FALL PROTECTION

Hierarchy of Hazard Elimination and Control

The hierarchy of hazard elimination and control will be used to manage the risk of falls from elevation during construction. The list of controls (in order of preference) is:

Elimination: The preferred method of controlling a fall hazard is to remove it completely. Designers and workers should consider the cost and possible introduction of additional risks by moving equipment to ground level

Engineering Controls: If the fall hazard cannot be removed, engineered designs can be implemented to mitigate the risk.

Administrative Controls and Employee Training: If implementation of items 1) or 2) is not reasonably practical it is preferred that fall hazard exposure is to be managed through administrative controls.

Personal Protective Equipment: If the hazard cannot be eliminated or controlled through 1) 2) or 3) above, then appropriate personal protective equipment shall be used.

If anyone of the above approaches is not reasonably practicable, a combination of two or more is an acceptable means of managing a fall hazard.

General Fall Protection Requirements

Guardrails and Handrails

An area accessible to workers must have *guard*s or *guardrail*s installed in any of the following circumstances:

- if a raised floor, open-sided floor, mezzanine, gallery, balcony, work platform (permanent), ramp, walkway, or runway is 4 ft (1.2 m) or more above the adjacent floor or grade level;
- a construction walking/working surface (horizontal and vertical surface) with an unprotected side or edge which is 6 feet (1.8 m) or more above a lower level;
- on both sides of any walkway over or adjacent to any substance which is a hazard if a worker fell in, or on it, or which is over machinery;
- around the perimeter of any open container or containment area such as an open vat, bin, tank or pit which is 4 ft (1.2 m) or more in depth and which has sides that do not extend at least as high as required for a *guardrail* above the adjacent grade or work surface;

If the use of a *guardrail* is not *reasonably practicable*, the hierarchy of hazard elimination and control shall be used to recommend an appropriate means of fall protection.

*Guardrail*s and handrails must meet the requirements of the Occupational Safety and Health Association (OSHA), local State regulations, and be appropriate for the use and occupancy of the area. These guidelines state a guardrail must consist of:

- Top rail located between 42 inches (1.07 m) and 45 inches (1.14 m) in height above the walking/working surface.
- Mid rail at 21 inches (0.53 m) in height or approximately halfway between the walking/working surface and the top rail
- Intermediate members (such as balusters), when used between posts, shall not be more than 19 inches (0.48 m) apart.

- Toe board extending at least 4 inches (100 mm) above the walking/working surface and shall be capable of withstanding 50 lb (222 N). They shall have not more than ¼ inch (6.4 mm) clearance above the walking/working surface and shall not have openings over 1 inch (25.4 mm) in greatest dimension.
- Guardrail must be smooth and not cause a projection hazard if the top rail overhangs the terminal post
- Guardrail must be capable of withstanding, without failure, a force of at least 200 lbs (889 N) applied within 2 inches (50.8 mm) of the top edge, or 20 lbs per linear foot (290 N/m), whichever is greater.
- The top edge of the guardrail shall not deflect to a height less than 39 inches (1.0 m) above the working/working level when a 200lb (889 N) test load is applied in a downward direction.
- When guardrail systems are used around holes which are used as points of access (such as ladder ways), they shall be provided with a gate, or be offset so that a person cannot walk directly into the hole

Where work is performed at a work site at which a fall of 4 feet (1.2 m) or more may occur and workers are not protected by *guardrail*s, a written fall protection plan (i.e. Job Safety Analysis) must be prepared for and available at that work site before the work begins.

Excavations and Floor, Ground, and Roof Openings

Guardrails, fences, barricades or covers used to protect persons from falling into an excavation must meet the requirements of OSHA and local State regulations. Employees at the edge of an excavation 6 feet (1.8 m) or more in depth shall be protected from falling by guardrail systems, fences, or barricades when the excavations are not readily seen because of trees or other visual barrier; Employees working at the edge of a vertical pit, well, or shaft, which is more than 6ft (1.8 m) in depth, will be protected against falling by guardrails, fences or barricades. Barricades must be set back approximately 6ft (1.8 m) from the edge in order to be effective.

