Fire Watch

PARTICIPANT MANUAL
VERSION 20.2

ENERGY SAFETY CANADA

ACKNOWLEDGEMENTS

This course was developed by Energy Safety Canada through a collaboration of industry professionals representing CAGC, CAOEC, CAPP, EPAC and PSAC. Thank you to everyone who dedicated time and resources to creating this outstanding product.

SAFETY DOESN'T CLOCK IN AND IT DOESN'T PUNCH OUT. IT'S 24/7.

The creation of the Petroleum Industry Training Service in 1949 signaled a new day for safety in the industry. Today—recognizing that training is just one path to safety—Energy Safety Canada is advancing the work of its legacy organizations to act as a hub for safety expertise. We are continually evolving with a constant goal: zero injuries, zero incidents.

As the national voice for oil and gas safety, Energy Safety Canada advocates for those working in the industry and supports companies in their efforts to improve safe work performance.

AT ENERGY SAFETY CANADA, WE:

- Lead industry collaboration to develop common safety standards, making it easier for workers to move from site to site.
- Ensure workers have the training they need to get home safe at the end of each day.
- Help employers by providing leading-edge data and customized support for their health and safety programs.
- Reinvest training revenues, as a not-for-profit organization, back into safety for the oil and gas industry.

FOR WORKERS, WE:

- Make it easier to get safety training
- Reduce duplication of safety training
- Make safety standards more alike from site to site
- Make training certifications easy to access

FOR COMPANIES, WE HELP:

- Reduce injuries and incidents
- Improve safe work performance faster
- Improve access to safety data analysis
- Save time, money and increase efficiency through shared solutions and common safety standards

WE'RE LOCATED WHERE YOU NEED US:

Our Network of Authorized Training Providers (ATPs):

Energy Safety Canada works with hundreds of partners across the country to deliver safety training and services. From BC to the Atlantic provinces, you'll find ATPs close to where you work and live.

Energy Safety Canada has locations in:

Calgary
T 403 516 8000
F 403 516 8166
150 - 2 Smed Lane SE
Calgary, AB T2C 4T5

Nisku
T 780 955 7770
F 780 955 2454
1803 11 Street
Nisku, AB T9E 1A8

Fort McMurray
T 780 791 4944
F 780 715 3945
Box 13 – 8115 Franklin Avenue
Fort McMurray, AB T9H 2H7

Fort St. John
T 250 794 0100
F 250 785 6013
2060 – 9600 93 Avenue
Fort St. John, BC V1J 5Z2

Weyburn
T 306 824 9822
F 306 337 9610
208 – 117 3 Street
Weyburn, SK S4H 0W3

TABLE OF CONTENTS

1.0

CHAPTER 1:
Combustion: The Basics.....4

2.0

CHAPTER 2:
Fire Prevention..... 16

3.0

CHAPTER 3:
Working in Hot Work Areas.....20

4.0

CHAPTER 4:
Fire Equipment and Response 34

CHAPTER 1:

Combustion: The Basics

OUTCOME

Describe the basic properties of fire and heat transfer.

OBJECTIVES

Upon successful completion of this chapter, the student shall be able to:

1. Describe combustion and what is required for combustion.
2. Explain flammability range and physical states.
3. List the three types of heat transfer.
4. Identify potential fuel and ignition sources in the oil and gas industry.

FIRE WATCH IN INDUSTRY

Oil and gas workers often work near flammable substances, and sometimes that work requires welding or other operations posing fire hazards. If not managed properly, the risk of an accident and injury under these conditions can be severe.

Reducing or eliminating this risk is a top priority for the industry, and employers use a variety of control measures to reduce the risks from fire and explosions.

A vital control measure is the Fire Watch personnel who oversee work posing a fire risk. Often called 'Spark Watch,' this role is required by regulations and helps to protect everyone at the worksite.

The main duty of a Spark Watch is to monitor for sparks, or other ignition sources, and stop the work when there is a new hazard or a known hazard gets worse. To do this, the Spark Watch works as part of a team to assess and understand the hazards before, during and after work. The Spark Watch maintains the conditions and requirements of the work permit and keeps flammable materials from ignition sources.

In the event of fire or uncontained sparks, the Spark Watch must stop the work immediately, communicate the situation and activate the fire alarm, if needed. If possible, they may extinguish sparks by smothering with a fire blanket or by using a fire extinguisher but **only** if they are 100 per cent certain they can do so without causing undue risk of harm to themselves, others or property.

Preventing a fire, however, is **always** better than putting one out, and this course emphasizes the Spark Watch's need to identify the hazards of a worksite and make sure a fire never happens in the first place.

Note:
"Fire Watch" or "Spark Watch"?

The terms "Fire Watch" and "Spark Watch" mean the same thing, as they are the same job. In this course, we will use "Spark Watch" because it is a better description. As a Spark Watch, your main role is to prevent fires by eliminating ignition sources such as sparks.

COMBUSTION AND FIRE

To prevent fire, you need to understand what fire is, and how it spreads.

While we often think of combustion as a flame or fire, combustion can occur with or without flames.

Flaming combustion (fire) occurs when a fuel in a gaseous state reacts with oxygen giving off light and heat. Keep in mind liquids and solids do not burn in an open flame. Only their vapours do. For example, a pool of gasoline will give off vapours, which then turn into flames as the vapours combust in the air. The warmer it is, the more vapours solids and liquids will likely release.

Flaming combustion tends to use up the fuel quickly because the flames will warm the fuel source, which will then release more combustible vapours until the fuel is spent.

In contrast to flaming combustion, smouldering combustion is flameless and often much slower. Red-hot briquettes are a good example of smouldering combustion, where the surface of a solid fuel reacts directly with oxygen and combusts over time.

One of the reasons the Spark Watch must stay at the worksite after all work is finished is the potential for smouldering objects to ignite nearby objects or vapours in the air long after the work is complete.

Figure 1-1 Spark Watch on the Job

THE FIRE TETRAHEDRON

Four things must be present at the same time in order to produce fire (flaming combustion):

1. Enough oxygen to sustain combustion,
2. Enough heat to raise the material to its ignition temperature,
3. Fuel or combustible material,
4. And a chain reaction that heats the fuel to produce the gaseous fuel consumed in the flame.

Without any one of these four, fire is impossible (see figure 1-2 as an illustration).

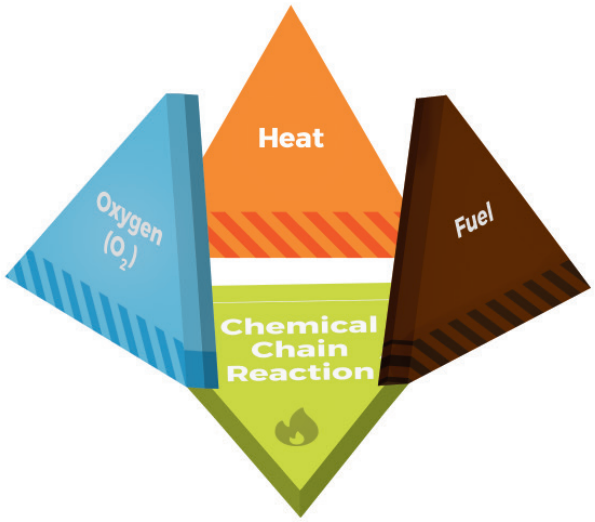


Figure 1-2 Fire Tetrahedron

Take any of these four things away and the fire will be extinguished:

1. Remove the oxygen.
2. Cool the burning material.
3. Remove the fuel.
4. Break the chemical reaction.

Note:
Fire safety, at its most basic, is based on the principle of keeping fuel sources and ignition sources separate.

FLAMMABILITY AND EXPLOSIVE LIMITS

Flammable vapours in air will burn only if the fuel concentration lies within well-defined lower and upper explosive limits. Too much fuel or too little fuel in the air means there will be no sustained combustion.

Each fuel has its own flammable range based on the air we normally breathe.

Lower Explosive Limit (LEL)

The Lower Explosive Limit (LEL), sometimes called the lower flammability limit, is the minimum amount of fuel that must be present in the air for combustion to begin. If there is not enough fuel the mixture is referred to as “lean,” and it will not burn.

Upper Explosive Limit (UEL)

The upper explosive limit, sometimes called the upper flammability limit, is the maximum amount of fuel that can be present in the air to burn. If there is too much fuel, the mixture is referred to as “rich,” and it will not burn.

