38 IRONWORKERS: STRUCTURAL STEEL

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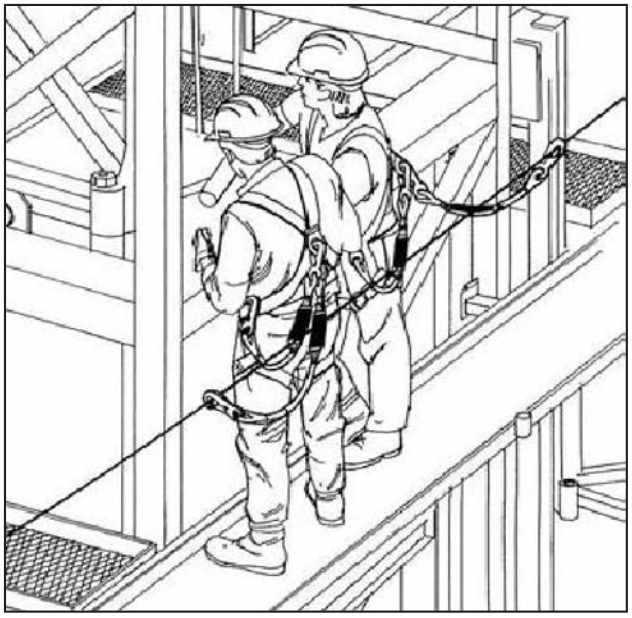

Figure 1. Ironworkers at work

Personal protective equipment (PPE)

Clothing: Many injuries can be prevented by choosing the right clothing. Don't have cuffs on your pants or sleeves because they can get caught on something and cause you to fall. Cuffs can also catch sparks and cause a burn.

Hearing protection: Hearing protection is a must for today's ironworker. Hammering, reaming, and equipment all produce noise at levels that can harm your hearing. Wear appropriate hearing protection. It should filter out noise above 85 decibels but still allow you to communicate with your co-workers and hear any alarms or warnings. Reduce the risk of infection: Make sure that your hands are clean before using expanding foam hearing protection.

Eye protection: Wear proper eye protection when reaming drilling, grinding, burning, welding—or whenever hazards require it. The right eye protection can be different for different activities. For example, it's common for ironworkers to perform activities such as gas cutting and stud welding. These activities would require the use of Class 2C goggles for radiation protection. It is also common for ironworkers to be grinding and cutting. These activities would require the use of a full face shield to reduce the risk of injury from flying objects and particles. At some jobsites, eye protection is mandatory. Always wear eye protection as required. For further information, refer to the chapter on PPE in this manual for a list of activities with recommended eye and face protection.

Skin protection: Ironworkers must protect their skin against burns from hot metal, ultraviolet (UV) radiation from the sun, welding radiation, and other hazards. Skin protection includes

- clothing that is flame-resistant and provides UV protection
- long sleeved shirts
- full-length pants
- leather-faced gloves
- sunscreen with a sun protection factor (SPF) of 15 or higher.

Leather-faced gloves provide protection from hot steel and resistance to abrasion.

Head protection: A hard hat complying with the Construction Regulation (Ontario Regulation 213/91) is required on construction projects at

all times. A CSA Type 2 Class E or equivalent hat with chinstrap is recommended because ironworkers

- work at elevations in windy conditions
- have increased risk of a lateral impact due to the specific nature of their work.

Please note that hard hats must be worn with the brim forward unless the hat has been tested and the manufacturer confirms that it can be worn with the brim pointing backwards. (The hard hat will have an embossed symbol indicating that it has been certified as safe to be worn backwards.)

Foot protection: Workers must wear CSA certified Grade 1 boots. Boots should also be resistant to electric shock (certified by a white label with the Greek letter omega Ω). Ironworkers should wear boots with slip resistant soles because of the time spent walking on smooth beams.

Hand protection: Gloves are an essential part of everyday PPE. Select your gloves based on site conditions such as temperature, the work being performed, the chance of getting cuts and abrasions, and the dexterity required.

For more information, see the chapter on PPE in this manual.

Cold Stress and Heat Stress

Cold Stress

Working in cold environments presents health risks. The cold can be caused naturally by the weather or be created artificially, as in refrigerated environments. You can get serious cold-related illnesses and injuries, leading to permanent tissue damage and even death.

Exposure to cold causes two major health problems: hypothermia and frostbite.

For more information, see the chapter on Cold Stress in this manual.

Heat Stress

Heat stress can occur wherever construction operations take place in hot, humid environments. The locations may be indoors or outdoors.

Works that requires you to wear semi-permeable or impermeable protective clothing can contribute significantly to heat stress. Heat stress causes the body's core temperature to rise and could lead to confusion, irrational behaviour, loss of consciousness and even death.

For further information please see the chapter on Heat Stress in this manual.

Lead exposure

This section supplements the chapter on Occupational Health in this manual with material of particular importance to ironworkers.

The fumes from welding and cutting are the greatest health hazards for ironworkers. Exposure to welding by-products such as fumes, radiation, noise, or vibration is covered in the chapter on Occupational Health. The risk to your health is worse when there is a lead-based paint on the metal being cut or welded.

The following sections deal with the hazard of lead exposure during welding and cutting processes. For further information refer to the Ministry of Labour's guideline *Lead on Construction Projects*. We have excerpted a chart from that guideline at the end of this section.

HOW CAN I GET LEAD POISONING?

Lead poisoning can occur when you inhale or ingest lead dust and fumes during burning or welding of steel structures coated with lead-containing paints.

WHAT ARE THE HEALTH EFFECTS?

Common symptoms of acute lead poisoning are loss of appetite, nausea, vomiting, stomach cramps, constipation, difficulty in sleeping,

fatigue, moodiness, headache, joint or muscle aches, anaemia, and decreased sexual drive. Severe health effects include damage to the nervous system, including wrist or foot drop, tremors, and convulsions or seizures.

The frequency and severity of medical symptoms increase with the concentration of lead in the blood.

Chronic lead poisoning may result after lead has accumulated in the body over time, mostly in the bone. Long after exposure has ceased, some physiological event such as illness or pregnancy may release this stored lead from the bone and produce health problems such as impaired blood synthesis, alteration in the nervous system, high blood pressure, effects on male and female reproductive systems, and damage to the developing fetus.

APPLICABLE REGULATIONS

Regarding regulations governing lead exposure on construction projects, the Ministry of Labour references *Designated Substances—Lead* (Regulation 843) and makes it relevant for construction projects with section 25(2)(h) of the *Occupational Health and Safety Act*, The following excerpt regarding lead exposure was taken from the Ministry of Labour's guideline *Lead on Construction Projects*:

"The Ministry's designated substance regulation (DSR) for lead, Regulation 843, specifies occupational exposure limits (OELs) for lead, and requires assessment and a control program to ensure compliance with these OELs. The OEL for inorganic lead is 0.05 milligrams per cubic metre (mg/m^3) of air as an 8-hour daily or 40-hour weekly time-weighted average."

"Measures and procedures that ensure construction workers receive the same standard of protection as workers covered by Regulation 843 should therefore be implemented on construction projects where exposure to lead is a hazard. Such measures and procedures are deemed to be in compliance with section 25(2)(h) of the OHS, as taking "every precaution reasonable in the circumstances for the protection of a worker."

