Part 15 Managing the Control of Hazardous Energy

Highlights

- This Part reflects the most current views on "locking out", widely referred to as the "control of hazardous energy".

- This Part explicitly recognizes that the control of hazardous energy applies to machinery, equipment and powered mobile equipment, as well as piping, pipelines and process systems containing a harmful substance under pressure.

- This Part recognizes that energy-isolating devices can be secured
  (a) by individual workers,
  (b) by a group (often referred to as a "group lock-out"), or
  (c) a complex group process (a procedure-based "group lock-out" process that is implemented when circumstances, such as a plant turnaround, make "group lock-out" impractical)

- Sections 215.4 and 215.5 present requirements specific to pigging and the isolation of piping.

Introduction

In this Part, hazardous energy is defined as

> *"electrical, mechanical, hydraulic, pneumatic, chemical, nuclear, thermal, gravitational, or any other form of energy that could cause injury due to the unintended motion energizing, start-up, or release of such stored or residual energy in machinery, equipment, piping, pipelines, or process systems"*

Workers servicing, repairing, testing, adjusting or inspecting machinery, equipment, powered mobile equipment, piping, pipelines, or process systems may be injured if there is unintentional movement, the equipment is unexpectedly energized, unexpectedly started up, or releases stored energy. A detailed, comprehensive hazard assessment can identify the type and location of hazardous energy sources. Part 2 of the OHS Code requires that a hazard assessment be conducted before the work activities listed above are performed on machines, equipment, piping, pipelines, or process systems.

If there is a hazard to workers, control of hazardous energy involves the following steps:

(1) Isolating the location at which work is to be carried out from sources of energy. This is accomplished by shutting off the machine, equipment, or process systems, or regulating flow in piping or pipelines and by operating or installing a mechanical device (energy-isolating device) that relieves, blocks, bleeds, restrains or otherwise physically prevents or controls the transmission or release of energy for each energy source that may affect the work area.

(2) Verifying that the work area is isolated from all energy sources and the machinery, equipment, piping or process system is inoperable. This requires testing to verify that energy from each source cannot reach the work area. In the case of interlocked systems, the interlock sequence should be fully completed or overridden.

(3) "Locking" the isolation by ensuring that the energy-isolating device and all relevant components are physically secured to prevent the release of energy that could cause inadvertent movement or activation. Access to the securing device must be properly managed.

(4) Once the work activity has been completed, returning the system to operation by removing any securing devices, verifying that no worker is in danger, and releasing the energy-isolating device.

Section 212 Isolation

Subsection 212(1)(a)

The employer is responsible for ensuring that the work activity is performed safely. Specifically, work cannot be performed until the machinery, equipment, or powered mobile equipment has come to a complete stop (except as permitted by subsection 212(2)), all sources of hazardous energy have been isolated by an energy-isolating device and the device has been secured. An employer can choose from three approaches to securing an energy-isolating device:
(1) by individual workers (see section 214),
(2) by a group (see section 215), or
(3) by a complex group process (see section 215.1).

Subsection 212(1)(b)

"Rendering inoperative" may involve removing vital parts, putting blocking in place, pinning, or other equally effective methods. Whatever method is used, it must provide a level of worker protection *equal to or greater* than that provided by isolating and securing. If such alternate practices are used, it is important to advise workers that the method is for energy control and must not be altered.

While this approach typically creates a "zero-energy" states it can also result in residual energy being contained in element(s) of the machine, equipment, or powered mobile equipment. In this case, a hazard analysis can indicate if further hazardous energy control may be needed.

Subsection 212(2)

In some instances, it may be necessary to work on equipment while it is operating e.g. troubleshooting, minor adjustments, testing, etc. This approach is only justifiable if it is required by the manufacturer or it is not reasonably practicable, in the case where there are no manufacturer specifications, to render the equipment inoperative. The approach cannot be used simply because it is more convenient than isolating and securing. In this case, the employer must develop and implement written procedures for control of identified points of hazardous energy to ensure that the work is performed safely. It is suggested that workers be involved in the preparation of these procedures and controls. Section 8 of the *OHS Regulation* requires that the procedures be in writing and available to workers.

Subsection 212(3)

When the work activity involves piping, a pipeline, or a process system that contains a "harmful substance" as defined in the OHS Code, the employer must stop or reduce to a safe rate the flow of product in the piping, pipeline or process system. The location at which the work is to take place must then be isolated from the flow and the isolation secured in accordance with section 215.4

Energy-isolating devices

Before carrying out the work, all energy-isolating devices that control an energy source and will be involved in the isolation must be located. This may include isolation points in different areas e.g. material conveyor that runs through two operating units. Examples of an energy-isolating device include

(a) a manually operated electrical circuit breaker,
(b) a disconnect switch,
(c) a line valve, and
(d) a block or similar device that blocks or isolates energy.