Floor, ground and roof openings, temporary or permanent are to be guarded by either a guardrail or a covering meeting the requirements of OSHA. Removable/retractable barriers can be used in temporary conditions if the barrier is set back approximately 6 feet (1.8 m) from the opening.

A guardrail or temporary barrier must guard wall opening, temporary or otherwise, with a four (4) foot (1.2 m) or greater drop. Temporary barriers must be set approximately 6 feet (1.8 m) from the opening.

For construction sites, working on, at, above, or near wall openings (including those with chutes attached) where the outside bottom edge of the wall opening is 6 feet (1.8 m) or more above lower levels and the inside bottom edge of the wall opening is less than 39 inches (1.0 m) above the walking/working surface, shall be protected from falling by the use of a guardrail system, a safety net system, or a personal fall arrest system.

Stairways and Platforms

Stairs and platforms must meet the requirements of OSHA and local State regulations and be appropriate for the use and occupancy of the area. Stair railings are to be installed on any stairway that has four (4) or more risers, or on any stairway that is adjacent to hazardous machinery.

Scaffold

See scaffolding section.

Ladders

Workers must inspect, use, and maintain portable ladders in accordance with OSHA requirements, local State regulations, and the *manufacturer's specifications*. The minimum rated capacity for portable ladders should be 300 pounds (1.3 kN). When working from a ladder at a height of 6 feet (1.8 m) or greater and cannot use one hand to hold onto the ladder while working from the ladder, fall- protection must be used.

Fixed ladder design must meet the requirements of OSHA. Extensive ladder design requirements are listed in the regulations. General requirements are as follows:

- Cages (except as provided in OSHA Section 1910.27 (d)(5)) shall be provided on ladders of more than 20 feet (6 m) to a maximum unbroken length of 30 feet (9 m), where the length of the ladder refers to the vertical distance between landings. The design of the cages is detailed in OSHA requirements.
- Cages are required on ladders less than 20 feet (6 m) in length where the ladder is located at an elevated platform that does not provide adequate fall protection.
- When ladders are used to ascend to heights exceeding 20 feet (6 m), landing platforms shall be provided for each 30 feet (9 m) of height or fraction thereof, except that, where no cage, well, or ladder safety device is provided, landing platforms shall be provided for each 20 feet (6 m) of height or fraction thereof.
- Platforms shall be not less than 24 inches (0.61 m) in width and 30 inches (0.76 m) in length.
- All platforms shall be equipped with standard railings and toe boards, so arranged to give safe access to the ladder.
- Ladder safety devices may be used on tower, water tank, and chimney ladders over 20 feet (6 m) in unbroken length in lieu of cage protection. No landing platform is required in these cases.

Elevating Work Platform or Aerial Device

Any elevating work platform or aerial device must meet OSHA, and local, and State regulations. These regulations required the following:

- Belting off to an adjacent pole, structure, or equipment while working from an aerial lift shall not be permitted
- Employees shall always stand firmly on the floor of the basket, and shall not sit or climb on the edge of the basket or use planks, ladders, or other devices for a work position.
- A fall restraint attached to the boom or basket when working from an aerial lift.
- Climbers shall not be worn while performing work from an aerial lift

Controlled access zone

Controlled access zones and their use shall conform to the following provisions:

When used to control access to areas where leading edge and other operations are taking place the controlled access zone shall be defined by a control line or by any other means that restricts access.

- When erecting precast concrete members, the control line shall be erected not less than 6 feet (1.8 m) nor more than 60 feet (18 m) or half the length of the member being erected, whichever is less, from the leading edge.
- The control line shall extend along the entire length of the unprotected or leading edge and shall be approximately parallel to the unprotected or leading edge.
- The control line shall be connected on each side to a guardrail system or wall.