WELDING, CUTTING, OR BURNING

Before welding, cutting, or burning any metal coated with lead-containing materials, remove the coating to a point at least four inches from the area where heat will be applied. When removal of lead-containing paint is not feasible, use engineering controls (e.g., local exhaust ventilation) to protect workers. The controls

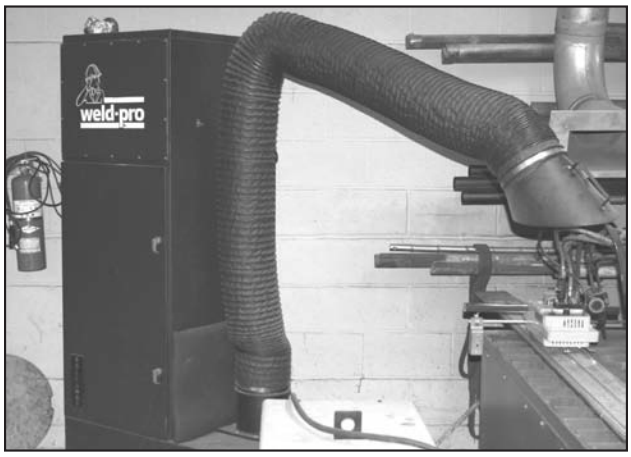

Figure 2. Portable fume extractor

should remove fumes and smoke at the source and keep the concentration of lead in the breathing zone below the exposure limit.

REMOVAL OF LEAD PAINT

Lead-based paint can be removed by a variety of methods, including

- chemical stripping (do not use chlorinated solvents for stripping paint because they can lead to toxic fumes being produced during welding)
- wet scraping using a paint scraper
- mechanical stripping if the sander or grinder is equipped with a High Efficiency Particulate Air (HEPA) filter.
- heat stripping if the temperature is below 600°C. Above 600°C lead fumes become airborne creating a significant inhalation hazard.

Use protective sheeting to collect debris that has been sanded, grinded, or stripped away.

Do not do any of the following activities when working in areas that might contain lead-based paint because they can create dangerous levels of lead dust or fumes.

- Open flame burning or torching (including propane-fuelled heat grids) and heat guns operating above 600°C. These activities release toxic fumes.
- Machine sanding or grinding without a HEPA filter. These activities create lead dust.
- Uncontained hydroblasting, high-pressure washing or abrasive blasting, or sandblasting. These activities create lead dust.
- Using methylene chloride paint removal products. These products release toxic fumes.
- Extensive dry scraping creates lead dust.

PERSONAL HYGIENE

Personal hygiene is an important element of any program for protecting ironworkers from exposure to lead dust. Employers should provide adequate washing facilities at the jobsite so that workers can remove lead particles that accumulate on the skin and hair. For certain high-hazard operations, decontamination facilities with showers may be required.

All workers exposed to lead should wash their hands and faces before eating, drinking, or smoking, and they should not eat, drink, or use tobacco products in the work area. Tobacco products (cigarettes, cigars, chewing tobacco, etc.) and food items should not be permitted in the work area. Contaminated work clothes should be removed before eating.

Workers should change into work clothes at the jobsite. Work clothes include disposable or washable coveralls. Street clothes should be stored separately from work clothes in a clean area provided by the employer. Separate lockers or storage facilities should be provided so that work clothing and shoes do not contaminate clean clothing.

Workers should change back into their street clothes after washing or showering and before leaving the jobsite. Doing so will prevent the accumulation of lead dust in workers' cars and homes and protect their family members from exposure to lead. Separate laundering of washable coveralls can help prevent take-home exposures.

WARNING SIGNS

Post warning signs to mark the boundaries of lead-contaminated work areas. These signs should indicate that there is a lead hazard and prohibit eating and drinking in the area.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Use engineering controls and good work practices to minimize worker exposure to lead. PPE should supplement the engineering controls and good work practices.

PROTECTIVE CLOTHING

Workers who are welding, cutting, or burning should wear non-flammable clothing.

Protective clothing not only shields workers from the hazards of welding, but it also minimizes the accumulation of lead on the workers' skin and hair. Workers should change into washable coveralls or disposable clothing before entering the contaminated work area.

Wearing protective equipment or clothing can contribute to the development of heat stress. Take steps to prevent heat stress. See the chapter on Heat Stress in this manual.

To reduce the amount of lead that could accumulate in a worker's car and home, and to protect the members of the worker's household, lead-contaminated clothing (including workboots) should be left at the jobsite.

RESPIRATORY PROTECTION

The best way to minimize worker exposure to lead is "control at the source" (such as containment or local exhaust ventilation). Control at the source, however, is often impractical at construction sites, where airborne lead concentrations may be high or may vary unpredictably. Therefore, respiratory protection is also necessary for operations such as sanding or grinding. A respirator is the last resort, but sometimes it's your only choice.

When respirators are used, the employer must establish a comprehensive respiratory protection program as outlined in the CSA standard Z94.4-93: *Selection, Use, and Care of Respirators*. Important elements of the CSA standard are:

- an evaluation of the worker's ability to perform the work while wearing a respirator
- regular training of personnel
- periodic environmental monitoring, and
- respirator fit testing, maintenance, inspection, cleaning, and storage.

The employer should evaluate the respiratory protection program regularly.

Respirators should be selected by the person who

- is in charge of the program
- is familiar with the workplace
- knows about the limitations of each type of respirator.

The amount of lead released during construction and can vary substantially, so use the highest anticipated exposure to determine the appropriate respirator for each job.

Respirator selection should be made according to the guidelines in the table below, which is an excerpt from the Ministry of Labour's guideline *Lead on Construction Projects*. Employers must use respirators that are approved by the National Institute of Occupational Safety and Health (NIOSH).

Medical Monitoring

The level of lead in the blood is currently the best indicator of a person's exposure to lead. Workers who can potentially be exposed to lead should be monitored for the presence of lead in their blood and for any effects of lead on the blood-forming system. This assessment is necessary to ensure that engineering controls, personal hygiene practices, and PPE are preventing lead exposure. Workers are not required to participate in a medical monitoring program if they don't want to.

TRAINING

Workers should receive training that includes

- information about the health effects of lead exposure
- information about how to recognize lead poisoning early
- description of proper personal hygiene practices that reduce the risk of lead poisoning
- instruction on the use and care of protective equipment (including protective clothing and respiratory protection)
- instruction on specific practices for working safely with lead-containing paints.