Explosive or Flammable Range

The explosive or flammable range of a substance is the range between the LEL and the UEL. Both are expressed as a per cent (%) of fuel per volume of air.

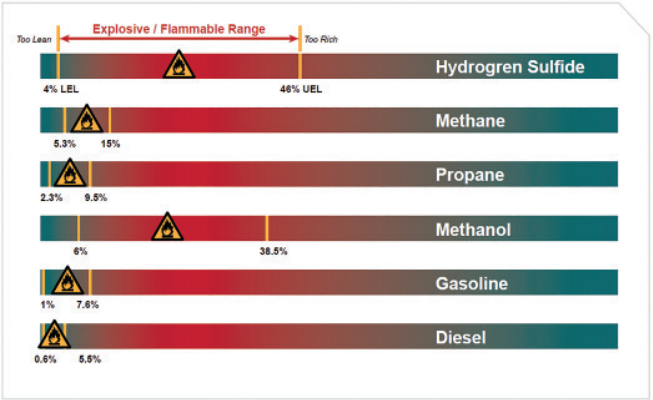


Figure 1-3 LEL and UEL

CLASS DISCUSSION

» Provide common examples of when a fuel is too lean or too rich to ignite.

Safety Factor

The maximum allowable concentration of flammable vapours in the air is much less than the LEL. The allowable will depend on your jurisdiction.

In Alberta, no work may proceed if vapour levels reach 20 per cent of the LEL.

Methane Example:

The LEL of methane is 5.3 per cent. But the maximum allowable amount of methane is only 20 per cent of 5.3. This means no work may proceed if methane levels reach 1.06 per cent (5.3 X (20/100)) = 1.06).

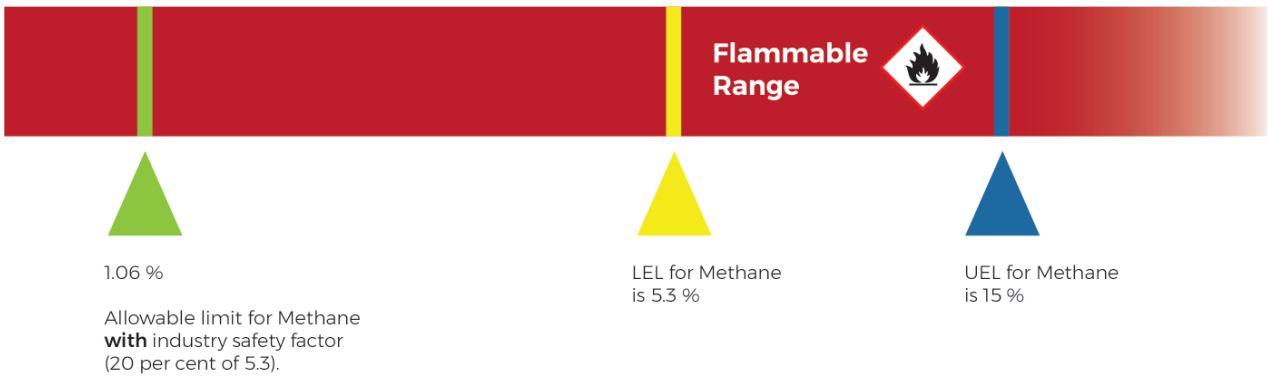


Figure 1-4 LEL of Methane (Yellow) Versus Maximum Allowable Limit with Industry Safety Factor (Green)

ACTIVITY

What is the maximum allowable concentration in Alberta for methanol which has an LEL of 6 per cent?

Flash Fires

When vapour levels approach the LEL, a flash fire becomes a major risk.

Flash fires are different from normal fires such as a campfire. They are sudden, intense fires caused by ignition of flammable substances in air and may only last a few seconds. Once they consume the fuel in the air, they have no remaining source of fuel and the fire dies out.

For oil and gas workers, flash fires create very different hazards than those faced by a firefighter responding to a house fire.

The flame-resistant (FR) clothing worn by oil and gas workers will minimize burns from a short flash fire to covered areas but are completely inadequate for a sustained fire with a persistent fuel source. In contrast, non-flame-resistant work clothes exposed to a flash fire can act as fuel, ignite and will continue to burn even after the source of ignition has been removed.

Warning:
When wearing flame resistant clothing, the clothing layers underneath should be made of natural materials. Synthetic materials can melt when exposed to heat without being directly exposed to flame.

PHYSICAL STATES OF FUELS

Flammable substances are divided into four physical states:

- Solids
- Liquids
- Vapours
- Gases

Solids

Solids come in many forms with some being more flammable than others. Some common examples of solid flammables you may find in an industrial workplace are wood, iron sulphide, dust, magnesium, oily rags and phosphorous.

When solids are heated in a fire (or in any situation) they begin to decompose and produce flammable gases and vapours (pyrolysis). When enough gases and vapours are produced, you can have sustained combustion where the vapours provide fuel for the fire and the fire, in turn, heats the solid. The result is a fire that grows until there is no more fuel.

The by-product of this process is smoke, which is far more dangerous than the fire itself. Smoke is made up of products of incomplete combustion that can be toxic if inhaled. An example is hydrochloric acid, which is one toxic substance created from incomplete combustion of plastic products.

Warning:
Smoke is a fuel and is always potentially flammable. Wear personal protective equipment (PPE) and respiratory protection equipment (RPE) any time you work around smoke.

Liquids

Flammable liquids give off vapours that can easily be ignited at normal working temperatures.

Flammable liquids include hydrocarbons such as crude, diesel, gasoline, petroleum solvents and other distillates and are found throughout the oil and gas industry.

An important characteristic of any flammable liquid is its flashpoint. The flashpoint of a liquid is the lowest temperature at which the liquid gives off enough vapour to be ignited (start burning) at the surface of the liquid.

The lower the flash point of a liquid, the easier it is to ignite and the greater the fire hazard.

Gasoline's flash point is -46C, which means that even on a cold day, gasoline will give off vapours that will ignite when exposed to an ignition source such as a spark or flame. Phenol is another liquid, but it has a high flash point — at plus 79C — so it must be heated above that temperature before it can be ignited in air.

Any liquid with a flash point between 37.8C and 93.3C is considered combustible.

Vapours

Flammable vapours come from solids or liquids that are giving off vapours (evaporating). All liquids and solids will vapourize. The hazardous ones readily vapourize at normal working temperatures (e.g., gasoline). Less volatile, "safer" products only vapourize at higher temperatures (e.g., diesel fuel).

Vapours will spread out, mix with air and other vapours and fill all available space. Thus, any source of vapours will create a hazard that extends beyond its source.

If the vapour is heavier than air, it will settle and concentrate in low-lying areas. There, the vapour can form a combustible mixture even when the source itself is well below LEL. Vapours can also travel along the ground to a source of ignition and "flash back" to where they originated. A good example of this is propane.

Note:
Solids and liquids do not burn in their original physical state! It is the vapour from a solid or liquid that burns.

Gases

The difference between a gas and a vapour is that vapours come from solids and liquids and gases are normally in a gaseous state.

Some of the flammable gases found in the oil and gas industry include:

- Methane CH_4
- Ethane C_2H_6
- Propane C_3H_8
- Butane C_4H_{10} and
- Contaminant gases such as hydrogen sulfide (H_2S).

These gases are difficult for the human senses to detect because they are colourless, tasteless and, with the exception of H_2S at low levels, they are odourless.

However, in some circumstances, a chemical with a strong unpleasant odour (mercaptan) may be added to hydrocarbon gases so people can detect its presence. This process is known in the industry as stenching (odourizing). Even when stenching occurs, our human senses cannot be relied upon to provide reliable information on the flammability of a substance. The only reliable way to detect flammable gases is with a combustible gas monitor used by a trained and knowledgeable worker.

Figure 1-5 Gas Monitor in Use

Depending on the density, gases can be lighter or heavier than air. When they are heavier than air, gases and vapours will settle and pool in low-lying areas. When they are lighter than air, they will rise and can be trapped in spaces above the work space.

CLASS DISCUSSION

Provide examples of flammable solids, liquids, vapours and gases and their properties. Focus on examples that could commonly be found in the oil and gas industry.

HEAT TRANSFER

Around a campfire, you feel heat. And if you place a piece of paper too close to the fire, it will start to burn even though it never actually touches the fire. How does this happen? What exactly is heat?

Heat energy is the result of the movement of atoms and molecules in solids, liquids and gases. The more movement, the more heat. If you add heat, the temperature increases. Take it away and the temperature falls.