When used to control access to areas where overhand bricklaying and related work are taking place:

- The controlled access zone shall be defined by a control line erected not less than 10 feet (3.1 m) nor more than 15 feet (4.5 m) from the working edge.
- The control line shall extend for a distance sufficient for the controlled access zone to enclose all employees performing overhand bricklaying and related work at the working edge and shall be approximately parallel to the working edge.
- Additional control lines shall be erected at each end to enclose the controlled access zone.
- Only employees engaged in overhand bricklaying or related work shall be permitted in the controlled access zone.

Control lines shall consist of ropes, wires, tapes, or equivalent materials, and supporting stanchions as follows:

- Each line shall be flagged or otherwise clearly marked at not more than 6-foot (1.8 m) intervals with high-visibility material.
- Each line shall be rigged and supported in such a way that its lowest point (including sag) is not less than 39 inches (1 m) from the walking/working surface and its highest point is not more than 45 inches (1.1 m) [50 inches (1.3 m) when overhand bricklaying operations are being performed] from the walking/working surface.
- Each line shall have a minimum breaking strength of 200 pounds (889N).

On floors and roofs where guardrail systems are not in place prior to the beginning of overhand bricklaying operations, controlled access zones shall be enlarged, as necessary, to enclose all points of access, material handling areas, and storage areas.

On floors and roofs where guardrail systems are in place, but need to be removed to allow overhand bricklaying work or leading edge work to take place, only that portion of the guardrail necessary to accomplish that day's work shall be removed.

Fall Restraint and Arrest Systems

Personal fall arrest or restraint systems are to be used whenever the workplace assessment has identified the need for personal fall protection or work circumstances are encountered where personal fall protection systems can eliminate the hazard. All *fall arrest system*s shall meet the requirements of *OSHA*, local State regulations, and be certified by a professional engineer. A rescue plan shall be in place for retrieval when fall arrest system is used. If feasible, fall restraint systems are the preferred manner to provide fall protection over fall arrest systems.

Approved personal protective equipment and proper procedures to be followed for effective fall restraint and fall arrest. For offshore applications, floatation work vest (Type V) is required over water when using Personnel Restrain and Arrest Systems. Fall restraint systems must use the same approved equipment as fall arrest systems with the exception of the following:

- The attachment point to the body harness in a fall restraint system may be at the back, front or side dee-rings.
- Anchorage points for a fall restraint system must be capable of supporting 5000 pounds (22.2 kN) or be designed by a Qualified Person, with a safety factor of two.

Personal Fall Restraint

A personal fall restraint system is a fall protection system that is installed in a manner to restrain a person and prevent a fall of any distance from occurring. Fall restraint is the preferred method of fall protection over fall arrest and is used where other passive means of fall protection, such as guardrails, cannot be used. Fall restraint is also used where the clearance distance to the lower level is not enough to safely use fall arrest equipment and eliminates the additional risk of injury that can occur using fall arrest. Complicated rescues are also eliminated with fall restraint systems.

Personal Fall Arrest

Fall arrest systems will be used when the fall hazard cannot feasibly be eliminated by other means or when fall arrest has been identified as the preferred method of fall protection. Fall arrest systems must meet the requirements of OSHA, local State regulations, and be appropriate for the use and occupancy of the area. General guidelines are as follows:

- Personal fall arrest systems shall be rigged such that an employee can neither free fall more than 6 feet (1.8 m), nor contact any lower level and shall limit the maximum arresting force on an employee to 1800lb (8 kN).