Push buttons, selector switches and other control circuit type devices are not energy-isolating devices.

Cord-connected and permanently connected electrical equipment

When work is done on cord-connected electrical equipment e.g. repairing a radial arm saw, changing the blade on a circular saw, cleaning a delicatessen's meat slicer, etc., a worker can isolate the equipment by securing an isolating device to the electrical plug or, more practically, rendering the equipment inoperative. An acceptable approach to rendering the equipment inoperative is for the worker doing the work to

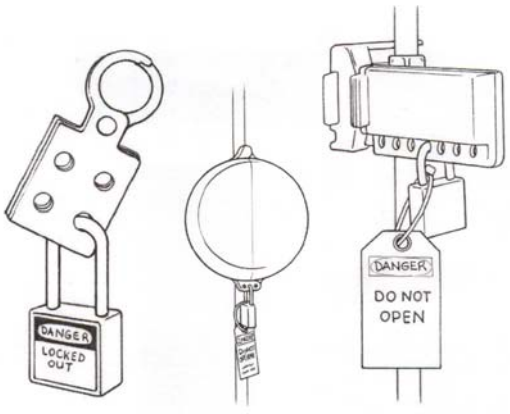
(a) disconnect the plug from its electrical supply,
(b) keep the plug in sight and within reach so that no one else can accidentally plug in the equipment, and
(c) keep the plug under his or her exclusive and immediate control at all times while working on the equipment.

If the worker leaves the equipment unattended and the work is incomplete, then the worker must verify that the plug is disconnected from its electrical supply before the worker resumes work on the equipment. The worker must then follow steps (b) and (c) as described above. In the case of permanently connected electrical equipment, the worker must secure the equipment's energy-isolating device(s) e.g. circuit breaker, disconnect switch, etc. before proceeding with the work.

Securing devices

To ensure that there is no inadvertent release of energy or energization, the energy-isolating device(s) must be physically secured in the isolating position. A securing device is anything such as a personal lock that holds an energy-isolating device in its off or safe position (see Figure 15.1). The device must be "positive", meaning that once secured into position, it cannot fall off or allow the energy-isolating device to move from its off or safe position. A dowel rod placed in a valve handle, duct tape across a circuit breaker or a sign placed above a box containing fuses that have been removed form an electrical panel would not be "positive" securing devices. The securing device or mechanism must be strong enough to withstand inadvertent opening without the use of excessive force, unusual measures, or destructive techniques e.g. metal-cutting tools.

Figure 15.1 Examples of securing



In some situations, several energy-isolating devices may be locked near one another and must be secured at the same time. One approach is to use a personal lock to secure each energy-isolating device in its off or safe position. Also acceptable is the practice of running a cable, bar or chain through the lock points of the energy-isolating devices (once they are in the off or safe position), then securing the cable, bar or chain against removal with a personal lock. If this approach is used, the following conditions apply:

(1) the strength, diameter and routing of the cable, bar or chain must be sufficient to keep the energy-isolating device in the "off" or "safe" position; and
(2) the construction and strength of the securing devices must be sufficient to prevent their removal without tools.

There is no limit on the length of cable, bar or chain that is acceptable, or the maximum number of energy-isolating devices that may be secured at one time. The system must provide a level of worker protection that is at least as good as if there was an individual securing device on each energy-isolating device.

Use of warning tags

While there is no requirement in the OHS Code to use a warning tag, if one is used it should indicate that the machinery, equipment, or powered mobile equipment to which it is attached is not to be operated until the tag is removed.

If used, such a tag should be securely fastened to the energy-isolating device. If the warning tag cannot be attached directly to the energy-isolating device, it should be located as close as safely possible to the device, in a position that will be immediately obvious to anyone attempting to operate the device.

Warning tags should be standardized so that their meaning is immediately clear to all workers. This may include standardizing colour, size, shape, and the format and type of information printed on the tag.