Sometimes a change in heat leads to a change in the physical state of the object. For example, a cooling liquid may become a solid or a warming liquid may become a gas.

Heat energy can be transferred from one object to another using one of **only** three methods.

1. Conduction
2. Convection
3. Radiation

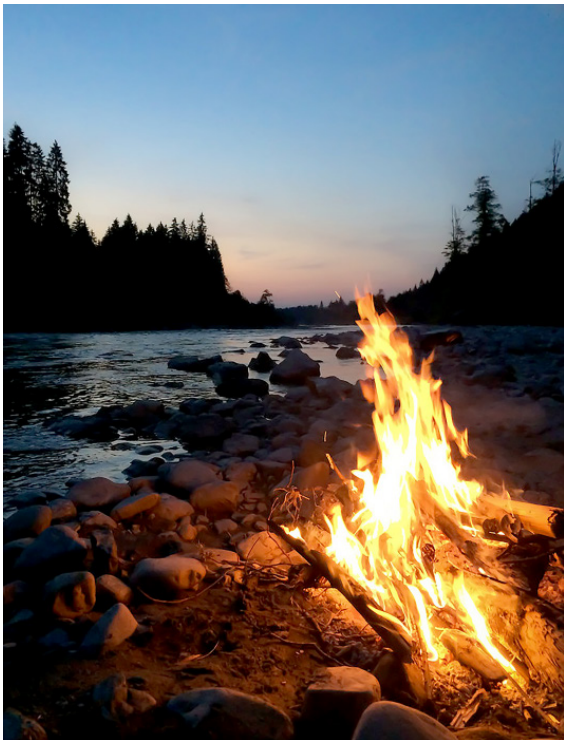


Figure 1-6 Campfire

Conduction

Conduction is the transfer of heat between substances that are in direct contact with each other. The better the conductor, the more rapidly heat will be transferred. For example, metal is a good conductor of heat.

Conduction happens when a substance is heated, the molecules gain more energy and vibrate more. These molecules then bump into nearby molecules and transfer some of their energy to them. This continues and passes the energy from the hot end down to the colder end of the substance.

An example of conduction is a metal poker. If you keep the poker in the fire, the heat can move up the poker to your hand.

Convection

Convection is heat transfer by the mass motion of a substance such as air or water when it moves away from the source of heat, carrying energy with it. Hot air rising from a fire is an example of convection.

Convection can also affect solid objects. For example, a hot mass of air that moves close to a solid object will warm it. Over time, the solid will reach the same temperature as the hot air.

Radiation

Both conduction and convection require matter to transfer heat. Radiation does not.

Radiation happens when heat moves as thermal radiation directly from its source to something else. The heat you feel from the sun light is an example of thermal radiation. Thermal radiation will travel in all directions until it meets a solid.

For example, we feel the heat from the campfire even though we are not touching it (no conduction), and the wind may be at our back (no convection). The hotter the object is, the more radiation it emits.

Definition: Thermal Radiation
Thermal radiation is the transmission of energy as an electromagnetic wave without an intervening medium. The radiation is created by the motion of atoms.

When explosions occur due to gas or vapour build-up such as a flash fire, people are often burned due to combination of convection and thermal radiation.

ACTIVITY

» Take a look at the image below and discuss how heat may be transferred to create a fire hazard.

» Give examples of each method of heat transfer from your worksite or home.

Figure 1-7 Heat Source in an Industrial Setting

Conduction

Convection

Radiation

FIRE HAZARDS IN THE OIL AND GAS INDUSTRY

When it comes to fire risk in the oil and gas industry, two things stand out:

1. The presence of hydrocarbons.
2. The presence of possible ignition sources.

Combine the two in the presence of air and you have all you need for combustion.

Presence of Hydrocarbons

If you work in the field in this industry, no matter where you are or what you do, you will likely be working around petroleum products that can combust easily or have the potential to explode.

All refined petroleum products derived from crude oil produce vapour that, when mixed with air, creates the potential for an explosive atmosphere. Working in the Oilsands, for example, you will likely encounter flammable products such as methane, naptha, amine, hydrogen, sulphur dioxide, hydrogen sulphide and natural gas.

If vapour levels ever reach the flammable range and encounter even a tiny ignition source, the result can mean serious injury to people and/or damage to property, shutting down operations.

An important message for anyone working in a hydrocarbon environment, is to always respect the potential risk associated with products you are handling and working around. There are many examples of tragic events related to incidents at refineries, petrochemical plants and petroleum storage facilities.

Figure 1-8 Example of Major Damage Caused by Fire and Explosion

What is a Hydrocarbon?

Hydrocarbons are organic chemical compounds composed only of the elements carbon and hydrogen. Hydrocarbons are the principal constituents of petroleum and natural gas. Hydrocarbons are used as fuel and lubricants and as raw materials to make plastics, fibres, rubbers, solvents, explosives and industrial chemicals.

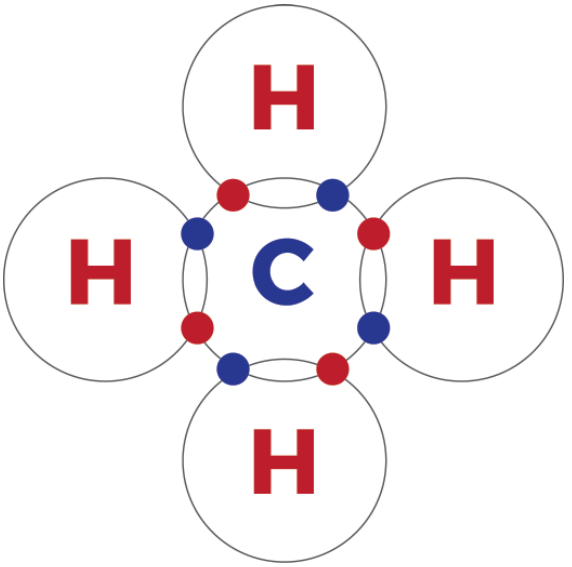


Figure 1-9 Example of a Hydrocarbon Molecule (Methane)

Possible Ignition Sources

When you combine enough flammable vapours with air, all you need is an ignition source to start combustion. In the oil and gas industry, ignition sources are common and must be identified and controlled. Maintenance activities create opportunities where tools and equipment can elevate the risk of an incident involving fire or explosion.

Among main causes of fires in the industry are sparks from electricity and open flames which nearly always carry enough energy to ignite a flammable atmosphere. But they are not the only possible ignition sources.

Figure 1-10 Red-Hot Metal

Examples of ignition sources:

- "Hot Work" such as cutting, welding, burning, air gouging, riveting, drilling, grinding and chipping
- Open flames from any source
- Heat (e.g., hot surfaces)
- Electric arcs
- Static electricity (e.g., when liquids are filtered, sprayed, pumped, mixed or flow through pipes, static electricity can be generated)
- Hot surfaces
- Friction and mechanical sparks
- Chemical action and sparks
- Spontaneous combustion
- Pyrophoric metals – for example, iron sulphide from corrosion
- Pressure or compression ignition (Dieselling)
- Sudden decompression – results in the sudden movement of hydrocarbons, potentially causing a build-up of static electricity
- Reactions – for example, those involving chemicals used to fracture wells
- Cigarettes or smoking
- Electric power tools and switches
- Two-way radios
- Vehicles with catalytic converters
- Portable generators
- Thawing frozen valves, hoses and lines

Using Intrinsically Safe Equipment

Intrinsically safe equipment limits the amount of energy coming from the device. At these low levels, the device can't ignite a flammable vapour. Approved lights and meters are examples of equipment that are available in certified intrinsically safe models.

Industrial petroleum facilities and refineries are required to follow strict standards when conducting high-risk work. Depending on the hazardous (classified) locations, it is likely the use of intrinsically safe equipment will be required.

Figure 1-11 Sparks at an Oil and Gas Facility

Thinking only in terms of a spark or open flame is dangerous and ignores the other energy sources that are also able to start a fire or explosion.

Keeping in mind the three ways of heat transfer, the Spark Watch must be aware of any possible ignition source and not simply the obvious open flames and sparks. For example, a simple static electricity spark you would not even be able to feel can release enough energy to ignite a flammable atmosphere. Or a piece of metal being heated indirectly could ignite a flammable atmosphere.