- The combined body and tool weight of a person using a fall arrest system will be 310 pounds (1.38 kN) or less. If the combined body and tool weight exceeds 310 pounds (1.38 kN), proper protection for heavier weights will be determined by a qualified person.
- The attachment point of a fall arrest system must be to the back Dee-ring, located between the shoulders.
- Personal fall arrest systems shall not be attached to guardrail systems, nor shall they be attached to hoists unless it is rigged to allow the movement of the employee only as far as the edge of the walking/working surface.
- Bring an employee to a complete stop and limit maximum deceleration distance an employee travels to 3.5 feet (1.0 m).
- Have sufficient strength to withstand twice the potential impact energy of an employee free falling a distance of 6 feet (1.8 m), or the free fall distance permitted by the system, whichever is less.

Fall Restraint and Arrest Anchors and Connectors

Fall restraint and arrest anchors must meet OSHA requirements and local State regulations. Connecting components consist of carabineers, Dee-rings, O-rings, oval rings, self-locking connectors and snap hooks meet the requirements of OSHA. General guidelines are as follows:

- *Anchor* points used for attachment of a personal fall arrest system shall be independent of any anchor being used to support or suspend a platform.
- The ultimate load capacity of fall arrest *anchor* points shall be *permanent*ly marked on the anchor if it's practically possible.
- Anchors, Dee-rings, and snap hooks shall be capable of supporting at least 5,000 pounds (22.2 kN) per employee attached or shall be designed by a Qualified or Competent Person, as part of a complete system which maintains a factor of safety of at least two.
- Dee-rings and snap hooks shall be proof-tested to a minimum tensile load of 3600lb (16 kN) without cracking, breaking, or taking permanent deformation.
- Connectors shall be drop forged, pressed or forged steel, or made of equivalent material.

Full Body Harnesses

Full body harnesses are required.

Lanyards

*Lanyard*s must meet the requirements of OSHA and local State regulations.

- If a *lanyard* is to be exposed to a tool or corrosive agent that could sever, abrade, or burn it, the *lanyard* shall be made of material not affected by the hazard.
- The *lanyard* shall be made of non-conductive material where the hazard is electrocution.
- The shortest length *lanyard* that will still permit unimpeded performance of the worker's duties shall be used.
- Only one *lanyard* between the worker and the *anchor* point shall be used.
- Knots are not to be tied in *lanyards*.
- The *lanyard* shall be secured to an anchor point no lower than the worker's shoulder height unless a shoulder height anchor point is unavailable, in which case the lanyard must be secured to an anchor point as high as *reasonably practicable*.
- Ropes used in *lanyards* shall be made from synthetic fibres except for when they are used in conjunction with hot work where the lanyard may be exposed to damage from heat or flame.

Horizontal Lifelines

Horizontal lifelines must meet the requirements of OSHA and local State regulations. General guidelines are as follows:

- Horizontal lifelines must be designed by a Qualified Person, who is a registered Professional Engineer (PE). The PE must have the appropriate education and knowledge in fall protection systems to appropriately design and oversee the installation and use of the system.
- Horizontal lifelines shall be designed, installed and used under supervision of a Qualified Person, as part of a complete personal fall arrest system which maintains a safety factor of at least two.
- Horizontal lifelines will be inspected before each use by the user and thoroughly inspected by a Competent Person, annually.
- Lifelines must be protected against sharp edges to prevent being abraded or damaged and shall be made from synthetic fibres except for when they are used in conjunction with hot work where the lifeline may be exposed to damage from heat or flame. Wire rope or other material appropriate to the hazard may be used when the lifeline may be exposed to a tool or chemical agent that could sever, abrade or burn the *lifeline*.
- Knots are not to be tied in lifelines.
- A copy of the design drawings and specifications of the system will be kept on site and available to the users of the system. The specifications will include all pertinent information regarding the use and limitations of the system, including, but not limited to, the maximum number of persons that may use the system at one time.

