Pipeline Construction Inspection Guide

NOTE: The numbering of the *Workers Compensation Act* has changed, effective April 6, 2020. See worksafebc.com/wca2019.

WorkSafeBC

A. Health and safety responsibilities

1 Introduction

This publication is meant to help WorkSafeBC officers, owners, employers, and workers understand the health and safety requirements related to pipeline construction work. It describes key items to consider when inspecting pipeline construction operations.

Note: This publication may not include every requirement for pipeline construction. You should always refer to the *Workers Compensation Act* and the Occupational Health and Safety Regulation to ensure you are meeting all the necessary requirements. Throughout this publication key sections of the Act and the Regulation are indicated by the headings "In the Act" and "In the Regulation."

Pipeline construction is the building of systems that transport products through a connected series of pipes. Typical products include liquids and gases, such as crude, refined petroleum, and fuels (oil, natural gas, and biofuels). Pipelines can transport any chemically stable substance.

Pipelines connect wellheads on leases to enable the transportation of raw products to production facilities. Pipelines also form a larger transportation infrastructure to transport processed or refined product to markets and shipping terminals.

The primary classification unit (CU) for pipeline construction is 721038. The initial phase of a project may also include contractors in CU 723006 (Road Construction) or CU 721031 (Excavation, or Private Landfill or Transfer Station Operation). Forestry CUs may also be employed on site.

There are three main phases of pipeline construction: pre-construction, construction, and post-construction. These phases will be described in more detail in panels B, C, and D of this publication.

Panel A will describe the health and safety responsibilities of owners, employers, prime contractors, suppliers, supervisors, and workers.

1 Introduction

In pipeline construction, the owner is the permitee authorized by the provincial or federal government to build and operate the pipeline. The type of government permit (provincial or federal) will determine jurisdiction over the owner and the owner's direct workers.

Pipelines permitted by the federal government can transport product across provincial boundaries. These are sometimes called interprovincial pipelines. They typically operate under a Federal Charter and are regulated by the National Energy Board (NEB), Human Resources and Skills Development Canada, or the Transportation Safety Board of Canada. Federal jurisdiction also applies to the owner's direct workers. Contractors may fall under provincial jurisdiction in some cases.

For more information on WorkSafeBC jurisdiction over oil and gas operations, see Guideline G-D1-108-9, which is meant to help interpret section 108 of the Act.

Inspection reports

WorkSafeBC officers who have any concerns regarding a failure of the owner to fulfill his or her responsibilities should document them in an inspection report. Give the owner a copy and forward a copy to the NEB office:

National Energy Board
517 – 10th Avenue SW

Calgary, AB T2K 0A8
Tel: 403.292.4800

Also forward the investigation report to the NEB inspector responsible for the area in which the pipeline is being constructed.

In the Act: Section 119

In the Regulation: Section 26.2

Even though **prime contractors (4)** have a responsibility to provide coordination and oversight for compliance with the Regulation, employers have a "general duty" responsibility, as specified in section 115 of the Act. The Regulation also describes specific employer responsibilities for a number of other activities.

Employer responsibilities include the following:

- Conduct risk assessments of worksites and control identified risks.
- Implement noise monitoring and hearing testing for workers.
- Develop emergency procedures and train workers in them.
- Develop helicopter emergency procedures.
- Train workers in safe work procedures for helicopter transport.
- Train workers in safe work procedures for dealing with hazardous wildlife.
- Conduct avalanche risk assessments.

If you have a section of pipeline where there may be an avalanche risk, conduct an avalanche risk assessment and implement monitoring and risk controls.

In the Act: Section 115

In the Regulation:

- Sections 3.3(c) and 3.17.1
- Sections 4.1.1, 4.1.2, 4.13, 4.14, and 4.16
- Sections 7.1–7.8
- Section 23.5

Prime contractor (PC)

The pipeline owner will often appoint a prime contractor (PC) for the forestry portion of the project and a PC for the construction portion. Sometimes one PC will provide oversight to both portions, which will be divided and awarded separately.

If two different contractors are providing PC oversight, the owner must ensure their work is separated by time or distance. For example, the forestry PC **clears the ROW (12),** and then the construction PC builds the pipeline. Or, if the PCs are working at the same time, the project is broken into separate geographical sections — the forestry PC works on one section, and the construction PC works on another.

The owner must ensure the following:

- The role of the PC is properly defined.
- Responsibilities are outlined in writing.
- The PC is qualified and has authority to be the PC.

The PC is responsible for ensuring the coordination of activities at the site and that there is a practicable health and safety system in place to ensure compliance with the Regulation and the Act.

In the forestry portion of the project, the owner is responsible for ensuring the forestry work is properly planned and conducted. The PC hired by the owner is responsible for providing and implementing that plan.

In the construction portion, the PC is responsible for appointing a qualified coordinator. This coordinator will provide oversight to ensure all hazards are identified and controlled. The PC must also ensure the following:

- A site layout is posted with an emergency response plan and provisions for emergency equipment.
- Appropriate safe work procedures are available for the work. Safe work procedures should be based on job safety analyses.

Supplier

Suppliers for pipeline projects provide many different types of equipment and products. Suppliers are often not considered significant players in a pipeline construction project because they usually don't have any employees at the site. Despite this, suppliers for pipeline projects have a number of responsibilities, including the following:

- Provide directions for the safe use of machinery and equipment.
- Ensure proper labelling of products.
- Maintain products as required under leasing agreements.
- Comply with the requirements of the Regulation and the Act.

In the Act: Sections 118(2) and 120

In the Regulation:

- Sections 20.1A and 20.3
- Sections 26.1.1 and 26.2(3)

4 Prime contractor (PC) – Supplier

Supervisor

Supervisors are the front-line workers who ensure an **employer's health and safety responsibilities (3)** are being met. Without the support of supervisors, an employer's health and safety program will not succeed.

Pipeline construction typically involves a hierarchy of roles and responsibilities for worksite supervision. The top supervisor is usually called the construction superintendent or spread boss. There may be several different phase superintendents.

Foreman

Under the superintendents are designated foremen for each crew (or gang). For example, the pipe gang is the crew responsible for setting and **welding (26 and 27)** the joints of pipe that become the pipeline. Foremen are responsible for the following:

- Ensure the health and safety of their workers.
- Be knowledgeable about their work and Regulation requirements.
- Comply with the Regulation.
- Inform workers of potential hazards.
- Consult and cooperate with the joint health and safety committee and WorkSafeBC.