Respirator Requirements & Other Measures and Procedures for Type 1, 2, and 3 Lead-Containing Operations From the Ontario Ministry of Labour's guideline *Lead on Construction Projects*

OPERATIONS	REQUIRED RESPIRATOR	OTHER MEASURES & PROCEDURES
TYPE 1		
• Application of lead-containing coatings with a brush or roller. • Removal of lead-containing coatings with a chemical gel or paste and fibrous laminated cloth wrap. • Removal of lead-containing coatings or materials using a power tool that has an effective dust collection system equipped with a HEPA filter. • Installation or removal of lead-containing sheet metal. • Installation or removal of lead-containing packing, babbit or similar material • Removal of lead-containing coatings or materials using non-powered hand-held tools, other than manual scraping or sanding. • Soldering.	Respirators should not be necessary if general procedures listed in Section 6.1 of the Guideline are followed and if the levels of lead in air are less than 0.05 mg/m^3. However, if the worker wishes to use a respirator, a half-mask particulate respirator with N-, R- or P-series filter, and 95, 99 or 100% efficiency should be provided.	• Washing facilities consisting of wash basin, water, soap and towels should be provided and workers should use these washing facilities before eating, drinking, smoking or leaving the project; • Workers should not eat, drink, chew gum or smoke in the work area; • Dust and waste should be cleaned up at regular intervals and placed in a container that is: - dust tight - identified as containing lead waste - cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before being removed from the work area - removed from the workplace frequently and at regular intervals; • Drop sheets should be used below all lead operations which produce or may produce dust, chips, or debris containing lead; • Cleanup after each operation is encouraged to prevent lead contamination and exposure to lead; • Work area should be inspected at least daily to ensure that the work area is clean; • Compressed air or dry sweeping should not be used to clean up any lead-containing dust or waste from a work area or from clothing.

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OPERATIONS	REQUIRED RESPIRATOR	OTHER MEASURES & PROCEDURES
TYPE 2		
TYPE 2a		
• Welding or high temperature cutting of lead-containing coatings or materials outdoors. This operation is considered a Type 2a operation only if it is short-term, not repeated, and if the material has been stripped prior to welding or high temperature cutting. • Removal of lead-containing coatings or materials by scraping or sanding using non-powered hand tools • Manual demolition of lead-painted plaster walls or building components by striking a wall with a sledge hammer or similar tool	Half-mask particulate respirator with N-, R-, or P-series filter and 95, 99 or 100 percent efficiency.	**(In addition to Type 1 measures and procedures.)** • Signs should be posted in sufficient numbers to warn of the lead hazard. There should be a sign, at least, at each entrance to the work area. The signs should display the following information in large, clearly visible letters: - There is a lead dust, fume or mist hazard. - Access to the work area is restricted to authorized persons. - Respirators must be worn in the work area. • Suitable protective clothing and equipment should be worn by every worker who enters the work area (refer to Section 4.3 of the guideline).
TYPE 2b		
• Spray application of lead-containing coatings.	Powered air purifying respirator equipped with a hood or helmet, and a high efficiency filter. OR Supplied air respirator equipped with a hood or helmet and operated in a continuous flow mode.	

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<table>
<tr><th>OPERATIONS</th><th>REQUIRED
RESPIRATOR</th><th>OTHER MEASURES & PROCEDURES</th></tr>
<tr><td colspan="3">TYPE 3</td></tr>
<tr><td colspan="2">TYPE 3a</td><td rowspan="5">(In addition to Type 1 and Type 2 measures and procedures.)
• For Type 3a operations conducted indoors or outdoors, enclosures should be provided in the form of barriers, partial enclosures, or full enclosures.
• For Type 3b operations conducted indoors, full enclosures should be provided.
• With the exception of dry abrasive blasting conducted outdoors, enclosures provided for all other Type 3b operations conducted outdoors should be in the form of barriers, partial enclosures, or full enclosures. For dry abrasive blasting outdoors, full enclosures should be provided.
• Where there is an enclosure, general mechanical ventilation should be provided.
• A decontamination facility (refer to 6.4.3 of the guideline) should be made available for workers carrying out the following operations:
- abrasive blasting of lead-containing coatings or materials
- the removal of lead-containing coatings or materials using power tools without an effective dust collection system equipped with a HEPA filter
- removal of lead-containing dust using an air mist extraction system
- demolition or cleanup of a facility where lead-containing products were manufactured.
• When abrasive blasting is finished, dust and waste should be cleaned up and removed by vacuuming with a HEPA filter equipped vacuum, wet sweeping and/or wet shovelling.
• Where a dust generating operation is carried out, local exhaust ventilation should be provided to remove dust at the source. Wet methods should also be incorporated in the operation to reduce dust generation.</td></tr>
<tr><td>• Welding or high temperature cutting of lead-containing coatings or materials indoors or in a confined space.
• Burning of a surface containing lead.
• Dry removal of lead-containing mortar using an electric or pneumatic cutting device.
• Removal of lead-containing coatings or materials using power tools without an effective dust collection system equipped with a HEPA filter.
• Removal or repair of a ventilation system used for controlling lead exposure.
• Demolition or cleanup of a facility where lead-containing products were manufactured.
• An operation that may expose a worker to lead dust, fume or mist that is not a Type 1, Type 2, or Type 3b operation.</td><td>Full-facepiece air-purifying respirator equipped with N-, R-, or P-series filter and 100% efficiency.
OR
Tight-fitting PAPR with a high efficiency particulate filter.
OR
Half-mask or full-facepiece supplied air respirator operated in a continuous flow mode.
OR
Half-mask supplied air respirator operated in pressure-demand or other positive-pressure mode.</td></tr>
<tr><td colspan="2">TYPE 3b</td></tr>
<tr><td>• Abrasive blasting of lead-containing coatings or materials.</td><td>Type CE abrasive-blast supplied air respirator operated in a positive-pressure mode with a tight-fitting half-mask facepiece.

Type CE abrasive-blast supplied air respirator operated in a pressure-demand or positive pressure mode with a tight-fitting full-facepiece</td></tr>
<tr><td>• Removal of lead-containing dust using an air mist extraction system</td><td>Supplied air respirator equipped with a tight-fitting half-mask or full-facepiece and operated in pressure demand or positive pressure mode.</td></tr>
</table>

Tools of the Trade

Hand Tools

Ironworkers normally carry their hand tools on their belt or in a pouch on their belt. Load your belt so that it does not hinder your movements. Balance the tools on the belt so one side is not loaded more than the other. Place commonly used tools such as a spud wrench on your dominant side, i.e., on your right if you are right-handed. Don't carry tools by slipping them under your belt and make sure that your tools are secure and cannot fall.

Regularly inspect all hand tools for:

- split or loose handles
- mushroomed heads
- sprung parts.

Stop using unsafe tools immediately and tag them to identify the defects. Turn them in for repair or replace them.

Don't leave tools on ledges, ladders, beams, or near the edges of scaffolds or other work surfaces where they can be knocked off or where workers can trip over them. Store tools in appropriate containers away from edges.

Don't carry anything in your hands while using a ladder. Use hand lines for lifting tools or equipment.

Wrenches

When working with a wrench, there is always the hazard that it can slip off the work, or that the object may suddenly turn free. There is also the chance that the wrench or bolt will break. Always brace yourself so you won't lose your balance or be injured. Inspect your wrenches for flaws that could cause them to slip.

The spud wrench is the ironworker's most common wrench. It should have a round tapered handle forged at an angle to provide ample clearance for the hand yet keep the head in proper position for maximum power. The

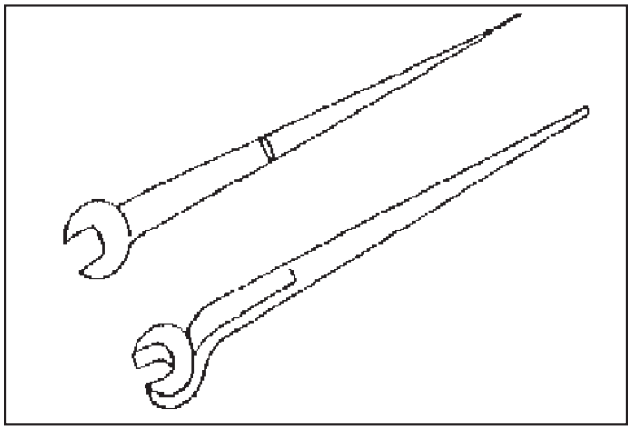

Figure 3. Spud Wrench

tapered end is used for aligning bolt holes in adjacent members. Spud wrenches are available in different sizes, so it is important to know the size of bolt being used before beginning work. Don't use a shim to make a wrench fit.