Vertical Lifelines

Vertical *lifelines* shall meet the requirements of OSHA and local State regulations. General guidelines are as follows:

- Lifelines are to be secured to an independent *anchor* point.
- Only one employee will be attached to a single lifeline.
- Vertical lifelines shall have a nominal breaking load specified by the manufacturer of at least 5000 lb (22.2 kN).
- Knots are not to be tied in lifelines except for a stopper knot at its lower termination.
- Lifelines must be protected against sharp edges to prevent being abraded or damaged and shall be made from synthetic fibres except for when they are used in conjunction with hot work where the lifeline may be exposed to damage from heat or flame. Wire rope or other material appropriate to the hazard may be used when the lifeline may be exposed to a tool or chemical agent that could sever, abrade or burn the *lifeline*.
- Be installed and used in a manner that minimizes the hazards of swinging if a worker falls.
- Alternate means of fall protection must be used when a worker is working near an energized electrical conductor or in a *work area* where a *lifeline* made of electrically conductive materials cannot be safely used.

Only one worker shall be attached to a vertical *lifeline* at any one time unless the vertical *lifeline* is:

- part of a ladder safety device, or
- The *manufacturer's specification* or specifications certified by a professional engineer allow for the attachment of more than one worker to the same vertical *lifeline*.

Inspection

All equipment used as part of a *fall protection system* shall be:

- Visually inspected by the worker before use
- Visually inspected not less than once (twice in California) annually by a *competent person* in accordance with the manufacturer's recommendations. The date of each inspection shall be documented.
- Kept free from substances and conditions that could contribute to deterioration of the equipment,
- Maintained in good working order
- Re-certified at intervals specified by the manufacturer.
- Damaged equipment will not be used and will be either returned to the manufacturer or destroyed once it is identified.
- Fall protection equipment that has been shock loaded in a fall will be discarded.
- All equipment used in a fall arrest system will be installed and used according to manufacturer's instructions and the Personal Protective Equipment.

Training

As part of a new hire orientation, all employees who may be required to climb above 6 feet where fall protection is required, will be instructed on general fall protection requirements and the contents of TransCanada's fall protection policy. When employees are directly affected by fall protection requirements, additional training will be provided. Depending on the nature of the work, training will include:

- Employees working from aerial lifts must be trained in the fall protection requirements related to aerial lifts.
- Employees requiring the use of fall arrest or restraint equipment will be trained in the use and inspection of the equipment.
- Tower climbing requires special instruction for qualified climbers.

Employees required to use fall restraint and fall arrest systems, will receive update training at least every three years. Training will be recorded in the company's electronic training records file.

Definitions

administrative controls	means controlling the hazard using methods that depend on the actions of the worker to be effective
aerial device	means a telescoping or articulating unit used for positioning a personnel-carrying basket, bucket, platform or other device at an elevated work location
anchor	means a secure point of attachment that has been certified by a professional engineer
assembly occupancy	refer to applicable building code definition
business occupancy	refer to applicable building code
carabiner	means a connecting component that • generally consists of a trapezoidal or oval body having a self-locking gate that requires at least two consecutive, deliberate actions to open to permit the body to receive an object and that, when released, automatically closes and locks to prevent inadvertent opening; and • has an ultimate tensile strength of at least 5000lb (22.2 kN)**;**
competent worker	means adequately qualified, suitably trained, and with sufficient experience to safely perform work, without or with only a minimal degree of supervision
controlled access zone	means an area in which certain work (e.g., overhand bricklaying) may take place without the use of guardrail systems, personal fall arrest systems, or safety net systems and access to the zone is controlled.
engineered controls	means controlling the hazard at its source using methods that do not depend on the actions of the worker to be effective
fall arresting device	means personal protective equipment that provides a means of arresting the fall or a worker and which, subsequent to the arrest of the fall, does not by itself permit the further release or lowering of the worker**;**
fall arrest system	means a system that will stop a worker's fall before the worker hits the surface below
fall protection system	means • a *fall arrest system*, • a *travel restraint system*, • a safety net, or • a *control zone*.
fixed ladder	means a ladder that is fixed to a structure in a vertical position or at an angle that is between vertical and 15 degrees to the vertical
free fall distance	means the vertical distance from the point where a worker falls to the point where the fall arrest system begin to cause deceleration of the fall
full body harness	means a body support device consisting of connected straps designed to distribute a fall arresting force over at least the thighs, shoulders and pelvis, with provision for attaching a lanyard, lifeline or other components
Guard	means a protective barrier around an opening in a floor or along the open sides