Falling supervisor

In the forestry portion of the project, **hand fallers (10)** often work under a falling supervisor to remove dangerous trees along the pipeline ROW. Falling supervisors are responsible for the following:

- Ensure that falling and bucking activities are planned and conducted as specified in the Regulation.
- Inspect each faller's workplace as often as necessary for risks.
- Keep records of inspections.

Worker

Workers on pipeline construction projects must do the following:

- Comply with the Regulation.
- Follow safe work practices.
- Use **PPE (6)** and other safety gear.
- Refrain from horseplay.
- Don't work while impaired by drugs, alcohol, or other causes.
- Report hazards and safety violations to a supervisor or the employer.
- Cooperate with the joint health and safety committee or worker health and safety representative (if applicable) and WorkSafeBC.

In the Act: Sections 116 and 117

In the Regulation: Section 26.22.1

6 Personal protective equipment (PPE)

Pipeline work presents a wide variety of hazards. Workers must be made aware of these hazards and protected against the risks associated with them. The various methods to control risks are, in order of preference, hazard elimination, substitution, engineering controls, administrative controls, and personal protective equipment (PPE). PPE should be used as a last resort, when it's not possible to reduce risk in any other way. Or it can be used in addition to other controls to help protect workers against a hazard that can't be eliminated.

Who provides PPE?

Workers on pipeline construction projects are responsible for providing basic safety headgear (i.e., hard hats), hand protection, safety footwear, and clothing appropriate for the weather.

Employers are responsible for providing any additional PPE required for the job, at no cost to the worker. Additional PPE may include high-visibility apparel, respiratory protection, fire-resistant clothing, noise protection, and face or body protection.

Selection, use, and maintenance

PPE needs to be properly selected, used, and maintained to be effective. PPE selection and use should be based on a risk assessment. Two examples where risk assessment is important are:

- Eye protection against debris and protection against conjunctivitis from arc flashes (for welders)
- Fire-resistant clothing for workers at risk of burn injuries

When selecting PPE, consider applicable standards for the type of PPE and whether using the PPE could create an additional hazard.

High-visibility apparel typically has fluorescent or retroreflective bands of orange or yellow.

In the Regulation:

- Sections 5.7–5.9
- Part 8 and guidelines G8.24 and 8.24-1
- Sections 12.112, 12.115, 12.122–12.124, and 12.126(1)
- Section 23.10

6 Personal protective equipment (PPE)

Crews may be separated by significant distances or obstacles that could delay or prevent emergency response (e.g., steep slopes, waterways, rock faces, or ravines). Employers must ensure that first aid equipment, supplies, facilities, attendants, and services are readily available for prompt treatment and transport of injured workers.

The PC must ensure a first aid risk assessment is completed and everything reasonably practicable is done to ensure first aid services remain available for the duration of the project.

Pipeline construction is considered a high-risk activity, and most pipeline construction sites are more than 20 minutes travel time to a hospital.

First aid requirements – More than 20 minutes surface travel time to hospital

# of workers per shift	Supplies, equipment, and facility	Level of first aid certificate for attendant	Transportation
1	• Personal first aid kit	N/A	Transportation at employer's expense
2–5	• Level 1 first aid kit	Level 1	Transportation at employer's expense
6–10	• Level 1 first aid kit • ETV equipment	Level 1 with Transportation Endorsement	ETV (emergency transportation vehicle)
11–30	• Level 3 first aid kit • Dressing station • ETV equipment	Level 3	ETV

In the Regulation:
- Sections 3.16, 3.17, and 3.20
- Guidelines G3.14–3.20

First aid (cont'd)

First aid requirements – 20 minutes or less surface travel time to hospital

# of workers per shift	Supplies, equipment, and facility	Level of first aid certificate for attendant	Transportation
1	• Personal first aid kit	N/A	Transportation at employer's expense
2–15	• Level 1 first aid kit	Level 1	Transportation at employer's expense
16–30	• Level 2 first aid kit • Dressing station	Level 2	Transportation at employer's expense

UTVs and ATVs

Utility-task vehicles (UTVs) have eclipsed all-terrain vehicles (ATVs) for industrial use because they are more versatile and have certified rollover protective structures (ROPS) and seat belts for worker protection.

In the Regulation: Sections 16.3–16.6, 16.22(2), 16.34, and 16.50–16.55

Publication: *All-Terrain Vehicles (ATVs) and Utility Transport Vehicles (UTVs) Checklist* — go to worksafebc.com and search for "ATV checklist."

B. Pre-construction

Pre-construction starts with the surveying and staking of the pipeline ROW and any temporary work areas along the pipeline corridor needed for the construction process. Temporary work areas may include staging areas, laydown yards, access roads (shooflies), decking areas for log storage, and compressor sites.

Note: The corridor is the pipeline route itself. The ROW includes the pipeline corridor and the surrounding temporary work areas.

Once the ROW is marked out, clearing crews **remove trees (10 and 11),** underbrush, and topsoil. The topsoil is stored for **reclamation (32).**

Following ROW preparation, the pipeline is surveyed and re-staked to indicate the centre line so workers can dig a trench. **Trenching (13 and 14)** can involve a wide variety of equipment, depending on the terrain, soil, and ground conditions, and the need for **blasting rock (15).**

Surveyors may have to work in difficult terrain and conditions. They must be informed of potential hazards. All workers must be trained and certified so they can work safely. Consider the following and plan accordingly:

- Difficult terrain and access may require the use of helicopters or other specialized transportation equipment, such as ATVs, UTVs, or boats.
- There may be hazardous wildlife along the corridor, including bears, cougars, and large ungulates (moose and elk).
- Timber may include dangerous trees resulting from disease, pests, fire, windfalls, or age.

After stripping the ROW, workers prepare the grade to provide access for construction equipment and materials.

Pre-construction may also include falling trees along the corridor to facilitate surveying where a line of sight is required along the ROW. Planning is necessary to ensure the project conforms to all the requirements for the safe falling of trees, including management of any dangerous trees and habitat trees that the project owner may want to protect.