Hazardous energy control in electric utility industry

The electric utility industry must follow two different safety regulations when dealing with the control of hazardous energy – Alberta's *Electrical and Communication Utility Code* (ECUC) and the OHS Code. The requirements of the ECUC apply to electric utility systems operating at voltages greater than 750 V i.e. generation, transmission and distribution systems, and to the auxiliary, metering and control circuits operating at lower voltages that affect or influence these high voltage systems. Strict adherence to the requirements of the ECUC ensures the safety of workers working on such systems and circuits. This is achieved through the use of elaborate procedures involving an operator-in-charge, voice commands, non-personal locks and/or warning tags.

For voltages and systems other than those described above, the electric utility industry must meet the requirements of this Part of the OHS Code.

Section 213 Verifying isolation

Before working on the machinery, equipment, or powered mobile equipment that has been de-energized (and energy points isolated and secured) or rendered inoperative, a worker must verify that it is, in fact, inoperative. This is often referred to as a "bump" test. The worker must try to activate the machinery, equipment, or powered mobile equipment to make sure that it doesn't operate – this usually involves activating the control switches and then listening to and watching the equipment.

In group lockout situations, a foreman, supervisor, or operator may perform the "bump" test on everyone's behalf. Workers must be satisfied that the machinery, equipment, or powered mobile equipment will not operate. A worker should refuse to work on the equipment until the test is done and the worker is sure that it is safe to proceed with the work. In rare cases, energy-isolating devices have been found to be defective, allowing start-up of the supposedly de-energized unit. Where such a problem is identified, and unless another energy-isolating device can be secured to truly isolate the equipment, the original, defective energy-isolating device(s) must be repaired or replaced before any work on the equipment is performed.

Securing Isolation

Section 214 Securing by individual workers

Subsection 214(1)

If an employer chooses this option for securing an energy-isolating device, each worker involved must attach his or her own personal lockable securing device, typically a keyed padlock, to the energy-isolating device.

Subsection 214(2)

A worker who has placed a lock is also responsible for verifying that the energy source has been effectively isolated.

Subsection 214(3)

In the case where more than one worker is working at the same isolation point, each worker must attach his or her own personal lockable securing device, typically a keyed padlock, to the energy-isolating device. The first worker to do so must then verify, on behalf of all workers, that the energy source has been effectively isolated.

Subsection 214(4)

When using personal locks and in the case where the worker is reassigned before the work is completed, or the work is extended from one shift to another, continuity of hazardous energy control must be maintained. This can be accomplished by

(a) another worker, authorized by the employer (typically a supervisor or crew leader), placing his or her lock prior to the first worker removing his or her lock, or

(b) ensuring that there is an effective transfer of control of the initial worker's lock to another worker who is typically designated by the employer for this purpose.

Subsection 214(5)

A personal lock must be traceable back to the worker who owns it and installs it. This is important when locks need to be removed and can serve as a check on the whereabouts of workers, particularly when many workers are involved and there are many pieces of equipment.

Locks can be made traceable in at least two ways:

(a) they can bear a marking unique to each worker e.g. engraved name, identification code, colour code, symbol code, etc., or

(b) incorporate an identification tag that identifies the worker to whom the lock is assigned. If this method is used, the tag must be secured to the lock in such a way that the tag cannot fall off.

Subsection 214(6)

It is not uncommon for personal locks to have engraved into them an identification code consisting of a combination of letters and numbers rather than the name of the worker to whom the lock is assigned. To provide traceability back to the lock owner, the employer must ensure that the worker's name is readily available throughout the period of time that the lock is used. If a lock or locks must be removed, the employer must be able to readily determine to whom the lock has been assigned.

Subsection 214(7)

Removing a lock usually means that work is completed and the machinery, equipment, or powered mobile equipment is ready to be returned to operation. A lock should not be removed until this is the case. In some situations, removing the lock may create a dangerous situation for workers.

When an energy-isolating device is secured with more than one personal lock, the final lock being removed is the most critical. The removal of this lock means that energy may no longer be isolated and that the unit is ready to be returned to service. Although each worker removing his or her lock can "ensure that no worker will be in danger if [the lock] is removed", it is only the worker removing the final lock that really needs to do this. A situation worth noting in which keeping the final lock in place may be particularly important is during a shift or personnel change.

Maintaining continuity of energy control may mean that the final lock is not removed until the shift or personnel change is completed. If removal of the final lock may endanger workers during a shift or personnel change, then the final lock must not be removed until it is safe to do so.

Section 215 Securing by a group

Subsection 215(1)

When multiple workers are involved or multiple energy-isolating devices must be secured, a group process can be used. For example, securing by a group can be used when ten workers are working on a project that requires four energy-isolating devices to be secured in order for the work to be done safely. If the employer chooses to use a group procedure, the procedure must meet the requirements of subsections 215(2) through 215(6)

Subsection 215(2)

Section 8 of the *OHS Regulation* requires that the procedure be in writing.