- Always grip the wrench so you won't be injured if it slips.
- Discard any damaged box or open-end wrench.
- Don't try to repair a wrench with rounded or damaged points on the box end, or worn or spread jaws on the open end.
- Wrenches are made from tempered steel and should not be welded.
- Face an adjustable wrench forward and turn the wrench so pressure is against the permanent jaw.
- Always pull on a wrench toward your torso, this will reduce the chance of finger injuries if the wrench slips.
- Handle stops on channel locks or pliers will prevent pinching injuries to the hand and fingers.
- Never overload a wrench by using a pipe extension on the handle or by striking the handle with a hammer. This can weaken the metal of the wrench and cause the tool to break. Heavy-duty box wrenches with extra long handles and "hammer" or striking-face wrenches are available for these jobs. The striking-face wrenches with

12-point box openings are designed for striking with a ballpeen or sledge hammer. Both offset and straight styles are available but the straight type is safer.

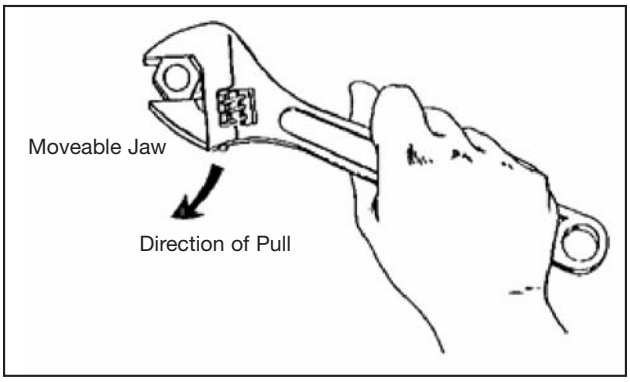

Figure 4. Correct use of adjustable wrench

Socket Wrenches

Socket wrench sets offer a multitude of options in both the types and sizes of the sockets, and the variety of drivers available for them including ratchet, universal, speeder, and their many extensions and adapters. When using adapters and adapting down in size, be careful not to over-torque a smaller socket and fastener with a larger driver.

Always use the correct size of socket; make sure it fits snugly. An oversized or sloppy fit can lead the wrench to slip and injure you, as well as causing wear to both the socket and the fastener.

Never use "hand" sockets on a power drive or impact wrench. (Hand sockets normally have a bright finish, while power and impact sockets usually have a dull finish and usually have thicker walls.)

Hickey Bars

Hickey bars are used to position steel for connection, or while shaking out or sorting steel. They provide the extra leverage required for a worker to move steel members which are heavy and awkward. When using a hickey bar,

- inspect it before using it
- position your feet and body so that you won't lose your balance
- avoid pinch points

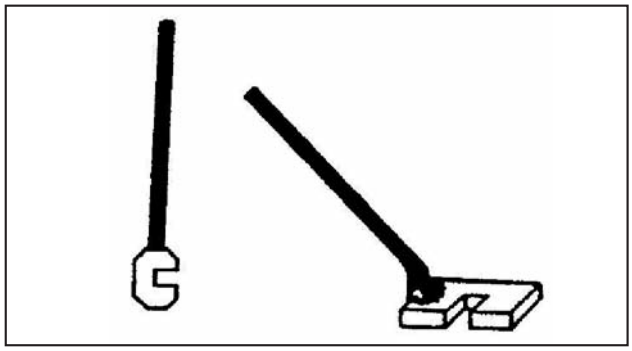

Figure 5 Hickey bars or beam turners

- ensure that there is enough clearance for the member to move
- stand to the side and turn the beam away from you.

Drift Pins and Punches

A drift pin is a tool tapered at one or both ends which is used to align holes before connecting. When striking drift pins, wedges, punches, or chisels with a hammer, hold them with tongs to prevent injuries to hands. Bull pins are tapered at one end with a striking head on the other. Using this type of drift pin reduces the chances of hand injury.

Don't use the tool if a mushroom head develops. If you hit a mushroom head, particles can fly off.

Figure 6: Bull Pin *Figure 7: Reamer* *Figure 8: Drift Pin*

Power tools

- Inspect and maintain power tools on a regular basis. Repair or discard defective tools.
- Power tools should have a "dead man" trigger or switch to prevent accidental activation.

- All portable electric hand tools must be grounded or double-insulated. The ground wires must be continuous from the tool housing to the power-source ground. Make sure that the casing on double-insulated tools are not cracked or broken.
- Use only those electric hand tools bearing Canadian Standards Association (CSA) approval.
- Safety guards should be kept in place on grinders and other power tools.
- Do not use a rotary screw with a protruding set screw that can catch on gloves or clothing.
- Use proper pins and o-rings to secure sockets to impact wrenches. Do not rely on rods, wire, or other makeshift materials.
- To thaw pneumatic tools place them in a warm area. Do not use direct heat. Proper use of a de-icer will keep pneumatic tools from freezing.
- All moving parts need to be guarded to prevent loose clothing or hair from becoming entangled in them.
- Use only the right tool for the job.

Gas- or Diesel-Driven Equipment

- Do nor refuel or lubricate an engine while it is running. Stop the motor and allow it to cool. Plan to refuel equipment first thing in the morning or at the beginning of the shift.
- Do not refuel while welding or burning is taking place in the area. Hot slag can bounce over a wide area.
- When using cold-weather starting fluids, such as ether, take extra care and follow the manufacturer's instructions. Too much ether can damage the engine.
- If a gasoline line or any part of an engine freezes, do not use a torch to thaw it out. Use gas-line antifreeze or a heating pad, or wrap the frozen part in a cloth and pour hot water over it. In sub-zero weather, skin contact with gasoline increases the risk of frostbite. Protect your hands from contact with gasoline or similar fluids.
- Provide proper ventilation if you're operating engines in an enclosed or unventilated area.
- At the start and end of each shift—and at least once during the day—bleed compressors (release air from the chamber) to blow off any condensation that has collected.
- Check to ensure that all gauges are working properly and report any malfunction.
- Use only non-flammable solvents to clean an engine.

Propane-driven equipment: Follow the manufacturer's instructions for checking regulators, fittings, cylinders, and other components. Only workers who have received training in handling propane are allowed to handle propane bottles or equipment. For propane training, contact the Construction Safety Association of Ontario or other certified trainers.

Electrically Driven Equipment

Wired electrical connections must be made by only qualified electricians and must conform to all applicable regulations.

Assume that all wires and switches are energized until proper inspection can prove otherwise.

When working on or near electrically driven equipment, follow appropriate lock-out procedures. Turn off the equipment, then close down and lock the switch box. See the chapter on Lockout and Tag in this manual for more information on procedures.

On grounded electrical machines or motors, the ground wire should be continuous from the housing to the power source.