EXERCISE

1. What are the two types of combustion?

2. Label the fire tetrahedron.

3. Relying on the fire tetrahedron, what are the four ways to put out a fire?

4. Label the LEL, UEL and maximum allowable concentration of this example.

5. What are the three types of heat transfer?

6. List flammable materials in your workplace or home and list two possible ignition sources for that material.

Flammable Materials

Ignition Sources

CHAPTER 2:

Fire Prevention

OUTCOME

Describe the preferred methods to control the potential for fire and spark migration using the hierarchy of controls.

OBJECTIVES

The student will:

1. List the methods used to control hazards from most effective to least effective.
2. Provide examples of each method of hazard control.

HIERARCHY OF CONTROLS

In all areas of industrial safety, a hierarchy of controls is traditionally used to implement feasible and effective controls. The figure below identifies the different controls, starting with the most effective and protective systems at the top through to the least effective at the bottom.

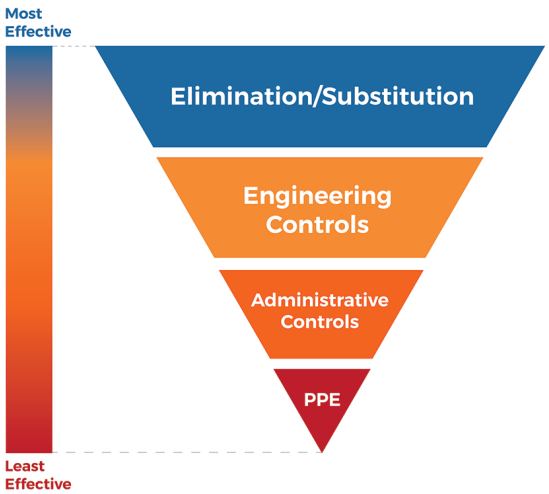


Figure 2-1 Hierarchy of Controls

Elimination or Substitution

The best control is to eliminate the hazard completely or substitute the equipment or work activity with a safer alternative.

Examples of Elimination Controls for Fire Hazards

- Instead of a torch, use a hydraulic cutter
- Conduct the work in a safe location where there are no flammable materials

Engineering Controls

If it is not possible to eliminate or substitute the hazard with a safer alternative, engineering controls should be considered.

Engineering controls involve installing or modifying facilities and equipment in order to control the hazard at its source. This is typically done during the design of a worksite or process but can be implemented at an existing operation.

Examples of Engineering Controls for Fire Hazards

- Provide spark arrestors for internal-combustion engines.
- Use fire retardant materials such as fire blankets or onion skin tarps to build a hoarding around the hot work to contain the sparks.
- Grounding and bonding
- Use intrinsically safe tools, lighting and ventilation equipment.

Administrative Controls

Administrative controls focus on the work process and the worker. They control the hazard by managing how the work is performed and are often used in conjunction with other types of controls.

Examples of Administrative Controls for Fire Hazards

- Training
- Hazard assessments, Hot Work permits, Field Level Hazard Assessments, etc.
- Standard work procedures
- Use of signage to direct workers or warn of hazards
- Rules that prohibit vehicles with catalytic converters from the immediate vicinity
- Rules that prohibit open flame or presence of matches or lighters in the workplace.

Personal Protective Equipment (PPE)

PPE is commonly required and issued to workers in industrial settings. It is the employer's responsibility to ensure all potential hazards are identified before setting rules on what PPE is to be worn. As well, the employer must ensure workers are educated in the use, care and maintenance of their PPE and there is a process in place to ensure workers wear or use their PPE.

Examples of PPE Controls for Fire Hazards

- CSA approved fire resistant clothing, safety glasses, footwear, gloves, etc.

EXERCISE

In small groups, identify the hazards and controls that you see in each picture shown by your instructor. Then list three examples of each type of control that might be used at your worksite to reduce the risk of fire.

CHAPTER 3:

Working In Hot Work Areas

OUTCOME

Explain the role of the Spark Watch before, during and after Hot Work.

OBJECTIVES

The student will:

1. Explain activities and tasks within the role of the Spark Watch:
   - » During pre-site work
   - » During pre-task work
   - » During the task
   - » When closing out the task.

DUTIES OF THE SPARK WATCH

The main duty of a Spark Watch is to monitor for sparks or other ignition sources and **stop** hot work when a new hazard develops or when a known hazard presents a risk of exceeding the controls in place.

To do this effectively, the Spark Watch must be aware of the hazards and controls on the worksite, stay vigilant and communicate with the team and superiors before, during and after hot work.

Figure 3-1 Spark Watch at Work

HOT WORK

Working with ignition sources near flammable and combustible materials is called “hot work.”

Hot work may involve burning, welding, cutting, brazing, soldering, grinding, using fire- or spark-producing tools or other work that produces a source of ignition. Welding and cutting operations are common to all areas of work in the oil and gas Industry.

Whether work will be treated as hot work depends on a detailed analysis by operations personnel. Only competent personnel, such as supervisors or operations managers, will have the authority to classify hot work.

Even when you are working in an area that is not strictly a hot work area according to the definition, your employer may decide to treat the work as hot work to ensure safety.

REGULATORY REQUIREMENTS FOR HOT WORK

Once work has been identified as hot work, strict regulations apply. Regulatory requirements differ from province to province. Take the time to review the regulations for your jurisdiction. Don’t assume. Be aware.

Alberta regulations require the employer to ensure that hot work is not begun until:

» a hot work permit is issued,

» the work location is clearly or suitably isolated from combustible materials,

» procedures have been implemented to ensure continuous safe performance of the hot work

» and testing shows that the atmosphere does not contain

- a flammable substance in a mixture with air, in an amount exceeding 20 per cent of that substance’s lower explosive limit
- or exceed the minimum ignitable concentration for dust.

Alberta OHS Code, 2020, Part 10, 169(2)

Managing the Worksite

The employer is also required to have safe work practices and procedures and take precautionary measures to ensure that flammable substances that are stored, handled, processed or present at a work site will not be exposed to an unintended ignition source.

One of the most important controls to prevent an incident is the Spark Watch role. The Spark Watch is involved with many of the stages between planning for Hot Work and closing out the task.

HOT WORK PERMITS

The Spark Watch will probably not be involved with the pre-site work. But they will review and work with the Hot Work Permit. Hot Work Permits are a type of Safe Work Permit designed specifically for hot work with added detail related to hot work hazards. Hot Work Permits replace Safe Work Permits, so you will not get one of each.

Hot Work Permits are written records that authorize specific work at a specific work location for a specific time period. Permits are used for controlling and co-ordinating work to establish and maintain safe working conditions. They ensure all foreseeable hazards have been considered and that the appropriate precautions and controls are defined and carried out in the correct sequence.

Generally, companies have an office for issuing permits with designated staff who are competent in the development of the permits. Several stakeholders will work together to write the permit and ensure the information is accurate.

At the worksite, a designated company representative, such as a lead operator or supervisor, will have the final say on whether the permit is valid and can veto it if they feel hazard identification or controls were inadequate or insufficient to manage the hazards associated with the task.

The Spark Watch and the entire crew will **always** review the permit before work begins in at **least** one safety meeting. Everyone must read the permit, completely understand the content, the reasons for the permit, and the requirements of the permit before work begins.

If you have any questions about the permit, ask them in the safety meeting before work begins. It is critical that everyone on the team understands the conditions in the permit. If any one team member seems to be confused or is worried about the contents of the permit, you must clarify before you proceed.

Key Point:
The Hot Work Permit helps to identify and control hazards but does not, by itself, make the job safe.

Hot Work Permit Sample

You can usually tell immediately if a safe work permit is a hot work permit. They are often printed on pink or red paper or the content is outlined in red (see example on the next page).

CLASS DISCUSSION

Looking at the Safe Work Permit, discuss what information the Hot Work Permit requires specifically related to the hot work hazards.