	of stairs or a ramp, landing, balcony, mezzanine, raised walkway or any other area to prevent a fall to a lower level, or inadvertent entry into a dangerous area
guardrail	a guard consisting of a top rail that is 42 inches (1.07 m) to 45 inches (1.14 m) above the work surface, and an intermediate rail located approximately midway between the underside of the top rail and the top of the toe board, if one is provided, or the work surface if no toe board is provided.
heavy duty scaffold	means a scaffold designed to support an evenly distributed load of no more than 75lb/ft^2 (3.6 kPa) with a plank span of no more than 7ft (2.1 m).
horizontal lifeline system	means a system composed of a synthetic or wire rope, installed horizontally between two or more anchors, to which a worker attaches a personal fall protection system
lanyard	means a flexible line of webbing or synthetic or wire rope that is used to secure a full body harness or safety belt to a lifeline or anchor
lifeline	means a synthetic or wire rope, rigged from one or more anchors, to which a worker's lanyard or other part of a personal fall protection system is attached
light duty scaffold	means a scaffold designed to support an evenly distributed load of no more than 25lb/ft^2 (1.2 kPa) with a plank span of no more than 10ft (3.0 m).
manufacturer's specifications	means the written specifications, instructions or recommendations of the manufacturer of equipment, which describe the manner in which the equipment is to be erected, installed, assembled, started, operated, used, handled, stored, stopped, adjusted, maintained, repaired or dismantled and includes a manufacturer's instruction, operating or maintenance manual or drawings for that equipment
medium duty scaffold	means a scaffold designed to support an evenly distributed load of no more than 50lb/ft^2 (2.4 kPa) with a plank span of no more than 8ft (2.4 m).
permanent	means any structure, process, or action that is intended to exist, and continue to exist, after the activities involving its construction, preparation or introduction are complete
personal fall arrest system	means personal protective equipment consisting of an assembly of subsystems and components used to arrest a worker's fall and may contain some or all of the following: • an independent anchor point; • a lanyard, lifeline or static line; • a full body harness; • a shock absorber; and, • connectors
personal protective equipment	means equipment or clothing worn by a worker for protection from health or safety hazards associated with working conditions at a work site
reasonably practicable	comparing the nature or extent of the risk to what is involved to eliminate or mitigate it in terms of costs. If the risk is low and the costs of elimination or mitigation are high, then a defendant may be able to argue that the risk control method proposed is not cost effective
scaffold or *scaffolding*	means any temporary work platform and its supporting structure used for supporting workers or materials, or both, but does not include suspended cages, permanent suspension powered work platforms, boatswain's chairs, elevating platforms and aerial devices, work platforms mounted on a forklift

	truck, temporary supporting structures and fly form deck panels
shock absorber	means a device intended to limit deceleration of a worker during fall arrest;
swing fall hazard	means the hazard to a worker of swinging and colliding with an obstruction following a fall when connected to a lanyard or lifeline that runs at an angle off vertical;
total fall distance	means the vertical distance from the point a worker falls to the point where the fall is stopped after all fall arresting devices have extended to their maximum length
travel restraint system	means a personal fall protection system, guardrails or similar barrier that prevent a worker from travelling to an edge or work position from which the worker could fall
unusual risk of injury	means, with respect to the risk of injury from a fall, there is a risk of injury greater than the risk of injury from impact on a flat surface;
work area	means a place at a work site where a worker is or may be during work or during a work break
work positioning system	a system used to support a worker so that the worker's hands are free when he or she reaches the work position.