Only explosion-proof motors and switches should be used in locations where ignition can cause a fire or explosion.

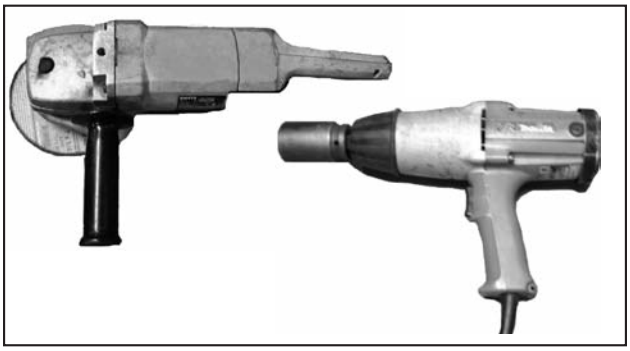

Figure 9: Grinder

Figure 10: Impact Gun

Site Preparation and Steel Erection

Hoisting Equipment

Cranes are used primarily to hoist steel into position. The crane operator must have the correct licence for the type of crane being operated and be familiar with the crane.

See the chapter on Rigging in this manual for complete information on rigging.

Before any steel structure can be erected safely and efficiently, the sequence of erection must be planned in advance and the structural members laid out in the order of their erection. Work areas for cutting should be laid out in advance to ensure safe and efficient operation. When stockpiling steel for on-site fabrication, ensure that a good solid base is provided for storage. If the steel is to be piled high, use long sleepers to ensure a level and safe storage area.

Keep work areas clear of clutter, debris, and scrap material. Keep a box or barrel close by for the disposal of scrap.

Preparing On-Site Storage Areas

The area where the material is to be stored should be as level as possible, well-drained and with good access. Storage areas should be as close to the work area as possible. Storage areas should be well laid-out with clear and direct access to work areas. Store the material so that it will be kept free from mud, oil, grease, etc. In general, a clean work area is a safe work area. Store materials away from travelled walkways.

Avoid storing materials under powerlines, especially if using hoisting equipment to move it.

4x4 sleepers should be used to keep the steel off the ground and to allow slings to pass freely under the load. Make sure there is adequate blocking available before steel is delivered.

The general contractor should be consulted before setting up storage areas so that the general is aware of potential weights to be stored in each area. Ensure that steel stored on floors does not overload the structure, and that reshoring is in place if necessary.

Material should be stored at least 1.8 metres (6 feet) away from all slab edges and openings.

Normally, members are laid down on site and sorted after they arrive. Plan the job well so that members can be laid out in sequence. This will avoid moving the steel repeatedly.

Unloading and Storage Precautions

Post “DANGER” signs and cordon off unloading areas as required. Always keep people who are not directly involved with off-loading out of the area.

Be sure to communicate with the driver about unloading procedures.

Serious accidents can occur if tie-downs are released without the load being contained to prevent materials from spilling over. It is very important to check if the load has shifted before you off-load it. If it has shifted, the weight on the trailer may not be evenly distributed and the straps may be over-tensioned. Many workers have been struck by shipping straps upon release.

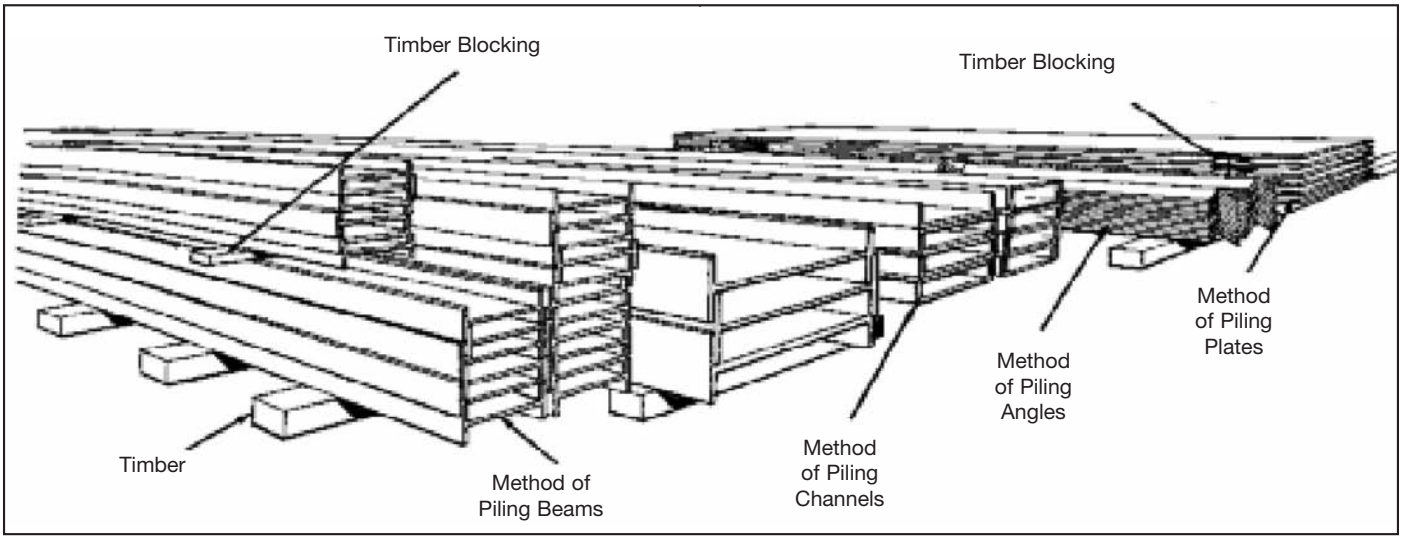

Figure 11. Picture of steel laid out

When unloading the trailer always watch for loose or small pieces. Sometimes, steel suppliers or delivery companies place small pieces either on or in-between larger pieces. These small pieces can cause serious injury if they shift or fall while being lifted. Always walk to the ends after hooking up and examine the blocking that was used. Blocking should be hardwood, but it could be something else. Don't assume that the supplier's delivery company has used hardwood when loading the trailer.

Land and block the load before unhooking it. Lower loads onto adequate blocking to prevent damage to slings.

Make sure identification marks are clearly visible to avoid extra handling.

Space the members so that they can be picked in sequence without having to move other members. If members must be stacked in layers, put sleepers between each layer.

Near openings, arrange material so that it cannot roll or slide in the direction of the opening.

Positioning the Truck

- The truck should be positioned on a level area as close to the crane as possible to prevent the crane from overreaching.

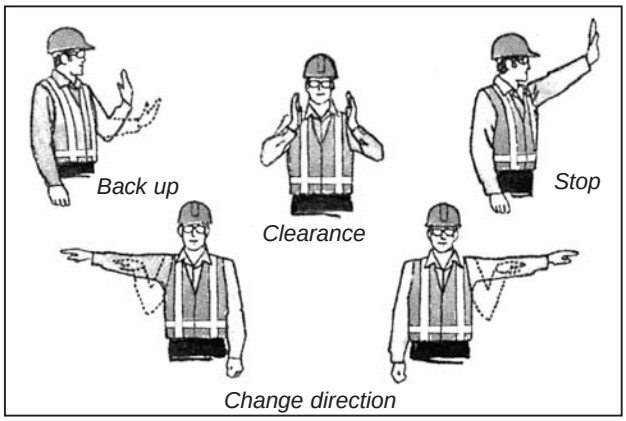

Figure 12. Hand Signals for Traffic Control

- Keep the truck and crane away from overhead powerlines.
- Trucks backing up must be directed by a competent signaller.
- The supervisor should tell the truck driver where to wait during loading and unloading.
- Always stake loads before unloading.
- Unload the truck in such a way to prevent uneven weight distribution. Uneven load distribution could cause the truck bed to shift, resulting in material spill over.