SAFE WORK PERMIT FOR HOT WORK
NO WORK IS ALLOWED EXCEPT THAT WHICH IS SHOWN ON THE PERMIT

DATE OF ISSUE _____ TIME OF ISSUE _____ EXPIRES _____
LOCATION OF WORK _____
DEPARTMENT DOING WORK _____
DESCRIPTION OF WORK TO BE DONE _____

NAME MATERIALS ONLY TOXIC _____ CORROSIVE _____
FLAMMABLE _____ OTHER _____

	N/A	NO	YES
(1) Has an inspection been made of the unit/equipment to be worked on?			
(2) Where inspected, was it found to be free of the above materials?			
(3) Is an adequate supply of fresh air assured?			
(4) Do unit and atmospheric conditions permit safe work?			
(5) Equipment has been cleaned by (Specify) _____			
(6) The necessary equipment has been adequately protected by (Specify) _____			
(7) Have electrical switches been locked out and tagged? Signature for Process: _____ Electrical: _____ Mechanical: _____ Other: _____			
(8) Have combustible waste materials been removed from the area?			
(9) Have nearby sewers been properly protected?			
(10) Is fire protection required? (Specify)			
(11) (a) May underground obstructions be encountered? (b) May underground or overhead electrical power lines be encountered? (c) Signature of electrical supervisor or designate: _____			
(12) Have precautions been taken against radioactive sources?			
(13) Is permit receiver aware of material safety data sheets pertaining to this job?			
(14) Is there a need to review a special procedure such as handling asbestos, pyrophoric materials, confined space entry, Hydrofluoric Acid Area, etc.?			
(15) Are gas tests required during the job?			
(16) Has the confined space or vessel been prepared for safe entry and entry signs installed?			
(17) Is it permissible to use (a) Electrical equipment? (b) Diesel, gasoline & propane driven equipment?			
(18) Is welding permitted?			

TYPES OF GAS TESTS REQUIRED & RESULTS OBTAINED (Check Where Required)
I examined the above equipment at _____ AM/PM & observed the reading to be :
Combustible: _____% Hydrogen Sulphide: _____ ppm Oxygen: _____ % Other: (Name): _____ ppm
Gas Tester's Signature: _____

What additional protective equipment is required? (Specify) _____

PRECAUTIONS TO BE FOLLOWED OTHER THAN THOSE LISTED ABOVE

AGREEMENT: I HAVE CHECKED BOTH THE PERMIT AND THE JOB. I UNDERSTAND THE NATURE AND EXTENT OF THE WORK AND THE PRECAUTIONS TO BE FOLLOWED IN COMPLETING THE WORK.

Permit Issued by: _____ Job Title: _____ Time: _____
Received by: _____ Job Title: _____ Time: _____

Permit Sign Off
Work Complete: _____ Job Title: _____ Time: _____
For Permit Issuer: _____ Job Title: _____ Time: _____
Work Not Complete: _____ Job Title: _____ Time: _____

All Safe Work Permits must be signed by both the Permit Receiver and Permit Issuer before work is started and after it is completed.

Permit No:

Figure 3-3 Blank Hot Work Permit

SITE-SPECIFIC HAZARD ASSESSMENT

Along with the Hot Work Permit, the Spark Watch and the team will read, discuss and ensure understanding of the Site-Specific Hazard Assessment contents and take part in at least one safety meeting before work begins.

The Site-Specific Hazard Assessment identifies hazards and controls specific to the site rather than generic hazards. The Site-Specific Hazard Assessment may identify flammable materials in the work area, poor lighting, ergonomic issues or weather conditions at the site that could create a hazard.

Reviewing and adding information to the Site-Specific Hazard Assessment involves everyone on the team and is done at the site of the work. Generally, a supervisor or lead will facilitate the Site-Specific Hazard Assessment discussion. However, an experienced worker may be designated.

At a minimum, Site-Specific Hazard Assessments must identify:

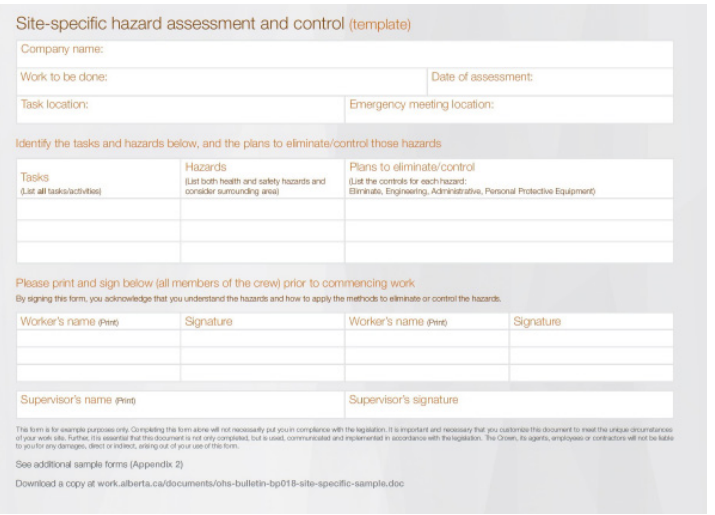
- Hazards associated with task activities as they are conducted for a specific worksite
- Hazards associated with the surrounding work environment
- Plans to eliminate or control identified hazards or potentially emerging hazards
- Conflicts that may arise during task completion due to neighbouring work
- Information on the tasks, key names, date-time and location
- Names of reviewers and person(s) responsible to carry out actions prior to work beginning, if required

The Site-Specific Hazard Assessment is not a static document. It is a living document that must be changed if the Spark Watch or the team sees a new hazard that was not accounted for. Once a new hazard has been identified, the control used to mitigate it must be recorded in the Site-Specific Hazard Assessment.

As living documents, Site-Specific Hazard Assessments are only effective if they are up-to-date and specific to the worksite where the workers are performing the tasks. The Spark Watch and the team must take the time to review the site of the work and its surrounding area before any work begins, **while** the work is ongoing and **after** the work is finished.

It is critical that any newly discovered hazards recorded on the Site-Specific Hazard Assessment are shared with all relevant staff. Each company will have its own process should a Site-Specific Hazard Assessment need updating during completion of tasks. Often company staff or contractors must have a company representative sign off on any changes to Site-Specific Hazard Assessments.

Note:
Site-specific Hazard Assessments are often called a Field Level Risk Assessment (FLRA) or a Field Level Hazard Assessment (FLHA).



Site-specific hazard assessment and control (template)

Company name:

Work to be done: | Date of assessment:

Task location: | Emergency meeting location:

Identify the tasks and hazards below, and the plans to eliminate/control those hazards

Tasks (List all tasks/activities)	Hazards (List both health and safety hazards and consider surrounding area)	Plans to eliminate/control (List the controls for each hazard: Eliminate, Engineering, Administrative, Personal Protective Equipment)

Please print and sign below (all members of the crew) prior to commencing work

By signing this form, you acknowledge that you understand the hazards and how to apply the methods to eliminate or control the hazards.

Worker's name (Print)	Signature	Worker's name (Print)	Signature

Supervisor's name (Print) | Supervisor's signature

This form is for example purposes only. Completing this form alone will not necessarily put you in compliance with the legislation. It is important and necessary that you customize this document to meet the unique circumstances of your work site. Further, it is essential that this document is not only completed, but is used, communicated and implemented in accordance with the legislation. The Crown, its agents, employees or contractors will not be liable to you for any damages, direct or indirect, arising out of your use of this form.

See additional sample forms (Appendix 2)

Download a copy at work.alberta.ca/documents/ohs-bulletin-bp018-site-specific-sample.doc

Figure 3-4 Example of a Blank Site-Specific Hazard Assessment

ACTIVITY

In groups of 3-5, take a look at the photo below and identify hazards that should be in the Site-specific Hazard Assessment or the permit.

CONTROLLING HOT WORK HAZARDS IN STAGES

Every company will operate differently and probably use different terms, but generally, the control of hot work hazards divides into four stages:

1. Pre-site Work (activities that happen before any hot work begins)
2. Pre-task Work (activities that happen on-site just before hot work begins)
3. During the Task Work (activities that happen while the work is conducted)
4. Post-task Work (activities that happen after the hot work is finished)

1. PRE-SITE WORK

Before any work begins, company representatives responsible for planning work must ensure adequate controls are in place to carry out the tasks safely. Operations staff may assign their own staff or contractors to carry out prep work prior to hot work being initiated.

Due to the high risk and complexity of hot work in hydrocarbon environments, companies have detailed processes for carrying out tasks in a working plant.

A variety of controls may be used to support a safe workplace including:

- Reviewing a detailed work plan for the tasks to be completed
- Determining whether hot work is necessary in the first place
- Assessing whether other less hazardous options could be used, such as substitution of hydraulic shears instead of using a cutting torch
- Confirming workers to be dispatched are oriented and properly trained for their roles
- Establishing a fire and explosion hazard management process that includes hazard and risk assessment, planning and confirmation of site controls and plans for operational completion of tasks
- Ensuring the hazard management plan has been communicated to those who need to know
- Ensuring the hazard management plan has a provision for a site-specific component
- Writing a hot work permit

Looking at the list above, you can see a lot happens well before the Spark Watch gets to the site and a lot of work goes into identifying the hazards and controls before work begins. Much of this information will be passed on to the Spark Watch and the team in the Hot Work Permit.