Subsection 215(3)

In this case, one worker designated by the employer (typically a supervisor or crew leader), is assigned the responsibility of placing and/or activating the energy-isolating devices. Another designated worker (or the same worker) must then

(a) place a securing device (typically a keyed padlock) on each energy-isolating device,
(b) put the key to each securing device in a lockable key-securing device (lock box, key ring, etc.) an apply his or her personal lock,
(c) complete, sign, and post a list identifying the machinery or equipment included in the procedure, and
(d) confirm and document that all hazardous energy sources in the group lockout situation are effectively isolated.

The purpose of subsection 215(3)(d) is to verify that all energy sources that could cause injury due to unintended motion, energizing, start-up or release of residual energy (see OHS Code definition of "hazardous energy") are effectively isolated. Verification may be achieved by testing circuitry, attempting to cycle machinery, visual inspection, monitoring movement or discharge, observing bleeds, gauges or indicators, or other equally effective approaches. The approach used should offer the best degree of assurance that isolation has been achieved.

Documenting this step provides a record of the activity having been completed. This is not confirming that the locks were placed in the correct locations. This is making sure that placement of the locks has resulted in the energy sources being effectively isolated. Having a worker confirm that locks are physically placed in the correct location is not the same as verifying that all energy sources are effectively isolated.

Subsection 215(4)

Once effective isolation has been verified and before starting the work activity, each worker involved in the work then applies his or her own lock to the key-securing device. This ensures that the master key(s) cannot be removed from the key-securing device until each worker removes his or her personal lock. This prevents the equipment from being returned to operation until each personal lock is removed.

Subsection 215(5)

In the case where a worker is reassigned before the work is completed, or the work is extended from one shift to another, continuity of hazardous energy control must be maintained. This must be accomplished by an effective transfer of control of the initial worker's lock to another worker who is typically designated by the employer for this purpose.

Subsection 215(6)

Upon completing the work, each worker removes his or her lock from the key-securing device. When the last lock is removed, the worker authorized by the employer to do so then removes his or her lock from the energy-isolating device and verifies that no worker will be in danger due to removal of the lock in accordance with section 215.3.

Section 215.3(2) applies in an emergency or if the worker who attached the lock is not available when required to remove it. In this case a worker designated by the employer (typically a supervisor or crew leader) may remove the lock in accordance with a procedure that includes verifying no workers will be in danger due to removal of the lock.

Section 215.1 Securing by complex group control

In some cases it may not be reasonably practicable to use an individual or group lock out process. To maintain worker safety, normal group lock out practices may need to be adapted or modified. A complex group control process allows an employer to do this.

The complex group control process relies on written procedures and a work permit or master tag procedure to ensure the safety of workers. These two elements replace the traditional approach of each worker placing a personal lock on each energy-isolating device or on a group lock box.

The reasons for choosing to use a complex group control process most likely involve a combination of several of the following factors:

(1) *the physical size and extent of the machinery, equipment, piping, pipeline or process system* — the machinery, equipment, etc. may occupy such a large area, or occupy multiple areas, that it becomes impractical for all affected workers to apply their personal locks to all the energy-isolating devices. This usually results in the employer using a group lock out process but may, based on the other factors listed, lead to the use of a complex group process;

(2) *the relative inaccessibility of the energy-isolating devices* — some energy-isolating devices may be difficult to access and the act of getting to and from them could potentially expose workers to hazardous situations or conditions e.g. fall hazards, confined space entry hazards, exposure to elevated noise levels, etc. Eliminating this unnecessary exposure may be a good reason for choosing to use a complex group control process;

(3) *the number of workers involved in the work requiring hazardous energy control* — at some point so many workers may be involved in the work that using group lock boxes and their accessories becomes impractical. This may occur in situations such as plant shut downs when significant numbers of workers new to the work site begin working there;

(4) *the number of energy-isolating devices involved* — so many energy-isolating devices may be involved that it is impractical for all affected workers to apply their personal locks to all of them. This usually results in the employer using a group lock out process but may, based on the other factors listed, lead to the use of a complex group process;

(5) *an extended length of time of the isolation* — an extended or lengthy lock out period may prevent personal locks from being put to use elsewhere, requiring an employer to issue additional personal locks to workers; or

(6) *the interdependence and interrelationship of the components in the system or between different systems* — the system or systems being locked out may be so complex that from the safety and efficiency perspectives, using a complex group control process makes the most sense.