Notice of Project (NOP)

The owner must ensure that a forestry NOP is submitted to WorkSafeBC. The owner or PC submits a construction NOP. Because of the differences in the hazards associated with these two portions of the project and often the considerable differences in timing, NOPs for both parts must be submitted to WorkSafeBC.

Hand falling

Hand falling is one of the most hazardous occupations in B.C. Employers must use **certified hand fallers** who are qualified through demonstrated competency to fall the type of timber that is on the ROW. Employers are responsible for validating a faller's knowledge, skills, and abilities. Often, a qualified falling supervisor will conduct the validation.

Wherever hand fallers are working, a dedicated, qualified falling supervisor is required to oversee the planning and hand falling. When planning hand falling activities, ensure the following:

- Workers will not be within two tree lengths of active falling.
- Fallers will not be working above other fallers or workers where a tree could slide down a slope.

Use signage and traffic control to ensure workers don't enter the two-tree-length zone, whether hand or mechanical processes are used.

In the Regulation: Sections 26.2(1)–26.2(4) and 26.21–26.30

Mechanical falling

Mechanical falling along the ROW is a common way to reduce the risk to workers by putting them in machines with protective structures. When planning mechanical falling, consider what type of equipment will be needed for the size and type of timber along the ROW. Hazard zones must be identified to ensure workers do not enter those areas until it is safe to do so. Where necessary, steep slope assessments must be conducted and safe work practices must be developed for forestry mechanical equipment.

A feller-buncher may be used to remove timber along the ROW. Operational distances must be maintained between work areas and equipment.

In the Regulation: Sections 26.16 and 26.29.1–26.30

11 Skidding and removing timber

Skidding and removing timber may involve a lot of different equipment and processes. The work may include the removal of large, old-growth timber on steep, rugged slopes. During the planning process, consider the following questions:

- Is the equipment sufficient for the timber size on the terrain and slopes?
- Can the equipment safely navigate the terrain and remain stable?
- Are workers trained to operate the equipment safely? Has the employer developed safe work procedures?
- Does the emergency response plan for the site address rescue and extraction of injured workers from machinery?
- Do all pieces of equipment have a secondary functioning escape hatch in case of rollover?
- Do all pieces of equipment meet ROPS, FOPS, or OPS standards and secondary braking or steering requirements?
- Is all equipment safely maintained and documented? Are there processes for pre-use inspections and repairs?
- Are seat belts available?
- Is there enough room to process, deck, and store timber along the pipeline ROW?

In the Act: Section 115(2)(e)

In the Regulation:

- Sections 4.13–4.14
- Sections 16.1(1), 16.3(6), 16.6, 16.13–16.14, 16.17(1), 16.21–16.23, and 16.32–16.34
- Sections 26.3, 26.12.1, 26.16, and 26.53–26.61

11 Skidding and removing timber

Once **timber has been removed (11)** from the ROW (or if there was no timber to begin with), workers begin clearing and stripping to prepare for the construction phase. Preparation may be as simple as a dozer stripping and moving soil. Or it may involve difficult terrain where soil, rocks, roots, and woody debris must be cleared, piled, and burned.

Mulchers with protective structures clear underbrush on the ROW.

Consider the following:

- If workers won't be stripping against timber faces, machinery may only require ROPS canopies.
- If workers will be stripping outside the cleared ROW and machinery will be pioneering into standing timber or along a timber face, the guarding requirements increase.
- On very steep or slippery terrain, towing may be necessary to complete the stripping or clearing. For more information, see the manufacturer's specifications for the equipment's braking capabilities and working or travelling on slopes.
- If workers are using an excavator with a rake or thumb attachment to clear debris, the excavator may need a FOPS and front window guarding.
- Workers must be trained for the work that will take place. Workers may need additional training and PPE to burn debris.

Fire safety training

Any workers who may have to respond to a forest fire must receive fire safety training. The *Wildfire Act* requires all industrial activities within 1 km of a forest fire to be available to respond.

The B.C. Ministry of Forests, Lands and Natural Resource Operations has created the S-100 Basic Fire Suppression and Safety course. This is currently the only recognized course for this type of training. The ministry also requires employers to have forest firefighting tools available at the workplace.

In the Regulation:

- Section 8.31
- Sections 16.21–16.28 and 16.38
- Sections 26.3 and 26.3.1

12 Clearing and stripping the right-of-way

Two different types of equipment may be used to dig the pipeline trench: ditching machines or excavators.

Ditching machines are typically used on flat terrain that is clear of debris and underground obstacles, such as rocks, other pipelines, or underground power lines. Guarding is not required if there is no risk of timber or other protrusions.

Excavators are used when it isn't possible to use a ditching machine. Excavator buckets are typically designed to meet sloping requirements.

A pipeline trench is considered an excavation. The Regulation specifies requirements for excavation construction, including the following:

- Trench support structures
- Sloping in lieu of shoring
- Benching in lieu of shoring
- Combined sloping and supporting options

Trench sloping and trench support requirements must be followed if workers will be working in the excavation.

In-ditch work

If workers will be doing in-ditch work within an excavation that is deeper than 1.2 m (4 ft.), such as in a bell hole, the employer must ensure the following:

- There is protection against excavation collapse.
- There is a safe means of access and egress, with consideration for emergency extraction.
- Spoil piles are at least 60 cm (2 ft.) away from the excavation edge.
- A confined space risk assessment has been completed if work processes (e.g., welding, line purging with an inert gas, or exhaust from vehicles and machinery) could generate a hazardous atmosphere in the excavation.

Drills and explosives may be necessary for constructing a trench in rock. The **drilling (15)** and **blasting (17)** process must address safety concerns related to drilling rock and the **safe handling and use of explosives (16).**

In the Regulation:
- Sections 4.13, 4.14, 4.32, and 4.63
- Sections 9.9, 9.10, 9.12, 9.24, and 9.25
- Sections 20.78–20.95, table 20.1, and figures 20.1–20.3

14 Trenching requirements

First a shot hole is drilled, and then a blaster loads an explosive into it and detonates it. All blasting work must be done by or under the direct visual supervision and control of a certified blaster. The work must be within the scope of the blaster's certification.