2. PRE-TASK WORK

Before any hot work begins, the Spark Watch and the team will review the Hot Work Permit issued to them, complete a Site-Specific Hazard Assessment and conduct at least one safety meeting.

Use these meetings well! Safety meetings offer an opportunity to talk face-to-face with your team and supervisors.

Figure 3-2 Safety Meeting

Communication

Once the Spark Watch and the team reach the site, the rule is communicate, communicate and communicate some more!

What does that look like? Be engaged. Listen with purpose. Ask concise questions. Get clarification and confirmation to questions asked.

As part of a team, everyone has responsibilities to:

- review and understand the conditions of the permit,
- be aware of the hazards listed in the Site-Specific Hazard Assessment,
- familiarize themselves with their surroundings
- and be mindful of any changes to their working environment that could create a hazard.

This helps ensure everyone on the team is on the same page and stays on the same page throughout the operation. All members on the team must understand exactly what is happening and why, and if something comes up that seems out of the ordinary, always report it.

Remember, all questions are welcome and should be considered when it comes to the safety of workers or the safe operation of a facility. An open trusting culture leads to a better understanding of the hazards for everyone.

Note:
Communicate! Communicate! Communicate!

Always verify that the air monitoring device is calibrated according to the manufacturer's specifications and there is sufficient battery power to complete the shift.

Figure 3-5 Always Ensure Radios and Gas Detectors are Charged and Have Backup Batteries

Pre-Task Duties

Just prior to work beginning at the site, the Spark Watch will have to do the following:

- Survey all parts of the area, looking for any hazard not identified in the permits and the Site-Specific Hazard Assessment. If the Spark Watch identifies a hazard they feel cannot be controlled sufficiently, they need to contact a supervisor. It is important to check everything in all directions: **Above, Below, Behind and Inside (ABBI)**
- Participate in at least one safety meeting during which the entire team will review, discuss, and completely understand the permit, emergency plans and the Site-Specific Hazard Assessment. Any new hazards identified by the team must be added to the Site-Specific Hazard Assessment, and controls must be put in place. If the Spark Watch identifies a hazard they feel cannot be controlled sufficiently, they need to contact a supervisor.
- Clarify with the entire team when, how and under what conditions work will stop or the emergency plan will be activated. Make sure you know how the chain of command is structured.
- Complete any checklists required by the employer. Confirm with craft persons where the shutoffs are for powered equipment (welders) or shutoffs for compressed gas bottles.
- A gas test must be taken before any hot work is performed and must be repeated at regular intervals appropriate to the hazards involved.
- If a restricted zone is required by the permit, mark it off with signage, pylons and tape, as necessary. The team must have control and custody of the hot work areas. The restricted zone for hot work is often called the hot zone.
- Confirm nearby teams know what you are doing, and check to see if their work may affect your team's hot work. If there is conflicting work nearby, go to the supervisor.
- Establish and confirm communications with the team members (radio check, etc.)

Prior to beginning work at the site:

- Make sure the work area is neat and tidy.
- Sewers, ducts and drains may contain flammable vapours. If any are near the point of hot work, refer to Site-Specific Hazard Assessments and follow company procedures to make the area safe. This may include, ensuring an impervious material is in place to prevent sparks from entering.
- Clarify where the Spark Watch will be located during work.
- Make sure the equipment is readily available, working and in a usable position.
- Identify and mitigate any hazards as much as possible. Combustible materials must be protected from ignition by relocating, and/or shielding (e.g., using blankets as hoarding).

HOT WORK STANDARD
WORKSITE PREPARATION CHECKLIST

Prior to starting any high energy hot work, the Permit Issuer (PI) and Permit Receiver (PR) must complete this checklist together at the worksite.

Safe Work Permit #: _____			PI Initials	PR Initials
1.	Are all flammable liquids and materials removed or suitably isolated from the work area? (including above and below work area). Have fluids been sampled to determine flammable hydrocarbon presence?	☐ Yes ☐ N/A	PI Initials	PR Initials
2.	Are all containers, within the work site area, closed, sealed, or removed?	☐ Yes ☐ N/A	PI Initials	PR Initials
3.	Are manholes, catch basins, drains, sumps and other sewer connections covered using fire retardant materials and sealed?	☐ Yes ☐ N/A	PI Initials	PR Initials
4.	If welding, cutting, or grinding is being conducted, has a curtain or barrier been erected to contain spark and shield equipment and personnel?	☐ Yes ☐ N/A	PI Initials	PR Initials
5.	Where possible, are welding machines or gas cylinders located outside the hot work area?	☐ Yes ☐ N/A	PI Initials	PR Initials
6.	Has the Permit Receiver or designate checked that welding equipment is in good condition? Splices or joints in cables must be properly made, insulated, and inspected. Inspect the connections to cylinders.	☐ Yes ☐ N/A	PI Initials	PR Initials
7.	If working with pipe pilings, have they been covered, sealed, and atmospheric tested?	☐ Yes ☐ N/A	PI Initials	PR Initials
8.	Are all walkways, ladders and other approaches to and from the area accessible and free from obstruction? (safe routing of cables and cords)	☐ Yes ☐ N/A	PI Initials	PR Initials
9.	Has the Fire Watch ensured that fire extinguishers, personal protective equipment and rescue equipment in the work area are in good condition, operating correctly and are readily available to the Fire Watch?	☐ Yes ☐ N/A	PI Initials	PR Initials
10.	Fire Watch Name - Print Here:_____	☐ Yes ☐ N/A	PI Initials	PR Initials
11.	The Fire Watch must stay at the work site one hour after the last spark. Time of last spark___:___ Fire Watch initial:_____	☐ Yes ☐ N/A	PI Initials	PR Initials
12.	Has the area control room operator been contacted?	☐ Yes ☐ N/A	PI	PR

Figure 3-6 Example of a Pre-Work Checklist

Blankets

As always, preventing a fire in the first place is far better than putting one out. When flammable items can't be removed from the area, cover them with a fire-resistant material such as a fire blanket.

Fire blankets are made from two layers of woven glass fibre fabric and an inner layer of fire-retardant film. They work by cutting off the oxygen supply to an occurring fire or by preventing an ignition source from reaching an area where there are flammable materials.

A lot of welding fires start after hot material gets lodged in small cracks, crevices or holes. When these are present in the area, they need to be covered with a fireproof material, such as a welding blanket or fire blanket. By preventing sparks from lodging in these little spaces, we reduce the chances of an out-of-control welding fire.

In the images below, you can see how a team put controls in place to mitigate the hazards at a site before the work begins.

Figure 3-7 Fire Blankets Used to Protect Flammable Materials

Figure 3-8 Site with No Controls

Figure 3-9 Blankets

Figure 3-10 Introducing Signage

Figure 3-11 Example of Hoarding Used to Enclose a Welding Site

Important!
Remove all flammables! The box of rags is no joke. It is the most common source of fires.

Questions to Ask

Asking questions is part of the Spark Watch's job. You need to be comfortable and confident that you and your entire team fully understand the situation, the work to be completed and what happens if something goes wrong. The safety meeting is an ideal time to ask questions, but do not hesitate to ask questions at any time.

Here are some questions a Spark Watch might need to ask if not addressed at the kick-off meeting or they are not sure of:

- **What is the evacuation route? Where are the assembly areas (muster points) located? What is being used to warn of an emergency?**
- **What is the wind direction? (That will determine where you go if there is an evacuation.)**
- **Where is the kill switch or power shut-off switch? Be clear on how to shut off equipment in case of evacuation.**
- **Can I review the hot work permit?**
- **Who do you contact and what do you do if something happens outside the permit's requirements? And under what conditions?**
- **Where should the Spark Watch be located when performing fire watch duties? Make sure you can observe as much as possible and can communicate with the team.**
- **Did you verify the method of communication?**
- **Where is the Emergency shower, first-aid kits, eye-wash stations, etc.?**

Your role is important!! And asking questions is part of the job!

Fear of Reprisal

Often a new worker at a job site is reluctant to speak up when issues of safety arise. It cannot be stressed enough that Spark Watch personnel must be confident to address safety issues promptly.

Hot work is often expensive work, but Spark Watch personnel should never hold back from stopping work when a new hazard is identified. There will be no reprisals for ensuring a safe job.

Our work is never so important that we won't stop for safety.