An employer wanting to use a complex group process must have it approved by a Director of Inspection. A Director of Inspection is a member of the staff of Alberta Employment and Immigration appointed by the Minister under section 5 of the *OHS Act*. A Director of Inspection reviews the employer's application to ensure that the level of protection provided to workers is at least equivalent to that provided by

the individual or group process.

An application for approval must include:
(a) a rationale for using a complex group process, answering the question "Why is individual or group lockout not practical?",
(b) a copy of the hazard assessment completed in accordance with Part 2 of the OHS Code,
(c) a summary or copy of the procedures to be used that ensure continuous safe performance of the work,
(d) a thorough description of the work permit or master tag system to be used, and
(e) recognition of a worker's right to place a personal lock on an energy-isolating device(s) despite the permit or master tag system (see subsection 215.1(4)).

Approval is not required each time a complex group process is used unless there are substantive differences from the approved process.

The Director of Inspection can be reached by writing to:

Director of Inspection
Alberta Employment and Immigration
Workplace Standards Division
8th Floor, 10808-99 Avenue
Edmonton, Alberta T5K 0G5

A worker designated by the employer (typically a supervisor or crew leader), carries out the isolation by activating and securing all energy-isolating devices. Another worker, designated by the employer, is responsible for verifying that the isolation is effective.

To ensure the safety of all workers involved in the lock out process, the work permit or master tag system being used requires that
(1) each involved worker personally signs on and off the job, or
(2) a crew leader signs on and off the job on behalf of a crew or team of workers.

When complex group control is used, each worker must be allowed the option of placing a personal lock on the lockable securing device and then verifying isolation.

Upon completing the work, each involved worker must be accounted for before locks are removed. The worker authorized by the employer to do so must verify that no workers are in danger due to the locks/isolating devices being removed and the machinery, equipment, piping, pipeline or process system being returned to operation.

Verifying isolation

Subsection 215.1(3)(d) requires that a second worker, designated by the employer, confirms that all energy sources in a complex group control situation are effectively isolated.

The purpose of the second worker's action is to verify that all hazardous energy sources that could cause injury due to unintended motion, energizing, start-up or release of residual energy (see OHS Code definition of "hazardous energy"), are effectively isolated. Verification may be achieved by testing circuitry, attempting to cycle machinery, visual inspection, monitoring movement or discharge, observing bleeds, gauges or indicators, or other equally effective approaches. The approach used should offer the best degree of assurance that isolation has been achieved.

The second worker is not confirming that the first worker physically placed the locks in the correct location. The second worker is making sure that the placement of the locks has resulted in the energy sources being effectively isolated. Having a second worker confirm that locks are physically placed in the correct locations is not the same as verifying that all energy sources are effectively isolated.

Section 215.2 Securing remotely controlled systems

Where machinery, equipment, piping, pipeline, or a process system is such that energy-isolating devices are in remote or non-contiguous locations, e.g. process control equipment is located 200 kilometres away from the computer that controls it, the securing process must still provide a level of protection that is equivalent to securing by individual workers (section 214), securing by a group (section 215), or securing by a complex group process (section 215.1). To achieve this level of protection, a control system isolating device must be used in combination with written authorizations and safe work procedures. The goal is to ensure that workers performing the work verify effective isolation through direct communication with the isolating authority designated by the employer.

A control system isolating device must physically prevent activation of remotely controlled equipment. In the case of a computer-controlled system, a password or series of passwords does not *physically* prevent activation of the control system. Before defaulting to using control system isolating devices, the employer should consider more traditional alternatives, including rendering the equipment inoperative. If the alternatives are not possible or practicable, examples of how to physically prevent activation of the control system include

(a) locking out the ports on the computer(s) to prevent control devices such as a keyboard or mouse from being used, and
(b) locking out the room in which the controlling computer(s) is located.

Section 215.3 Returning equipment to operation

Subsection 215.3(1)

Except as described in subsection 215.3(2), only the worker who installed the lock, or is the designated worker under section 215(3) or section 215.1(3), is allowed to remove it. This is intended to prevent other persons from removing the lock and unknowingly creating a safety hazard.

Subsection 215.3(2)

Situations may arise in which the worker who installed the lock is unavailable e.g. off shift, on holidays, in transit, etc. or an emergency involving the equipment arises. In such situations, the lock may be removed by a competent worker designated by the employer to remove the lock. This ensures that the employer is aware of what is going to be done and that an appropriate worker performs the removal. Such removal must be done in accordance with a written procedure (as required by section 8 of the *OHS Regulation*) that includes verifying that no worker will be in danger due to removal of the lock.