Safe work procedures for rock drilling

Employers must ensure that safe work procedures are established for all rock drilling operations, including the following:

- Before conducting any drilling, workers should scale and stabilize the area.
- Shot-hole remnants from pre-existing pipelines must be inspected. Concerns should be marked (flagged or painted).
- Drilling must not occur within 15 cm (6 in.) of a bootleg or 6 m (20 ft.) of a hole containing explosives. An employer may apply to WorkSafeBC to drill closer to loaded shot holes if it's essential to the operation.
- Shot holes must be large enough so blasters can insert explosives without ramming, pounding, or applying excessive pressure to the loading poles.

Safe work procedures must also describe handling procedures for drill steel, including manually removing or adding drill steel and bits, as well as the provision for a rod changer on precision-mounted drills capable of handling multiple lengths of drill steel.

Blasting certification

Blasting certification must be acceptable to WorkSafeBC and must be within the scope of the blasting ticket held by the blaster. Blasting tickets that are acceptable to WorkSafeBC outline the blaster's qualifications, endorsements, and the initiation systems they can use. Blasters must keep their certifications in a safe location at the worksite where the blasting is occurring.

Blasting logs

Blasters must also maintain a blasting log that documents pre- and post-blast inspections. The blasting log must be available at the blast site for inspection. The employer must ensure that blasting logs are kept for at least five years and that blasters keep a personal record of all blasting work performed.

Training workers

The employer must ensure that workers who load, unload, or transport explosives are trained to handle them safely. Training must include the hazards of fire and mishandling explosives. Worker training must also include procedures to follow in the event of a fire or unplanned explosion.

Handling, storing, and disposing of explosives

Blasters must handle explosives separately from detonators and only bring them together at the last practicable moment. All explosive products must be handled and disposed of as specified by the manufacturer. This includes removal from service because of deterioration or exposure to a cold environment.

Explosives must not be abandoned. The employer must ensure explosives are stored safely as specified by the manufacturer and federal storage standards.

Containers used to store explosives may contain explosive residue. They must be handled with care and either disposed of as specified by the manufacturer or burned in a controlled environment.

Explosives must be kept at least 15 m (50 ft.) away from smoking or ignition sources.

Federal transportation and storage requirements

Transportation and storage requirements help ensure explosives are not damaged. Employers must be aware of the limitations for transporting explosives, including in mobile drills. The federal government (Natural Resources Canada, Explosives Regulatory Division) has established detailed storage requirements for magazines and vehicles used to transport explosives.

Loading requirements

- Explosives must not be carried in a worker's clothing.
- Loading tools must be made of wood, plastic, or a non-sparking material that will not convey electric impulses or sparks.
- The primer must not be made up until just before loading the explosive.
- If there is any sign of thunder or lightning storm activity, all blasting activity must be suspended, and the danger area must be cleared and guarded if explosives are present at the blast site.
- Loaded shot holes must be fired by the end of the working day. If not, a guard must be posted to prevent tampering.
- Vehicles must not drive over loaded shot holes.

16 Drilling, loading, and blasting (cont'd)

C. Pre-construction – Construction

Initiation of blasting

The employer must ensure that blasters loading shot holes follow the requirements specified by the manufacturer and the Regulation for each type of initiation system. Common forms of initiation are detonation cord, shock tube, and electrical initiation. Once the shot hole is loaded, the blaster must ensure each circuit is tested. The blaster must use an appropriate instrument and record the measured resistance in the blaster's log. Blasters must consider common hazards (e.g., static electricity, leg wire handling, and electrical blasting) and take steps to control the risks.

Radio frequency transmitters must be kept at a distance specified in the publication *Safety Guide for the Prevention of Radio Frequency Radiation Hazards in the Use of Commercial Electric Detonators (Blasting Caps),* published by the Institute of Makers of Explosives (IME) and available at energetixsolutions.com.

Note: On public roadways, including resource roads, warning signs must be used to alert vehicle operators to turn off transmitters, including AM/FM, all two-way radios, and vehicle locator systems, such as OnStar.

Reporting and investigating blasting incidents

The employer must ensure any blasting incident resulting in personal injury is reported immediately to WorkSafeBC as a "dangerous incident." The employer must also initiate an investigation as soon as possible and forward a copy of the resulting report to WorkSafeBC.

Investigation reports must include the following:

- Dates and times
- Certificate numbers of blasters
- Names and occupations of anyone involved in the incident
- Types of explosives, detonators, and blasting machines involved
- An outline of the events leading to and during the incident
- A copy of the blaster's log book
- Any corrective actions taken by the employer

Excavators and dozers

Workers may need to use excavators and dozers to muck out trench overburden that has been blasted. These machines must be equipped with front window guarding to protect operators from flying debris in case the machine detonates a misfire shot hole.

In the Act: Section 172(1)

In the Regulation:

- Sections 12.84 and 12.89
- Sections 21.2–21.8, 21.16–21.32, 21.36–21.40, 21.45, and 21.48–21.63

WCB Standards: G602, G603, G604, G608 (or SAE 231)

17 Drilling, loading, and blasting (cont'd)

Self-propelled rock drills are the most commonly used mobile equipment for drilling shot holes on pipeline ROWs. If the rock drill is designed so the operator rides on it (sitting or standing), the machine must be equipped with the following:

- ROPS
- A safe seating location with an operational seat belt
- A braking system
- A backup alarm
- If equipped with a cab, a secondary means of escape

Requirements for rock drills

- The drill operator must inspect the rock drill before each use.
- The driller and helper must be protected from contact with rotating drill steel.
- If another machine will assist the rock drill by towing it on a steep slope, the rock drill must have a braking system that can control the unit and must be snubbed by a cable or vehicle to maintain it on the slope.
- All pressure hoses on drills must have restraining devices (whip checks) load rated to the maximum horizontal force the line could generate in an upset condition (e.g., if the hose breaks).
- Drill controls must be mounted in a safe location for the operator and labelled to identify their functions.
- Emergency shutdown controls must be clearly marked and their location communicated to anyone working with the driller.
- Rock drills must be equipped with water jets or other devices for suppressing rock dust.

Employers must ensure an exposure control plan (ECP) is developed and implemented to prevent worker exposure to silica dust. Silica dust is classified as a human carcinogen, so exposure must be reduced to ALARA (as low as reasonably achievable) levels.