High-Visibility Clothing

The Construction Regulation (Ontario Regulation 213/91) requires that any worker who may be endangered by vehicles on a project must wear high-visibility clothing.

Unless stated otherwise, the high-visibility clothing described in this section applies to signallers and workers directing traffic.

High-visibility clothing has two main features:

- **Background material** — The fabric must be fluorescent orange or bright orange and provide the wearer with increased daytime visibility. We recommend fluorescent orange because it provides a higher level of daytime visibility.
- **Retroreflective stripes or bands** — The stripes or bands must be
  - yellow, fluorescent, and retroreflective
  - arranged in two vertical stripes down the front, and in an "X" on the back
  - 50 mm wide

These retroreflective stripes give the worker both low-light and nighttime visibility. For night work, you also need stripes or bands on the arms and legs. One way to meet this requirement is to dress workers in fluorescent orange coveralls with retroreflective bands or stripes attached.

Risk Assessment

Before selecting high-visibility clothes, assess the risks you need to control. Workers who need greater visibility, such as roadway construction workers, should wear clothing that is very noticeable under the conditions expected.

For further recommendations on high-visibility clothing, consult CSA standard Z96-02.

Mounting and Dismounting Truck Beds

Many accidents have occurred as the result of workers getting on or off a flatbed truck.

- Before getting on the truck, clean off your boot soles to avoid slips.
- Mount the truck platform in full view of the crane operator or signaller. This will prevent you from being struck by the load or the crane hook.
- Climb up and down facing the truck, maintaining 3-point contact at all times (two hands and one foot, or two feet and one hand on the trailer).
- If steps and handrails are provided, use them. Tires or hubs don't give you stable footing.

Safe Rigging and Slinging

There are times when workers who are not professional riggers must rig loads. Ironworkers are often involved, not only in handling, but in hoisting and receiving material. When in doubt about rigging consult an experienced rigger or a professional engineer. Information in this section can only provide the basics of rigging. More information is contained in the Rigging chapter of this manual or the *Hoisting and Rigging Safety Manual* (M035) published by the Construction Safety Association of Ontario.

Safe rigging basically depends on knowing

- the weight of the load to be lifted
- the capacity of the hoisting device
- the safe working loads of ropes and hardware.

MAJOR HAZARDS

The most frequent cause of rigging accidents is lack of knowledge. In rigging, experience is not necessarily the same thing as knowledge. Since ironwork involves a lot of materials handling, the methods and equipment used to rig, lift, and move materials are important for the trade.

Overhead powerlines — Most lifting devices and all wire rope hoist lines and slings are excellent conductors of electricity. No part of a lifting device or its load must come closer than one boom length to a live overhead powerline, unless a signaller directs the operator. No part of a lifting device or its load must come closer to live powerlines than the minimum distances

listed in the table below unless the powerline has been insulated by the owner of the powerline and procedures are in place to protect the workers from electrical shock.

Voltage Rating of Powerline	Minimum Distance
750 or more volts, but not more than 150,000 volts	3 metres (10')
more than 150,000 but not more than 250,000 volts	4.5 metres (15')
more than 250,000 volts	6 metres (20')

Load too heavy for rigging equipment or rigging arrangement — This problem may be related to

- planning
- the selection, condition, and inspection of equipment
- improper estimates of the load to be moved or lifted.

Weather — Weather conditions such as rain and ice can affect the rigging, control, and handling of loads as well as the lifting devices involved. Visibility and wind can also create problems in hoisting and landing loads.

Unexpected loads – Loads can suddenly move or slip because of

- weather conditions
- travel or swing that is too fast or abrupt
- inadequate support under lifting devices
- unexpected drifting.

These and other conditions can create additional loads on rigging components, and lead to failure or collapse.

Inadequate components — Slings, shackles, hooks, and other equipment must be in good condition and properly sized, configured, and load-rated for the job.

Failure to keep hoist lines vertical — When hoist lines are not vertical, loads can swing unexpectedly. In particular, loads that must be drifted into position can pull lines out of vertical. The load may slip, come apart, and strike workers or the lifting device.

Toppling, shifting, or falling material — These problems can be caused by

- improper use of slings
- using slings not suited to the size, weight, and shape of the load
- inadequate attachment of load to lifting device.

Loads must be secure before, during, and after the lift. Pipe, in particular, is very likely to shift or roll unless properly secured. The critical moment often comes when the hoist line is tensioned up or slacked off. That's when workers should stand clear.

Lifting overhead — The dangers of standing directly under a load being lifted or lowered are obvious. Although it is sometimes difficult to do on crowded construction sites, workers and operators should avoid situations where loads are hoisted over people. Connectors must be extra diligent when they are receiving loads.

Inadequate landing surface — Loads must sometimes be lifted to scaffolding, planked platforms, or other temporary structures. These surfaces must be able to support whatever loads are applied. In some cases, a knowledgeable person may have to assess the load-carrying capacity of the temporary structure.

Determining Load Weights

The most important step in any rigging operation is determining the weight of the load to be hoisted. If this information cannot be obtained from shipping papers, design plans, catalogue data, or other dependable sources, it may be necessary to calculate the weight. Most structural steel is classified by size and weight. For example, a W310 x 79 beam means that the beam is 310 mm deep and 79 kg per linear metre. Therefore a beam of this size that is 10 metres long weighs 790 kg. Remember: The

weight of all rigging equipment must be included as part of the load to be lifted.

The time taken to calculate the approximate weight of any load is time well spent. It may prevent a serious accident from a failure of lifting gear or crane collapse.

Inspection

It is important to inspect rigging, before each use, for damage or excessive wear. The capacity of a worn or damaged fibre rope, metal sling, or synthetic sling can be greatly diminished, making them unsafe to use. More information is contained in the Rigging chapter of this manual, and in the *Hoisting and Rigging Safety Manual* (M035) published by the Construction Safety Association of Ontario.

MULTIPLE LIFTS (TIERED LIFTS)

Multi-tiered lifts may be performed under certain conditions to hoist structural members into position. This method can reduce the potential for some accidents by reducing the number of times the crane must swing when loaded. However, the practice is highly specialized and must be carried out only by trained workers, using established procedures and dedicated rigging assemblies.

Inspection and capacity requirements for rigging equipment

Before hoisting any structural members, the rigging equipment must be inspected by a competent worker at the beginning of each shift. Removal criteria must be established. If there is any doubt about the integrity of the rigging components, the component in question must be replaced. Remember, the rigging must be able to support the total load attached to it, not just individual beams.

The following conditions must be met to safely hoist multiple lifts.

- A complete inspection of all rigging equipment must be carried out daily.

