of people's efficiency in their working environment. Issues can be caused by lifting heavy/awkward objects, carrying heavy/awkward objects, installation of heavy/awkward objects, repetitive motion, entering awkward spaces, constant ladder use, repetitive power tool use, long periods of time on your feet with improper footwear, or improper shoveling techniques.
- Rolling paint can cause back strain and/or shoulder strain, if poor ergonomics are used.
- Hammer drills or jack hammers can cause vibration which can result in a Muscular Skeletal Injury (MSI).
- While working take 2–5 minute breaks to avoid MSIs.
- Pre-shift stretching helps reduce the risk on an MSI.
- While standing at your workstation, you can use anti-fatigue mats.
- Don't grab the tool too tightly, allow the tool to do the work to avoid an MSI.
- Shoveling can result in an MSI.
- Holding tools incorrectly can bypass the fatigue relief.
- If using a power tool with vibration and it is used incorrectly it could result in an MSI.

### Elements:

- Be aware of elements that may affect your safety. These include the spring and fall freeze, thawing that creates slippery conditions, cold and hot extreme temperatures, rain and snow, ice, wind, and lightning.
- Working over waterways resulting in dangers relating to the waves and current and water temperatures.
- Make sure you are dressing appropriately for the work conditions, layer appropriately.
- Watch out for insects such as mosquitoes and wasps; be aware of people's allergies.
- Make sure you are well hydrated while working as improper hydration can cause cramping and injury.



### Noise:

- If a worker is likely to be exposed to noise in a workplace that exceeds 80dBA Lex but does not exceed 85dBA Lex, the employer must:
  - a. inform a worker about the hazards of the level of noise, and
  - b. on the request of the worker, provide him or her with:
    - i. a hearing protector that complies with CAN/CSA Standard Z94.2-02, Hearing Protection Devices —Performance, Selection, Care, and Use, and
    - ii. information about the selection, use and care of the hearing protector.
- If you cannot be heard at a normal conversation level and distance because of the ambient sound around you, it is louder than 85 dB.
- Be aware of the noise of power tools, hydraulic tools, hand tools, mobile equipment, large or industrial fans, and onsite equipment ie. mechanical rooms. Types of hearing loss, both long term and acute hearing loss is due to an explosion or high dB.
- Working in an enclosed area may result in higher decibels. For example, grinding will be a lot louder because of echoing.
- Clean your hearing protection, clean your safety glasses and replace PPE as needed to make sure it's effective.
- An employer must post a warning sign indicating that any person entering the workplace or work area risks exposure to a noise level that is harmful to hearing at the entrance to any workplace or work area where the noise level is more than 85 dBA.
- When it is not reasonably practicable to implement sound control measures, or the sound control measures implemented by an employer do not reduce the worker's noise exposure to 85 dBA Lex or less, an employer must at the employer's expense, provide the worker with the following audiometric tests:
  - a. an initial baseline test as soon as is reasonably practicable but not later than 70 days after the worker is initially exposed to that noise level.
  - b. a further test at least once every year after the initial baseline test.
- Most commercial electricians will have hearing loss in one ear or the other from hammer drilling, chiseling concrete, or another repetitive noisy task.

## Teacher Led Activity

### A) Pair Activity:

What is a MSI?

Workplace Safety and Health Regulation defines a musculoskeletal injury (MSI) as an injury or disorder of the muscles, tendons, ligaments, joints, nerves, blood vessels or related soft tissue, including a sprain, strain, or inflammation that may occur to a worker in a workplace and that is caused or aggravated by any of the following:

1. A repetitive motion
2. A forceful exertion



3. Vibration
4. Mechanical compression
5. A sustained or awkward posture
6. A limitation on motion or action
7. Any other factor that creates a risk of musculoskeletal injury

### B) Group Activity

Visit [TradeupManitoba.com](http://TradeupManitoba.com) and select one of the trade talk videos to view. Identify some possible ergonomic issues that may be prevalent in this trade.

Step 1: Write down the specific MSI hazard you are concerned about. Write it on the worksheet.

Step 2: Ask why the MSI hazard exists. Write the answer following the MSI hazard your identified.