In the Regulation:

- Section 4.3(1)
- Sections 5.53 and 5.54
- Sections 12.2, 12.15, 12.84, 12.85, 12.90, and 12.91(1)
- Sections 16.8, 16.13, 16.17, 16.18, 16.22(1)(f), 16.29, 16.32, 16.34, and 16.38
- Sections 21.43 and 21.44

CSA Standard: *Z432-94, Safeguarding of Machinery*

18 Mobile drills

Blaster responsibilities during the firing process include the following:

- Take precautions to prevent damage or injury from flying material when the explosives are detonated.
- Establish a danger zone with guards who have received instructions to keep the zone clear of workers until the “all clear” is given.
  Note: Signs and signals are insufficient; guards must be used.
- Ensure that firing lines are not connected to the blasting machine until the danger zone is clear and guarded. The blast pattern must follow a logical sequence so charges do not affect the detonation of adjacent charges.

Blasting signals

There must be an audible signal different from any others used on site to warn that a blast is about to occur. The worksite must also have conspicuously posted signs showing the blasting signals. The pre-blast warning is 12 short blasts at one-second intervals, followed by a two-minute pause. After the blast and following an inspection of the area by the blaster, a five-second signal grants permission to return to the blast area.

After the blast, the blaster must not allow other workers to enter the blast zone until all of the following have occurred:

- The blaster has examined the area for misfires and other hazards.
- An "all clear" signal has been sounded.
- The blaster gives permission for work to resume.

Electrical blasting

On an electrical blasting site, no one, including the blaster, can enter the blasting area until the leg wires have been disconnected from the blasting machine and short circuited. If the blaster can't verify that all shot holes have detonated or suspects there has been a misfire, the firing lines must be disconnected from the blasting machine, and there must be a wait period of at least 10 minutes before anyone enters the blast area. If a safety fuse was used, the wait time must be at least 30 minutes.

Unexploded charges

The blaster must conduct a post-firing examination of the blast site. If there are any unexploded charges, the blaster should do the following:

- Follow the employer's misfire safe work procedures to gather and destroy the unexploded charges.
- Remove loose materials and rock by hand.
- Identify and cordon off misfired shot holes to prevent entry. Misfires are considered a dangerous condition. They must be reported to WorkSafeBC immediately, after which the employer may be required to conduct an investigation.

No other work can happen in the area until the misfires are successfully detonated. Attempting to extract an explosive charge or any part of one from a shot hole is prohibited. When drilling new shot holes to detonate misfires, the blaster must do the following:

- Determine the angle of the misfire shot hole.
- Direct the drilling angle and depth of the new shot hole.
- Ensure the hole being drilled is at least 60 cm (2 ft.) from any part of the misfired charge.

In the Regulation: Sections 21.3, 21.66–21.77, 21.80, and 21.81

Construction processes include stringing, bending, welding, coating, positioning, installing valves and fittings, and backfilling the trench.

Stringing

Stringing (23 and 24) involves distributing pipe and laying it out along the length of the pipeline ROW. Pipes may come from stockpiles in laydown yards along the pipeline corridor. Pipes may also be trucked to the ROW and strung out directly from the trailers of transport trucks.

Bending

In the **bending process (25),** workers bend individual pipes to fit the contours of the pipeline ROW. Workers use hydraulic bending machines for the size of pipe being used.

Welding

Welders then connect the pipe joints using manual or **automatic welding machines (26 and 27).** Workers are increasingly using automatic welding machines to weld large-diameter pipes. Once completed, the welds are inspected using **non-destructive testing (27).**

Coating

Although pipes arrive pre-coated, workers need to re-coat the welded sections before the pipe is buried.

Coating the inside and outside of pipes helps prevent corrosion from groundwater or product contaminants.

Positioning

Once the pipeline has been welded together on the ROW, workers lower it into the trench using **side-boom pipelayers (28)** and place pillows or pipe beds under the pipeline as necessary.

Installing valves and fittings

In most cases, workers install **valves and fittings (30)** after the pipeline is resting in the trench. When the pipeline becomes operational, valves control the flow of product, and workers use the fittings for branch line connections and maintenance.

Backfilling the trench

The final step of construction is to **replace the topsoil and overburden soils (30)** in the opposite sequence of how they were removed. Workers then re-contour the land so it is as close to its original state as possible.

The pipe gang will use at least one **side-boom pipelayer (28 and 29)** to hold the pipe during initial welding (or setting in). The pipe gang will also use other machines to transport and support automatic welding machines on large-diameter pipe projects.

Potential hazards

Setting-in workers

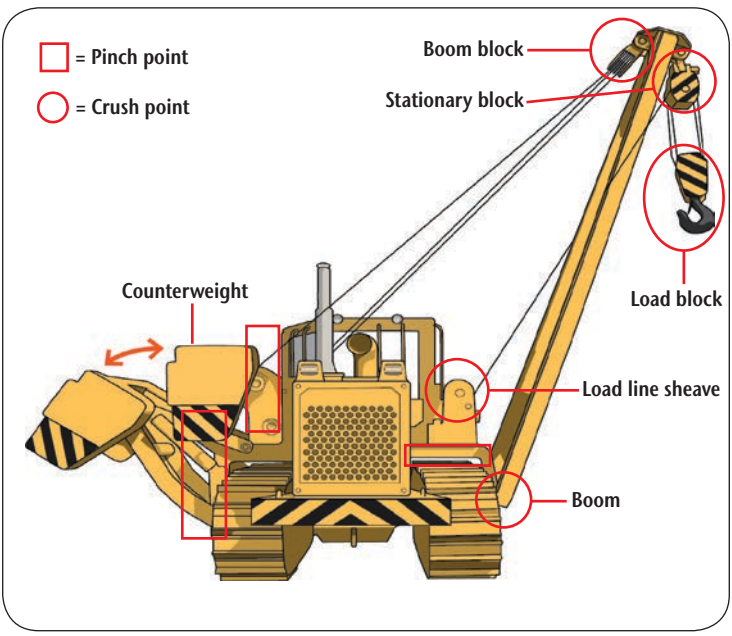
- Crushed or run over by machinery
- Struck by moving pipe or machines
- Struck by pipes being tensioned for welding or bending
- Struck by falling objects, including pipe or skids being thrown off trucks
- Struck by materials on the ground that are run over and swing up

Equipment operators

- Equipment flop overs or rollovers
- Struck by protruding joints of pipe or other materials along the ROW

Equipment requirements (23 and 24) are in place to help minimize hazards when working with mobile equipment and attachments.