Subsection 215.3(3)

Before all securing devices are removed,
(a) each worker involved in the work activity must be accounted for,
(b) any personal locks placed by workers must be removed in accordance with subsection 215.3(1), and
(c) the person about to return equipment to operation must first make sure that he or she, and other workers, are not in any danger. Audible and/or visual signals and warnings are often used to warn of equipment start-up. Personally contacting workers in the area who might be at risk of injury may be necessary in some circumstances to let them know that the equipment is being returned to operation.

Subsection 215.3(4)

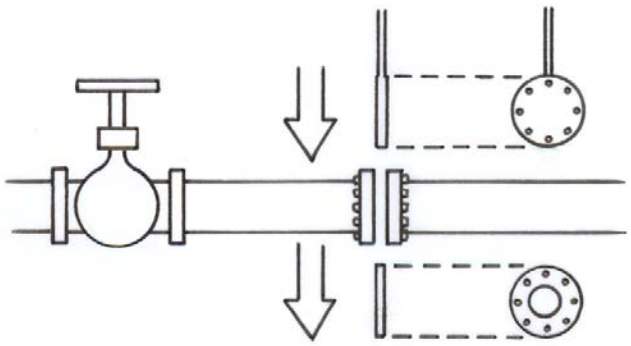
No explanation required.

Piping and Pigging

Section 215.4 Isolating piping

Employers must ensure that blanking, blinding or double block-and-bleed systems are in place and can be used to isolate pipes containing harmful substances under pressure. Blanking involves inserting a physical barrier through the cross-section of a pipe so that materials are prevented from flowing past that point (see Figure 15.2) Blinding involves disconnecting a pipe and attaching a physical barrier to its end so that materials are prevented from flowing out of the pipe.

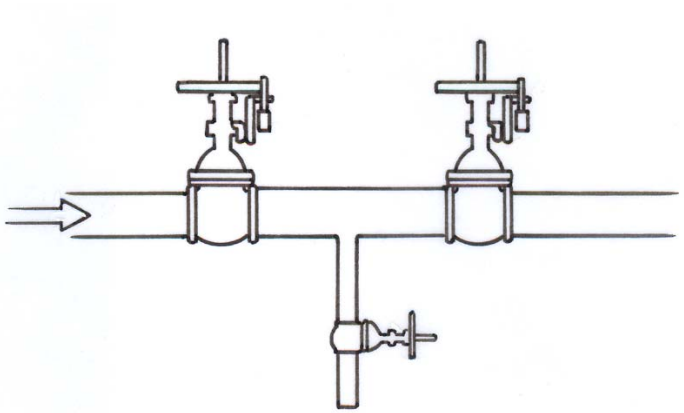
Figure 15.2 Example of blanking



Double blocking and bleeding involves use of a three-valve system where a pipe has two closed valves and an open drain valve positioned between them so that material is prevented from flowing and is re-directed in case of a valve leak (see Figure 15.3) When used, a double block-and-bleed must be situated directly upstream of the work area. This means that if flow in the pipe can come from more than one direction, a double block-and-bleed setup is required on each upstream side. The valves of a double block-and-bleed system must be secured to ensure an acceptable level of safety. Securing must be by a "positive" mechanical means that is either

(1) lockable (operated by a key or similar device) and attached to or integral with the securing device, or
(2) not lockable but is strong enough to withstand inadvertent/unauthorized opening without the use of excessive force, unusual measures, or destructive techniques e.g. metal-cutting tools.

Figure 15.3 Examples of a double block and bleed



Piping that has been blanked or blinded must be clearly marked to indicate the presence of the blank or blind. Piping systems that contain harmful substances must be blanked, blinded or double block-and-bled before and during the repair, modification or replacement of the piping.

In some circumstances it may not be reasonably practicable to provide blanking, blinding or double block and bleed isolation. In these cases the employer must ensure that an alternate means of isolation is implemented. The alternative must
(1) adequately protect workers, and
(2) be certified as appropriate and safe by a professional engineer.

Section 215.5 Pigging and testing of pipelines

Where pigging and testing is being done, only workers directly involved with that operation are allowed to be in the immediate area of piping exposed while the work is in progress. Workers must not be in the immediate vicinity of a pressurized pigcatcher or pipe-end during pigging and testing. Pigs may only be removed after the pigcatcher has been depressurized.