Consider the following:

#### **Process:**

- length of time allotted to tasks
- machine-paced tasks
- duration of task
- variety of tasks
- production/quality standards
- communication between staff within the department and outside the department

#### **Materials:**

- packaging
- weight and dimensions
- storage location
- quality

#### **Equipment:**

- working height
- location of controls and/or displays
- operation of the controls
- mobility
- location
- association with other equipment
- insufficient adjustability
- maintenance

#### **Environment:**

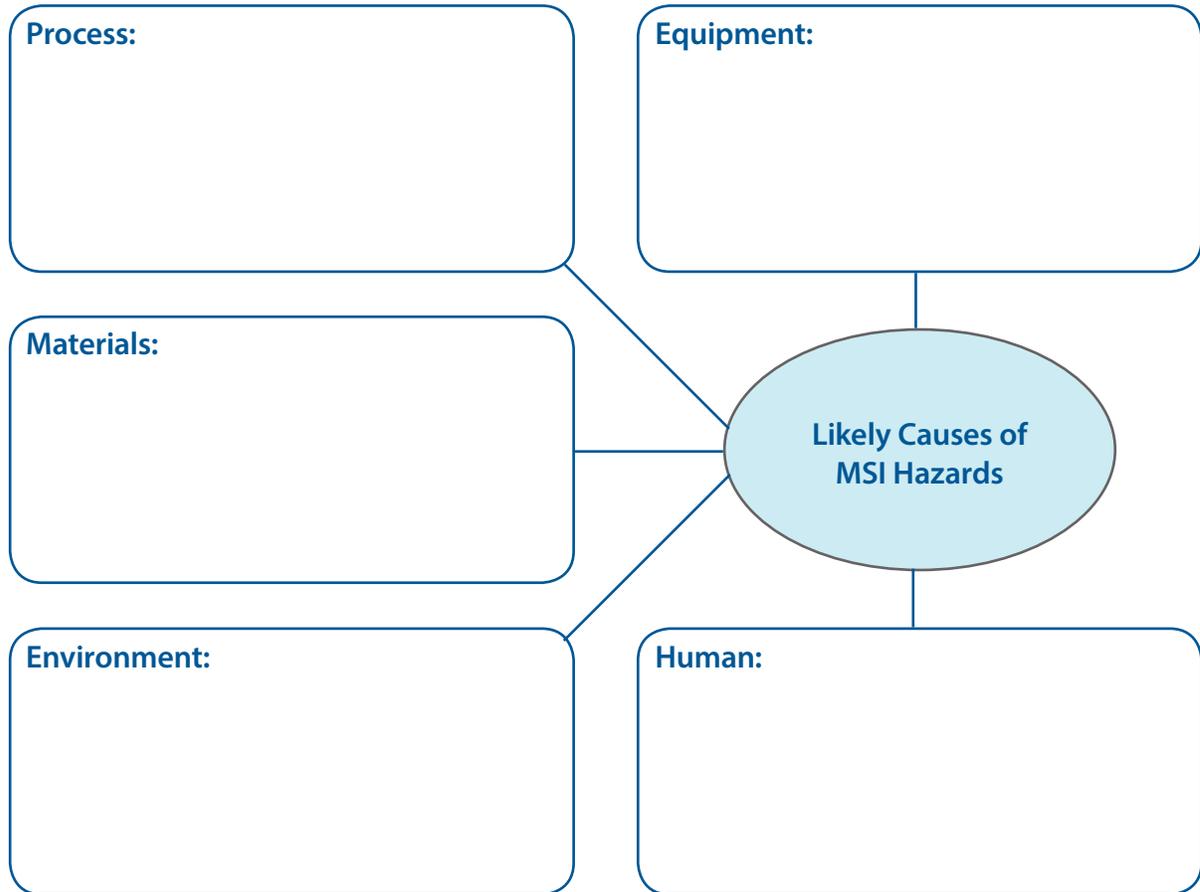
- working space
- overcrowding
- temperature
- flooring
- housekeeping

#### **Human:**

- insufficient training on techniques/processes
- insufficient supervision/coaching
- production pressures and demands
- inappropriate response to reports of MSD related concerns
- differences in work methods/techniques
- inconsistent use of equipment/controls that help reduce MSD risk



Worksheet: Identify the MSI and why the hazard exists



Discussion Questions:

- What are hazards associated with waterways?
- Give examples of ergonomic injuries. How can these be prevented?
- What hazards are associated with exposure to the elements? How do you control them?
- At your workplace, what noise hazards exist and how do you control them?