Pinch/crush points on a side boom



The stringing process may involve specialized equipment and a specific crew for work that is often fast-paced and hazardous. Depending on the pipe size and terrain, tractor trailer units may haul the pipe to the pipeline corridor, where stringing side booms will unload it.

A side boom unloads large-diameter pipe from a truck at a delivery point along the ROW.

Boom extensions

Side booms are usually equipped with boom extensions that must be load rated and certified by a P.Eng. The extensions allow for a shorter angle on the wire rope slings. The extensions also provide extra height for trailer bed clearance. The capacity rating of the extensions must be within the load capacity of the side boom and A-frame.

Pipeline clamps

In some cases, excavators with magnetic clamp attachments or specialized clamp heads may be used for stringing. These clamps must meet the excavator carrier specifications for attachments and must be used within the load limits established by the carrier manufacturer.

Lifting clamps must be certified and compatible with the equipment they are attached to.

Rigging

- Rigging (slings and attachments) must be load rated for the side-boom capacity and the loads being hoisted.
- Load weights must be determined before hoisting. Weights must be within the load capacity of the side boom.
- Rigging must be inspected before use on each shift. Defective items must be removed from service immediately.
- Rigging fittings must be marked with the working load limit.
- Workers involved in stringing operations must be qualified and trained in their specific roles, including hoist signalling.
- The employer must develop and implement safe work procedures that address hazards identified during the risk assessment process.

Athey wagons

When stringing pipe on steep slopes, the crew may use an Athey wagon consisting of a highboy trailer with tracks instead of wheels. A bulkhead is often attached to the front of the trailer to prevent pipes from sliding forward into the tow vehicle. Occasionally, the trailer will have bulkheads on both ends. Athey wagons are often towed by a side-boom tractor or a Nodwell vehicle.

Whenever specialized equipment is used, the employer must ensure that safe work procedures address hazards associated with the equipment, including operating on steep slopes or difficult ground. Equipment use must follow the specifications of the manufacturer or a P.Eng.

In the Regulation:

- Sections 4.3(1) and (2), and 4.8(2)
- Sections 14.11, 14.15(1) to 14.15(2.1), and 14.36(1) and (2)
- Sections 15.2, 15.5, 15.31, and 15.33
- Sections 23.5(1) to 23.5(3)

24 Stringing (cont'd)

D. Construction – Post-construction

After workers have **strung the pipe joints (23 and 24)** along the trench, but before they are **welded (26)** together, individual joints are bent using a track-mounted, hydraulic pipe-bending machine. This allows the pipeline to fit the trench contours. Workers use a series of clamps and hydraulic pressure to make smooth, controlled bends in the pipe.

Workers use hydraulic pipe-bending machines to bend pipe joints so they fit the contours of the trench.

Potential hazards

- Pipe joints striking the machine as they move in or out of it
- Severed hydraulic hoses flailing and striking workers
- Workers suffering crushing injuries by being caught in the clamps or between pipe joints and the machine

Measuring profile contours

Workers who measure the profile contours of the terrain often **enter the trench (14)** for measurements. Shoring, sloping, or benching requirements for safe access apply for trenches deeper than 1.2 m (4 ft.). In most cases, workers can take profile measurements at surface using a measuring tool that extends to the bottom of the ditch.

Individual pipe joints are bent before being welded together to form the pipeline.

In the Regulation:

- Section 4.3(1)
- Sections 12.2 and 12.15
- Sections 20.81–20.86

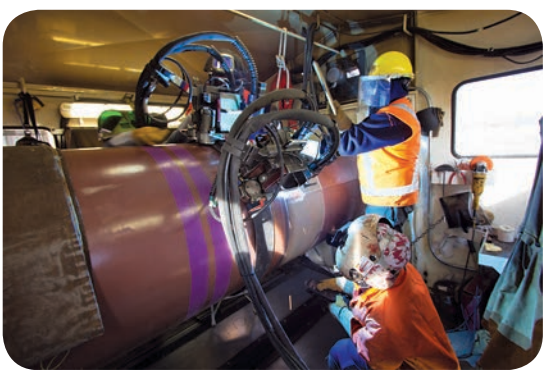
Once stringing and bending are complete, workers can begin welding the pipe joints together. On large projects, the pipe gang is spread along the pipeline ROW. The pipe gang includes crews of welders, helpers, setting-in workers, boom operators, and non-destructive testers. With larger diameter pipe, workers can use automatic welding machines that are transported along the ROW by **side-boom pipelayers (28).**

A worker sandblasts a pipe joint before welding.

Controlling exposure

- The employer must ensure worksite risk assessments are conducted to identify hazardous products, such as toxic resins and glues.
- The employer must ensure an ECP is developed to prevent worker exposure to welding fumes and hazardous products identified in the risk assessment.
- Automatic welding shacks must have adequate ventilation.
- All pipe-gang workers must wear **PPE (6)** to protect against hazards, such as exposure to toxic resins and glues, toxic gases when welding or cutting pipe, or silica when sandblasting.

All welding work needs to meet applicable welding standards, such as ASME standards. Cutting and welding equipment must be inspected, maintained, and equipped with required safeguards and must meet applicable standards.



Workers monitoring automatic welders inside portable welding shacks are at risk of exposure to a hazardous atmosphere. There must be an ECP and suitable ventilation.

Tack rigs

Workers on larger pipeline projects use welding units called *tack rigs.* Tack rigs are usually mounted on a dozer frame without the blade. Several welding machines mounted on the dozer allow more than one welder to work in a small area. This is useful for larger pipe joints that need several overlapping beads. The following requirements apply to tack rigs:

- Tack rigs must be equipped with ROPS.
- The operator (not a welder) must wear the seat belt.
- Material stands must be load rated.
- Hand tools and welding and cutting supports must be maintained and used as specified by the manufacturer.

Welding shacks can be positioned over pipe joints that need to be welded. Several shacks are generally in use at one time.