3. DURING THE TASK WORK

While the work detailed in the permit is conducted, the main duty of a Spark Watch is to monitor for sparks or other ignitions sources and respond appropriately to mitigate a hazard (e.g., stop work). To do the job well requires three things:

1. Be aware of the situation around you (situational awareness).
2. Stay in communication with your team and neighbouring teams.
3. Respond appropriately according to the Site-Specific Hazard Assessment and the permit.

Be aware of the situation around you

To make good decisions, the Spark Watch has to know what is going on around them at all times. The Spark Watch must use their senses, training, the Site-Specific Hazard Assessment, the permit and their industry and personal experience to recognize when a new hazard has been introduced.

The Spark Watch should maintain a line of sight with the hot work as much as possible and never forget the importance of smell. Often it is the smell coming from your hoarding that is the first clue something is different.

Staying vigilant and not giving in to complacency and boredom are not optional for a Spark Watch. They are essential parts of your job. Being fit for duty is another essential part of the job. Come to work well rested and focused on your task and responsibilities.

Situational awareness includes air monitoring and recording the levels as required by the Site-Specific Hazard Assessment.

Figure 3-12 Portable Air Monitor

Stay in communication with your team and neighbouring teams

The Spark Watch must always stay in communication with the team to ensure everyone is aware of what is going on. The key to communication is being clear about what you are trying to say and confirming the other person understands. Communication is a two-way process. Both parties are responsible for ensuring the message received is accurate, understood and effective.

Remember, the person performing the work will be focused on their job and may not be able to see as much, hear as much or even smell as much as the Spark Watch. A welder who is performing tasks has hearing and vision limitations due to PPE, while the Spark Watch can see the entire work area.

Always remain within communication range of the person(s) performing the hot work, and if sparks migrate out of the controlled area or a fire occurs, tell the team to cease all hot work immediately and inform your supervisor according to the chain of command.

Respond appropriately according to the Site-Specific Hazard Assessment

When any new hazard is identified, the Spark Watch must stop the work, the Site-Specific Hazard Assessment must be updated and the changes reported up the chain of command.

In rare cases, the Spark Watch may be required to extinguish a fire. Using their best judgment, a Spark Watch must not exceed the capacity of the fire extinguishing equipment available. Should the Spark Watch determine the fire is not within the capacity of the equipment, the Spark Watch will implement evacuation procedures immediately.

Unexpected Emergency

In the event of a worst-case scenario where the person you are watching goes down, the Spark Watch must call for help. Always remember, don't become another casualty, keep yourself safe and get qualified First Responders in as fast as possible to do the job they were trained to do.

Important!
Always stop work if the permit's conditions are exceeded! And always follow the Site-Specific Hazard Assessment.

Emergency Evacuation

In case of an emergency, your first job is to report and communicate it using the methods in your emergency response plan (ERP). That may require sounding an alarm or radioing the supervisor. Always remember to contact your teammates! Particularly if they are in a noisy environment.

As part of your plan, you may be required to shut down equipment. Leaving equipment on is potentially dangerous and could make a bad situation much worse. Before work begins, take a mental inventory of where equipment is located.

Note:
Always remember, your priority is getting yourself to safety. Emergency responders are trained for their job. Let them do it. In an emergency, your job is to know and follow your Emergency Response Plan as laid out by the company.

4. POST-TASK WORK

Once the work has been completed, the Fire Watch must remain in the hot work area for at least 60 minutes, and sometimes longer, to detect and extinguish possible smoldering fires and continue air monitoring. This time needs to be recorded and may vary between different sites and different jurisdictions.

The Spark Watch may also be required to sign off that the site was monitored.

If there was an incident during the work period, you will be involved in gathering the information.

EXERCISE

In small groups, read the case study and discuss the activities and tasks that could have been done to help prevent the incident from happening. Record your answers below.

A worker was using a cutting torch near an open horizontal vessel that contained an unknown hydrocarbon. The substance was not considered volatile, so it was not considered to be a risk to anyone. Before work started, gas readings were taken by a worker at the opening of the vessel and it was deemed safe to perform hot-work operations.

As the work progressed, the temperature rose and vapours from the heated substance formed an explosive atmosphere with the air in the vessel. The torch ignited the vapours causing an explosion.

1. Pre-site

3. During the Task

2. Pre-task

4. Post-task

CHAPTER 4:

Fire Equipment and Response

OUTCOME

Select and demonstrate the use of a fire extinguisher for a particular class of fire.

OBJECTIVES

The student will:

1. Identify the different classes of fires.
2. Choose the correct type of extinguisher depending on the fire.
3. Describe the inspection and maintenance requirements for extinguishers.
4. Demonstrate the use of a fire extinguisher.

THE FIVE CLASSES OF FIRE

Not all fuels are the same, and if you use the wrong type of fire extinguisher on the wrong type of fuel, it can make things worse. It is therefore very important to understand the different classifications of fires caused by different types of fuel.

Class A

Class A fires involve ordinary combustibles such as textiles, wood, paper, rubber and plastics.

These ordinary combustibles can be extinguished using water, wet chemical extinguishers (e.g., water and Class A foam) and dry chemical extinguishers.

Class B

Class B fires involve liquids and gases that are flammable in nature. These can be described as but not limited to alcohol, gasoline, lubricating oils and liquefied petroleum gas.

Class B fires are extinguished using carbon dioxide extinguishers, Class B Foam (Aqueous Film Forming Foam (AFFF)) and dry chemical extinguishers.

Class C

Any fire that is plugged into a power source is considered a Class C fire. Class C fires are extinguished using monoammonium phosphate, potassium bicarbonate, potassium chloride, or sodium bicarbonate extinguishers. You never want to put a conductor such as water on a Class C fire.

Class D

Class D fires involve metals such as potassium, sodium, aluminum and magnesium.

NOTE: It takes special extinguishing agents (Metal-X, foam) to fight Class D Fires.

Class K

Class K fires involve cooking oils or fats in cooking appliances and are typically found in restaurant and cafeteria kitchens.

Class K extinguishers use wet chemicals to cover the fuel with a soapy foam, preventing the release of vapours.

TYPES OF EXTINGUISHERS

Fire extinguishers put out fire by taking away one or more elements of the fire tetrahedron. Most fire extinguishers will have a label telling you which fuels the extinguisher is designed to fight. For example, a simple water extinguisher might have a label indicating it should only be used on Class A fuels.

The proper type and number of extinguishers should be determined during the planning stages of the job preparation. You need to be aware of the extinguishers' capabilities and ensure you have the proper type and number available. Check the appropriate paperwork, and verify this during your site familiarization tour. For example, if you are working on a job where sodium is present, you will need a Type D extinguisher.

The two main types of fire extinguishers used by the Spark Watch are dry chemical ABC extinguishers and CO_2 extinguishers, but you may encounter other types of extinguishers on your worksite.

Dry Chemical

Dry chemical fire extinguishers are filled with a fine yellow powder composed mostly of monoammonium phosphate. Nitrogen is used to pressurize the extinguishers.

Dry chemical extinguishers put out fire by coating the fuel with a thin layer of dust, separating the fuel from the oxygen in the air. The powder also works to interrupt the chemical reaction of fire. Dry chemical extinguishers are extremely effective at putting out fire.

As a Spark Watch, you will usually work with ABC dry chemical extinguishers, but there are also BC extinguishers.

Class BC extinguishers handle Class B (flammable liquid) and Class C fires (energized electrical equipment) very well but not Class A fires (ordinary combustibles). If you have BC extinguishers, make sure you know which ones they are and have ABC extinguishers as well.

Dry chemical extinguishers are not advised for metal fires (D) or oil and fat fires (K)

Typical ABC Extinguisher

As a point of reference, a typical fire extinguisher you may see on site is a 20-lb. extinguisher with a 2A: 40BC rating.

The A rating is a water equivalency rating. Each A is equivalent to 1 1/4 gallons of water (4A = 5 gallons of water). The B:C rating is equivalent to the amount of square footage that the extinguisher can cover as handled by a professional. (20 B:C = 20 square feet of coverage).

This is a reference only! Do not attempt to fight a large fire. Your safety is paramount.

CO_2

Carbon Dioxide extinguishers are filled with non-flammable carbon dioxide gas under extreme pressure.

Carbon dioxide extinguishers work by displacing oxygen or taking away the oxygen element of the fire tetrahedron. The carbon dioxide is also very cold as it comes out of the extinguisher, so it cools the fuel as well. CO_2 may be ineffective at extinguishing Class A fires because they may not be able to displace enough oxygen to successfully put the fire out. Class A materials may also smoulder and re-ignite.