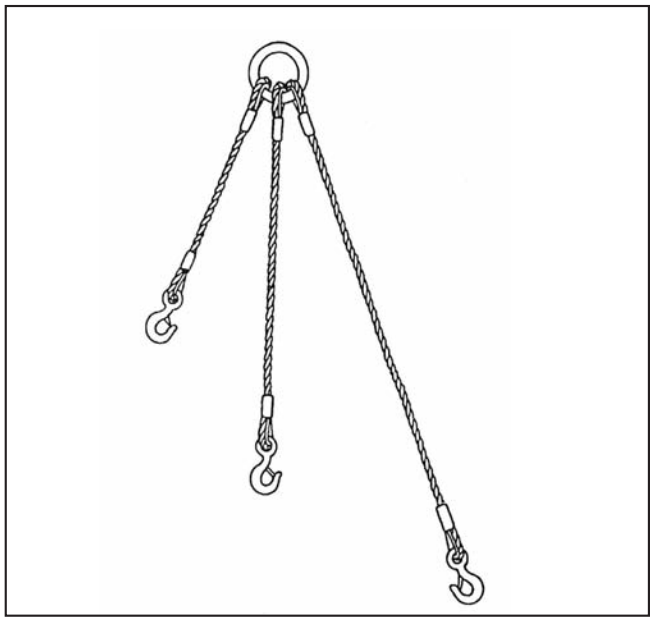

Fig. 13. Rigging assembly with 3 chokers of different lengths.

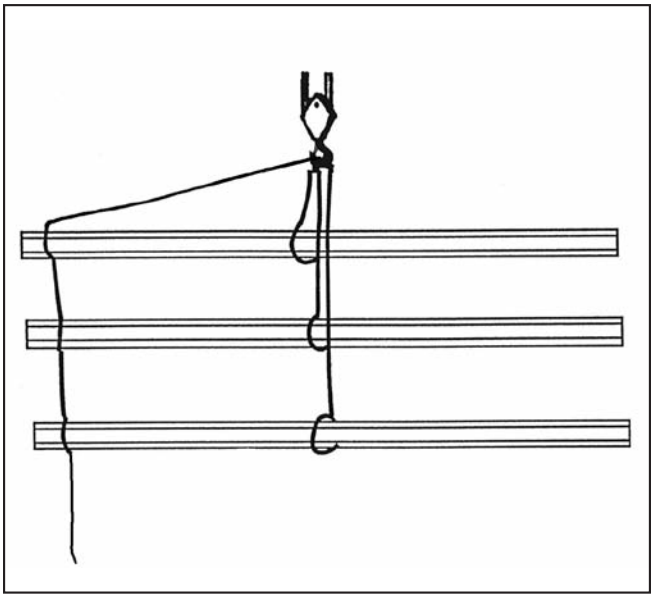

Fig. 14. Three beams hanging in an assembly

- An engineered, dedicated, multiple-rigging assembly must be used. This assembly is not to be used for other hoisting operations.
- All hooks must have safety catches.
- Only workers directly involved in hooking on the steel, or connectors who are receiving the loads, can be involved.
- Three members is the maximum that can be hoisted at any time.

- The members must be aligned so that a minimum clear distance of 2.1 metres exists between rigged members. This gives clearance so workers hooking up or connecting will not be struck by members overhead.
- Members are to be connected with a tag line at one end in order to prevent rotation.
- All workers involved in the process, including the crane operator, must be trained in the specific procedure being used. Records of training including names of workers and their responsibilities must be kept on site.
- Only structural members can be lifted. Bundled loads cannot be lifted.
- Routes for suspended loads must be pre-planned to ensure the load does not pass over other workers.
- A copy of the engineered lifting procedures and any alterations to the procedures must be kept on site.
- Before any multiple lifts, the nearest Ministry of Labour office must be notified.

Methods of rigging multiple loads

There are several methods of rigging multiple loads. One method is to use chokers of different lengths as shown in Figure 13. Another method is to string chokers end-to-end with members attached by slings to the chokers. These methods are acceptable if they have been designed by a professional engineer.

CHOOSING THE HARDWARE

Know the safe working loads of slings and rigging hardware. Never exceed the limit of the weakest device.

Rigging equipment must be inspected before use. If you have any doubt about a piece of equipment, change it, or consult with somebody more experienced in rigging.

Workers involved in offloading steel must be competent through training and experience. When staking is required, stake the load before releasing binders.

Softener such as wood or split pipe should be used on the sharp edges of a load to protect the sling from being cut. Secure the softeners to the sling to prevent them falling off.

Keep your hands away from the load and slings while the load is being lifted.

Use tag lines to guide suspended loads. Coil the ends of tag lines to prevent snagging or tripping. Do not stand in the coils of a tag line or wrap a tag line around your hand.

Do not take hold of the hoist cable close to a sheave or block. Your hand may be drawn in to the block.

Do not climb on to a vehicle or crane while it is moving or operating.

Before lifting the load make sure that it is clear of other material or obstructions.

Hooking On

- Normally two workers are involved in the hooking-on process.
- Rig the steel so that it will not shift during hoisting yet it will be relatively easy to unhook.
- Do not stand under a load or boom.
- Keep your eyes on the entire load as it is being hoisted to ensure that nothing shifts.

Hooking on multiple lifts (tiered lifts)

- Workers hooking on the steel must know the sequence of connecting so that the first member to be connected is the last member to be hooked on.
- The centre of each piece should be marked before being hooked up. When it is lifted it must hang level. It should be raised slightly off the ground to ensure that it is level. If

not, it must be put down and the choker adjusted. When rigging long members, use two chokers to keep the beam balanced.

- As the load is being hooked, take care to prevent the remaining hooks from snagging other beams.
- A tag line must be attached at one end of each member, connecting all the members to be hoisted. It will ensure that the members do not rotate independently. This tag line can be left to hang. Workers receiving the load can use it to guide the load into position.

Connecting

A connector is a trained ironworker who makes the initial connection of structural steel members. The supervisor should designate the connectors in the crew. There should normally be two connectors for each crane working.

Connecting steel members comes with many hazards. Falls are the greatest hazard because this work is done mainly at heights. It's difficult to find adequate lifeline anchors, particularly because members are not fully connected. See the chapter on fall protection in this manual.

Other common injuries are being struck by steel members and having hands and fingers pinched between members. These injuries can often lead to falls and more serious injuries. To prevent them, follow these precautions:

- Connectors must be ready for a member as it approaches. Don't do any other work at the time. Keep your eyes on the steel as it approaches and guide it into position.
- Use a drift pin or wrench to match up holes. Don't use your fingers. Many workers have lost fingers this way.
- Before being cut loose, the beam must be bolted so that it will not rotate. At least two or more bolts should be put in position, depending on the engineer's requirements. Do not rely on a drift pin or a wrench placed in a hole.
- Columns, trusses, and beams that are not properly tied-in should be guyed before you cut them loose.
- When working above reinforcing steel or dowels, ensure that the ends of the rods are covered to protect you from being impaled.
- Use extra care while working on a beam fitted with shear connectors or Nelson Studs. Grip the beam, not the studs. Tuck in or tape your pant cuffs to avoid tripping on the studs.

Connecting multiple lifts (tiered lifts)

When the beam is lowered into position, it must be connected with a minimum number of bolts in the usual way. After is has been unhooked from the crane, position the next member. The connectors must be aware of the overhead members at all times. When all the members have been released from the crane, the rigging assembly is lifted clear by the crane. The connectors must ensure that the rigging assembly does not snag a piece of the structure as it is being lifted clear. These chokers can easily trip a worker or become snagged in other members.