Non-destructive testing (NDT)

ASME standards for pipeline construction require all welds to undergo non-destructive testing (NDT). NDT methods include ultrasonic, magnetic particle, liquid penetrant, and radiographic testing. The common methods for pipelines are industrial radiography or industrial computed tomography (CT) scanning using X-rays or gamma rays.

NDT employers must develop and maintain an ECP that meets the requirements of section 5.54(2) of the Regulation as part of their health and safety program.

NDT workers must be part of a health monitoring program as specified by the *Canadian Nuclear Safety and Control Act.* NDT workers must also wear personal dosimeters to monitor their exposure to radiation.

Employers must ensure that workers in areas near NDT are protected against exposure to radiation. Post signs and barricade the work area to keep workers away from pipes that are being X-rayed.

In the Regulation:

- Sections 4.2, 4.3, and 4.8
- Sections 5.36–5.42
- Sections 7.18–7.23
- Sections 12.45 and 12.119–12.120
- Section 19.15(1)

Side-boom pipelayers are used to lower the pipeline into the trench. These are specially designed tractor units equipped with A-frame hoists capable of lifting and lowering large loads. While workers are positioning the pipeline in the trench, additional crews may need to position pillows or pipe beds under the pipeline.

Placing the pipeline on pillows or pipe beds reduces the risk of damage to the coating and the pipe during its lifetime.

Equipment requirements

The following requirements apply to equipment along the ROW:

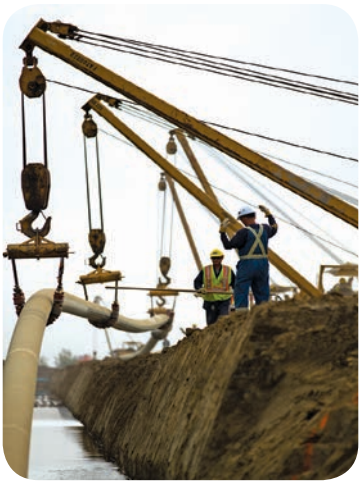
- All equipment must be equipped with ROPS, FOPS (typically installed on the roof structure), and OPS (typically installed over windows), as necessary.
- Equipment used for hoisting must be load rated and operated within the capacity of the load charts specified by the manufacturer.
- Equipment must be inspected as per manufacturers' specifications and any applicable standards.
- Machines used for hoisting and lifting must have a current log book with the machine as a permanent record of daily inspections, maintenance, repair work, and any certification documents.
- Mobile equipment operators must be trained and signed off as qualified operators by a qualified supervisor before operating equipment.
- Attachments used for hoisting, including spreader bars or load hooks, must be load rated, certified by a P.Eng., and identified, inspected, and maintained in a safe operating condition. This includes attachment points on automatic welding machines.
- All load hooks must be equipped with safety latches or other effective means to retain the slings.
- All shackles must be pinned to prevent dislodgement.

In the Regulation: Sections 14.42.1 and 14.43

28 Positioning (side booms)

Tandem lifts and critical lifts

If the lift requires more than one piece of equipment (i.e., two or more side booms or pipelayers), it is considered both a tandem lift and a critical lift. These lifts require a written lift plan and possibly a qualified lifting supervisor to provide oversight and direction.



Roller slings allow for side-to-side movement of the pipe while it is being lowered into the trench. In cold weather, workers need to ensure the rollers roll freely so the pipe will move through them with as little friction as possible.

According to section 14.1 of the Regulation, critical lifts include the following:

- A lift by a mobile crane or boom truck that exceeds 90% of its rated capacity while it is lifting the load at a load radius of more than 50% of its maximum permitted load radius, taking into account its position and configuration during the lift
- A tandem lift if the load on any one crane, hoist or other piece of powered lifting equipment exceeds 75% of the rated capacity of that crane, hoist or other piece of lifting equipment
- A tandem lift involving the simultaneous use of more than two cranes, hoists or other pieces of powered lifting equipment
- A lift of a person in a work platform suspended from or attached to a crane or hoist
- A lift in which the center of gravity of the load changes during the lift
- A lift in which the length of one or more sling legs changes during a lift
- A lift by a crane, boom truck or hoist, supported on a floating base, that exceeds 90% of rated capacity for the lifting system
- A lift of a load over or between energized high voltage electrical conductors
- A lift of a submerged load

In the Regulation:

- Sections 14.1, 14.5, 14.12–14.14, and 14.42–14.47
- Sections 15.10, 15.28–15.54, and 15.57–15.59
- Sections 16.4, 16.7–16.9, 16.13–16.14, 16.17–16.22, and 16.31–16.40

29 Positioning (side booms) (cont'd)

Valves and fittings

Once the pipeline has been **welded together (26 and 27)** and lowered into the ditch, workers can install valves and fittings. The types of valves and fittings installed depend on the size, length, and end use of the pipeline. Valves and fittings may include the following:

- Shut-off valves for isolating a section of the pipeline
- Risers for inserting devices, such as pig launchers and pig catchers, which are used for cleaning and inspecting pipelines, and for monitoring pipeline health
- Flow meters and branch line fittings for product inlet or outlet feeds

In some cases, metering valves are installed to measure and control product flow for sales or to monitor for royalty revenues.

Installing valves and fittings typically involves welding and cutting, hoisting, and entering the trench. Workers must follow all applicable safety requirements, including confined space requirements. Installation work may involve managing heavy loads, working in muddy and slippery conditions, and climbing in and out of the excavation throughout a shift. Properly constructed entry points to the trench can help prevent slips, trips, and falls. Stairs are preferable for longer jobs.

Sufficient illumination is also necessary for a safe working environment, particularly up north and during winter months.

In summer, longer days make lighting less of a concern.

Backfilling the trench

The final step in the construction phase is backfilling the trench. This is typically done with bulldozers. Excavators may be used to fill and pack bell holes.

In areas in where rock forms the main cover, the pipeline is often covered with gravel, sand, or dirt to protect against damage from rocks dropping onto the pipe or friction that can occur over time as a result of vibration. Pipe used in rock trenches may also be coated with cement or other materials to provide additional protection.

Equipment operators who are backfilling the trench may work on the same slopes as the clearing and excavating crews, so the requirements and precautions necessary for clearing and excavating also apply to backfilling. If operators are working alone away from the main construction crews, working alone procedures must be in place with regular person checks.