## Module 5: Electrocutation

### Learning Outcomes

Students will be able to:

- Identify, control and report incidents relating to electrocution safety hazards.



## Virtual Reality Content

- Warnings and signs with the use of barricades can be useful in preventing access to a dangerous area.
- A safety watch person might also be posted to warn of danger of electrical contract.
- Arc flash sign.
- Arc flash and shock training may be required.
- Signs should be posted and clean up personnel should be instructed that conductive cleaning materials should not be used without extreme caution around electrical equipment.
- Ensure all switch gear has been properly locked and tagged by all the different trades that are working on that specific piece of equipment.
- An example of equipment that could have multiple trades working on it is a motor.
- All workers should have their personal locks attached to the equipment they are currently working on.
- You should only be locked out on the equipment that you are currently working on.
- Locking out prevents accidents caused by rotating equipment or energized equipment while they are being worked on.
- You must always remove your lock when done working on the equipment for the day or when the job is complete.
- Workers should be alert and not impaired by fatigue, sickness, or for any other reason.
- Workers need to complete tasks in well-lit areas which does not impair vision of live circuits.
- Workers should not be wearing conductive articles of clothing or wearing jewelry such as watches, bracelets or necklaces.
- Insulated tools and personal protective wear should always be in 100% condition.
- Always inspect PPE and tools for wear and tear, defects, and damage before every work assignment.
- Any defect will render your tool or PPE unusable until it is repaired or replaced.
- You should never be wearing flammable clothing. Try to wear cotton based clothing. Synthetic clothing can melt to your skin.
- Contact lenses cannot be used on the job site, they can become fused to your eye.



- Only completely qualified and trained electricians familiar with the work assignment shall be allowed to work on live circuits or equipment.
- Personal protection is used including insulated tools.
- When working in an extremely hazardous electrical situation, there should be two or more people with at least one posted as a safety watch.
- Refer to rule 2-306 in the Canadian Electrical Code for information regarding shock and arc flash protection.
- Arc flash or shock is caused when a worker touches a live wire or a live wire comes in contact with another live conductor or ground.
- Always ensure you are using your PPE when on the job site.
- Never mix water with electricity. Wearing wet gloves can cause a shock.
- Portable ladders that are metal or have dangerous conductive parts (wooden ladders) cannot be used near or while working on exposed energized circuits.
- Protective barriers and shields shall be used to insulate workers from accidental contact with live circuits.
- Doors, panels, man-entry gates to confined spaces housing exposed electrical circuitry shall be secured from swinging into the worker while working in the enclosure.
- Dielectric (insulated) tools prevent electrocution, shock, or arc flash.

#### Electrical Current:

*There are three types of electrical hazards:*

1. Electrical shock (this is the most common)
2. Electrical burns
3. Effects of blasts which include pressure impact, flying particles

Workers who do not work directly with electricity are still at risk of electrical hazards.

Electrical hazards may be encountered by non-electrical workers:

- Welders
- Heavy equipment operators
- Excavators
- Warehouse workers
- Painters

There are many hazards non-electrical workers may experience, including:

- Power tools
- Extension cords
- Molded case circuit breakers



- Downed power lines
- Ladders
- Portable generators, battery banks, battery chargers

## Teacher Led Activity

Divide the class into 3-4 member groups and assign a trade to each group. Ask group members to read about the possible electrical hazards of that trade and present their findings to the larger group.

### Discussion Questions:

- When is arc flash or shock caused?
- What advice would you give to workers who are near live circuits or equipment?
- What are dangers associated with electricity?



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154 Notre Dame Ave. Winnipeg, MB R3B 556  
2085-982-204 tel  
com.www.ibew2085