You can recognize a CO_2 extinguisher by its hard horn and lack of pressure gauge. The pressure in the cylinder is so great that when you use one of these extinguishers, bits of dry ice may shoot out the horn.

CO_2 cylinders are red and range in size from 5 lb. to 100 lb. or larger. In the larger sizes, the hard horn will be located on the end of a long, flexible hose.

NOTE: CO_2 extinguishers are designed for Class B and C (flammable liquid and electrical) fires only.

All CO_2 extinguishers undergo hydrostatic testing and recharge every five years.

Figure 4-1 ABC Extinguisher and CO_2 Extinguisher Side-By-Side

Specialized Extinguishers

You may need specialized extinguishers for certain jobs or hazards. Specialized extinguishers can be foam for smothering hydrocarbon fires, CO_2 for cooling and displacing oxygen or Type D extinguishers specifically for metal fires. Specialized extinguishers should be identified on your hazard assessment paperwork.

WHEN TO USE EXTINGUISHERS

Only attack a fire that is very small such as the size of a small office trash can with flames no taller than yourself. If you have any worries the fire can't be controlled, do not try.

If a fire gets out of hand while you are using a fire extinguisher, continue using the extinguisher and get out of the area without turning your back on the fire.

WHEN NOT TO USE EXTINGUISHERS

You should not use an extinguisher in the following situations:

» You don't have adequate or appropriate equipment. If you don't have the correct type or large enough extinguisher, do not fight the fire.

» You might inhale toxic smoke. If the fire is producing large amounts of smoke that you would have to breathe in order to fight it, it is best not to try. Smoke is toxic and the number one killer during a fire.

» Your instincts tell you not to. If you are uncomfortable with the situation for any reason, do not attempt to fight the fire.

» You don't have a means of escape. Always position yourself with an exit or means of escape at your back before you attempt to use an extinguisher to put out a fire. In case the extinguisher malfunctions or something unexpected happens, you need to be able to get out quickly and you don't want to become trapped.

USING EXTINGUISHERS

It's easy to remember how to use a fire extinguisher if you can remember the acronym PASS, which stands for

- **P**ull
- **A**im
- **S**queeze
- **S**weep

Pull the pin. This will allow you to discharge the extinguisher.

Aim at the base of the fire. If you aim at the flames (which is frequently the temptation), the extinguishing agent will fly right through and do no good. You want to hit the fuel.

Squeeze the top handle or lever. This depresses a button that releases the pressurized extinguishing agent in the extinguisher.

Sweep from side to side until the fire is completely out. Start using the extinguisher from a safe distance away and then move forward. Once the fire is out, keep an eye on the area in case it re-ignites.

Once the fire is out, stop discharging the extinguisher. Back away from the fire towards your egress route. Do not turn your back as the fire may flare up. Stop all work, and notify your supervisor and the proper authorities.

FIRE EQUIPMENT INSPECTION AND MAINTENANCE

Inspect fire extinguishers at least once a month (more often in severe environments).

You must ensure

- The extinguisher is not blocked by equipment, coats or other objects that could interfere with access in an emergency.
- The pressure is at the recommended level. On extinguishers equipped with a gauge, the needle should be in the green zone — not too high and not too low. This extinguisher is in need of a recharge.

Figure 4-2 Pressure Gauge

» The nozzle or other parts are not hindered in any way.
» The pin and tamper seal are intact. If they are not, the extinguisher should not be used.
» There are no dents, leaks, rust, chemical deposits and/or other signs of abuse/wear. Wipe off any corrosive chemicals, oil, gunk, etc., that may have deposited on the extinguisher.

Some manufacturers recommend shaking your dry chemical extinguishers once a month to prevent the powder from settling/packing.

Fire extinguishers should be pressure tested (a process called hydrostatic testing) after five years to ensure that the cylinder is safe to use. Consult your owner's manual, extinguisher label or the manufacturer to see when yours may need such testing.

If the extinguisher is damaged or needs recharging, replace it immediately.

Important!
Recharge all extinguishers immediately after use, regardless of how much they were used.

Inspection

An inspection is a "quick check" to give reasonable assurance that a fire extinguisher is available, fully charged and operable. The value of an inspection lies in the frequency, regularity, and thoroughness with which it is conducted. The frequency will vary from hourly to monthly, based on the needs of the situation. Inspections should always be conducted when extinguishers are initially placed in service and, thereafter, at approximately 30-day intervals.

Maintenance

Maintenance of fire extinguishers beyond a basic inspection should only be completed by a person with the proper certification as laid out by the manufacturer and in applicable fire codes.

Fire extinguishers should be maintained at regular intervals (at least once a year) or when specifically indicated by an inspection. Maintenance is a "thorough check" of the extinguisher. It is intended to give maximum assurance that an extinguisher will operate effectively and safely. It includes a thorough examination and any necessary repair, recharging or replacement. It will normally reveal the need for hydrostatic testing of an extinguisher.

Once a fire extinguisher passes its annual maintenance, it is verified with a dated tag. That tag is good for one year from the date indicated. If the unit fails to pass its annual maintenance, it must be repaired or replaced.

Figure 4-3 Tagged Extinguisher

ACTIVITY

Participants will demonstrate the safe activation, operation, and technique used to extinguish a fire using an approved simulator.

EXERCISE

1. What are the four steps to use a fire extinguisher?

2. What are the two most common types of fire extinguishers used in the oil and gas industry? What types of fires can they extinguish?

3. How often should a fire extinguisher be inspected? How often should it be maintained?

NOTES

LIFE SAVING RULES

CONFINED SPACE

Obtain authorization before entering a confined space

- I confirm energy sources are isolated
- I confirm the atmosphere has been tested and is monitored
- I check and use my breathing apparatus when required
- I confirm there is an attendant standing by
- I confirm a rescue plan is in place
- I obtain authorization to enter

WORKING AT HEIGHT

Protect yourself against a fall when working at height

- I inspect my fall protection equipment before use
- I secure tools and work materials to prevent dropped objects
- I tie off 100% to approved anchor points while outside a protected area

WORK AUTHORIZATION

Work with a valid permit when required

- I have confirmed if a permit is required
- I am authorized to perform the work
- I understand the permit
- I have confirmed that hazards are controlled and it is safe to start
- I stop and reassess if conditions change

ENERGY ISOLATION

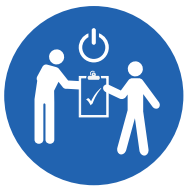
Verify isolation and zero energy before work begins

- I have identified all energy sources
- I confirm that hazardous energy sources have been isolated, locked, and tagged
- I have checked there is zero energy and tested for residual or stored energy

LINE OF FIRE

Keep yourself and others out of the line of fire

- I position myself to avoid:
  - Moving objects
  - Vehicles
  - Pressure releases
  - Dropped objects
- I establish and obey barriers and exclusion zones
- I take action to secure loose objects and report potential dropped objects



BYPASSING SAFETY CONTROLS

Obtain authorization before overriding or disabling safety controls

- I understand and use safety-critical equipment and procedures which apply to my task
- I obtain authorization before:
  - Disabling or overriding safety equipment
  - Deviating from procedures
  - Crossing a barrier

DRIVING

Follow safe driving rules

- I always wear a seatbelt
- I do not exceed the speed limit, and reduce my speed for road conditions
- I do not use phones or operate devices while driving
- I am fit, rested and fully alert while driving
- I follow journey management requirements

HOT WORK

Control flammables and ignition sources

- I identify and control ignition sources
- Before starting any hot work:
  - I confirm flammable material has been removed or isolated
  - I obtain authorization
- Before starting hot work in a hazardous area I confirm:
  - A gas test has been completed
  - Gas will be monitored continually

SAFE MECHANICAL LIFTING

Plan lifting operations and control the area

- I confirm that the equipment and load have been inspected and are fit for purpose
- I only operate equipment that I am qualified to use
- I establish and obey barriers and exclusion zones
- I never walk under a suspended load

FIT FOR DUTY

Be in a state to perform work safely

- I will be physically and mentally in a state to perform my assigned duties
- I commit to not being under the influence of alcohol or drugs
- I will inform a supervisor immediately if I or a co-worker may be unfit for work

customerservice@energysafetycanada.com
Enrolment Services and Certificate of Recognition:
1 800 667 5557

EnergySafetyCanada.com