Using a soil grinder during backfilling ensures a consistent size of small material surrounds the pipe. This reduces the risk of friction wear over time and prolongs the life of the pipe.

In the Regulation:

- Sections 4.20.1–4.21, 4.32, 4.33(1), 4.62, 4.65, and Table 4-1
- Section 16.38(1)

30 Valves and fittings – Backfilling the trench

After construction, the final two tasks before commissioning the pipeline are pressure testing it and cleaning up the ROW. The pipeline is tested to a prescribed pressure stated in the pipeline construction specifications. Pressure testing verifies that there are no leaks or damage to the pipe or its welds. Testing media may include air, water, nitrogen, or a mixture of water and methanol. If testing reveals leaks, the pipeline must be excavated so they can be repaired. Following repairs, pressure testing starts again from the beginning.

Workers setting up for a pressure test. A constructed platform with a welded guardrail over the pipe creates a safe work area for the workers.

Pressure testing process

Pressure testing begins by capping the ends of the pipeline with a pressure-rated relief valve. This valve allows the construction contractor to pump air into the line to the prescribed pressure for a specific amount of time. Any loss of pressure indicates a leak.

The inability to fully pressurize the line may indicate other problems, such as damage or a blockage. Bleeding off the air pressure will help discharge (i.e., clean) some foreign materials from the line.

On completion, there may be a follow-up test using water or an inert medium, such as nitrogen.
Note: Any water remaining in the line as a contaminant can result in freeze-offs during cold weather.

Large compressors are used for pressure testing. High-pressure lines need restraint in the event of a failure, and valves need pressure-relief devices to prevent a testing medium overpressure that could cause the pipeline or attached equipment to rupture. If an inert medium is used and workers could be exposed to a hazardous product, the employer must ensure that the risk is assessed and safe work procedures are developed and implemented.

In many cases, the worker doing pressure testing will be working in isolation. Employers are responsible for developing and implementing a person-check procedure for workers who are working alone or in isolation.

In the Regulation:
- Section 4.21
- Section 5.54
- Sections 12.15 and 12.174
- Sections 23.5 and 23.12

The final step is to clean up (or *reclaim*) the pipeline ROW. Cleanup includes reseeding the topsoil and removing temporary work areas and structures. Cleanup may also include the following:

- Clearing garbage
- Picking up rocks and roots
- Dismantling structures that are not needed for pipeline operations
- Deactivating construction access roads or trails that are no longer needed

Cleanup and reseeding the pipeline ROW is required to meet environmental standards and helps stabilize the soil to prevent erosion.

During cleanup, equipment requirements described elsewhere in this publication still apply for guarding, steep slopes, and assistance on steep grades. Workers must wear PPE (e.g., hard hats, gloves, eye protection, and high-visibility clothing) to protect against the potential hazards.

Terms

automatic control valve — A valve that closes automatically when there is a pressure loss or flow rate increase that exceeds a predetermined set point.

bell hole — An excavation dug to allow survey, inspection, maintenance, repair, or replacement of pipe sections.

blaster — A worker who holds a valid blaster's certificate that is acceptable to WorkSafeBC.

bootleg — The remnant of a blast hole that did not properly break when the blast was initiated. Also called a socket, butt, or button.

cathodic protection — A method of corrosion prevention in which the pipeline acts as the cathode in an electrochemical corrosion cell.

ECP — Exposure control plan.

encroachment — The unauthorized use of a right-of-way in violation of the terms under which it was established.

engineering control — The physical arrangement, design, or alteration of workstations, equipment, materials, production facilities, or other aspects of the physical work environment for the purpose of controlling risk.

FOPS — Falling object protective structure.

FSR — Forest service road.

holiday — A discontinuity or break in the anti-corrosion coating on a pipe or tubing that leaves the bare metal exposed to corrosive processes.

IRP — Industry recommended practice.

jeeping — A process in which a high-voltage loop is placed around and passed down a pipe to measure the effectiveness of its protective coating. Jeeping is used to find holidays in the coating before a pipe is placed in the trench.

joint — A section of pipe.

LAD — Logging associating districts. A radio channel used for general communication and not to be used as a road channel.

Terms (cont'd)

NOP — Notice of Project. NOPs for industries such as construction or forestry must be submitted to WorkSafeBC.

OGC — Oil and Gas Commission of B.C.

OPS — Operator protective structure.

PDR — Petroleum development road.

P.Eng. — Professional engineer.

pillows — Materials used to support a pipeline in a trench. Pillows are softer than the excavated material and help support the pipeline to reduce the risk of damaging its external coating. Typical pillow materials include screened soil, sand, strategically placed foam, and sandbags.

pipeline location — The entire span of the pipeline.

PPE — Personal protective equipment.

PPR — Personal performance review.

qualified — According to the Regulation, "being knowledgeable of the work, the hazards involved and the means to control the hazards, by reason of education, training, experience or a combination thereof."

QP — Qualified person. A worker identified by the employer as capable to fulfill the required function.

ROPS — Rollover protective structure.

ROW — Right-of-way.

RPs — Recommended practices. Also known as best practices.

SFOS — Seismic field operations supervisor.

shoofly — A temporary access road to a normally inaccessible location.

site safety plan — A site-specific plan that identifies all known hazards and controls. It should also include site drawings or a map that shows the project layout, first aid locations, emergency transportation provisions, and muster locations for evacuations.

tandem lift — According to the Regulation, a lift using more than one crane or one hoist, or a crane or hoist and another piece of powered lifting equipment.

About this publication

This publication is meant to help WorkSafeBC officers, owners, employers, and workers understand the health and safety requirements related to pipeline construction work in British Columbia. You may also find some of the information in this publication useful if you are a prime contractor, supplier, or supervisor.

This publication does not replace the *Workers Compensation Act* or the Occupational Health and Safety Regulation. It is not intended to explain all the health and safety requirements that apply to pipeline projects. Owners, employers, contractors, and supervisors should always refer to the Act, the Regulation, and applicable guidelines for specific requirements that apply to their operations and work activities.

For more information, visit worksafebc.com.

WorkSafeBC

Printed by Flip Productions Ltd.
Vancouver, BC, Canada
1.888.220.FLIP (3547)
flipproductions.com
Made in Germany by Infoflip Ulm e.K.

infoflip®
IF.G.01.01131.F.01

08/2017 BK162