Bolting Up

The bolting up crew follows the erection crew. Their role is to install the remaining bolts at each connection. They normally work from a temporary platform such as a scaffold, an elevating work platform, or from the steel itself. Fall protection is easier to achieve for this work because the structural members are secure at this stage, or fall arrest anchors have already been installed.

Tools and equipment should be carried in containers. Do not leave bolts, washers, drift pins, or empty bolt cans lying around on beams or work platforms.

Do not allow air hoses or cables to clutter walkways, platforms, or ladders where someone could trip. When it is necessary to work with a

long lead or hose be sure that it is tied off at several points to prevent whipping if the hose was cut or disconnected.

Reaming and drilling

Reaming and drilling is often necessary to properly align holes for connection. Basic precautions include eye and hearing protection because flying particles and noise are unavoidable.

In two-person operations, workers should stand on the same level and coordinate their movements. When reaming or drilling vertically, workers should stand on opposite sides of the tool and face each other. When reaming or drilling horizontally, workers should keep the tool between them, preferably at waist level and face the material. Avoid reaming or drilling overhead as controlling the equipment is difficult. Make sure that you have enough space, secure footing and proper balance when reaming or drilling, especially when you're above floor or ground level.

Do not use an electric reamer or drill on a steel beam that is being welded unless the members are grounded.

When using a magnetic base drill, secure it to the structure in case of a power failure.

Use the right size of bit for the job. Keep the bit straight when reaming or drilling. Take extra care with bits having two or three flutes because they tend to bite or stick. Make sure drill bits are sharp and true. Bits should be reconditioned regularly by a qualified person.

When drilling a deep hole beyond the flutes of the bit, clean out the chips by removing and reinserting the bit several times with the power off. Don't let the chips or shavings build up in a hole because the bit may become tight or jam up.

Lightweight or small pieces of steel should be clamped, bolted, or tack welded so they will not bind on the bit and whip around.

Riveting

Although riveting is no longer used extensively on structural steel, the following tips on safe riveting are still useful for renovations, maintenance, and demolition work and for driving drift pins with rivet guns.

- Snaps must be wired to the riveting gun bridle.
- Remove snaps and plunger when leaving the job for any length of time.
- The riveting gun should not be left in a position such that the trigger could be released unintentionally.
- When cutting or backing out rivets, use shields to stop rivets from flying and injuring someone.
- When rivets are driven out with a punch, the helper should hold the punch with a tongs or another suitable tool—not with their hands.

Q Decking and Floor Openings

The hoisting and installation of Q-Deck is a common job for many ironworkers. Each task comes with its own set of risks. Here are some precautions to help reduce the hazards.

- Never use bundle packaging or strapping to hoist the deck to upper floors.
- If loose items are placed on top of a bundle for hoisting they must be secured to the bundle.
- Bundles must be landed on framing members so that the bundles are sufficiently supported to allow un-banding without dislodging the bundles.
- Depending on weather conditions, such as wind, all decking must be secured so that it doesn't fly off and hit someone.
- Confirm with the steel erector that the steel is plumb and torqued before hoisting bundles to the upper levels.

- All floor openings must be covered immediately. This includes small holes, if any part of a worker can go through them. The covers must be secured and marked with a warning sign or marking.
- Holes and openings must not be cut unless they are essential to the construction process. If cut, they must be immediately covered.
- The spaces around columns must be covered or blocked to prevent objects from falling.

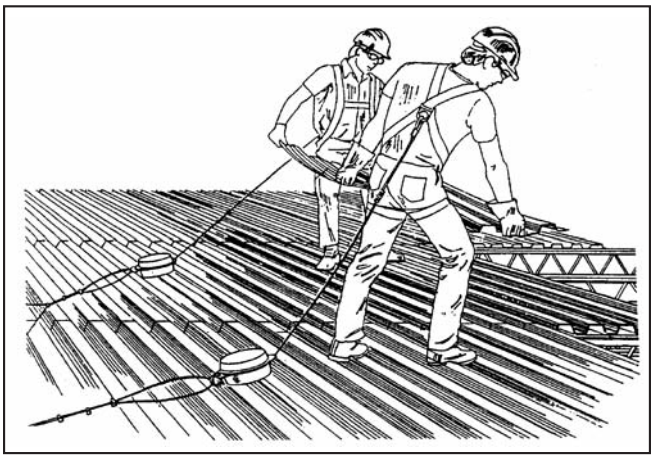

Fig. 15: Q-Decking

Due to the nature of Q-Decking installations, access to the floor where the decking is being placed and the area below it must be limited to persons performing the work. Remember, proper fall protection is required until the deck is complete and guardrails are installed.

Take special care when weather conditions are poor. For example, during winter months, the decking can become very slippery. Wear proper safety boots with slip-resistant soles.

Safe Access and Fall Protection

The main areas of concern are fall protection while working at heights and access to elevated work areas. The fundamentals are covered in the chapter on fall protection, and are supplemented by the following information.

General requirements

Fall protection must be used wherever workers are exposed to the hazard of falling:

– more than 3 metres (10 feet)

– more than 1.2 metres if the work area is used as a path for a wheelbarrow or similar equipment

– into operating equipment

– into water or another liquid

– into a hazardous substance or object

– through an opening in a work surface.

Where it isn't practical to install guardrails, you must employ fall protection measures which can include:

1) Fall prevention, such as
   - protective covers over floor and roof openings
   - warning barriers and bump lines
   - travel restraint.
2) Fall arrest, such as
   - fall restriction
   - fall arrest
   - safety nets.

Regardless of type, every fall protection system in Ontario construction must meet the requirements of the *Occupational Health and Safety Act* and the Construction Regulation (Ontario Regulation 213/91).

An integral part of fall protection is planning for work access before you begin erecting steel. Improper access leads to workers walking long distances on the steel. The longer you walk on the steel, the greater your risk of falling.

The employer must also develop written procedures for rescuing a worker whose fall has been arrested. Workers using fall protection must be trained in its use, and a written record of training must be kept.

Travel-Restraint Systems

A travel-restraint system lets a worker go just far enough to reach the edge but not far enough to fall over it.

The basic travel-restraint system consists of

- CSA-approved full-body harness
- lanyard
- lifeline
- rope grab to attach harness or lanyard to lifeline
- adequate anchorage, capable of supporting a static load of 2 kilonewtons (450 pounds) with a recommended safety factor of at least 2, that is, 4 kilonewtons or 900 pounds.

Travel-restraint arrangements must be thoroughly planned, with careful consideration given to

- selection of appropriate components
- location of adequate anchor points
- identification of every fall hazard in the proposed work area.

Try to select an anchor point that is as close as possible to being

- perpendicular to the unprotected edge, and
- at the centre of the work area.

You must identify all fall hazards in the work area. Pay special attention to work areas with irregularly shaped perimeters, floor openings, or locations near corners. A fully extended lifeline and/or lanyard that keeps a worker away from a fall hazard in one section of the work area may be too long to provide the same protection in another section.

Two methods of travel restraint are commonly used in construction.

- Connecting an adequately anchored lifeline directly to the D-ring of the worker's full body harness. It's absolutely critical that the length of the lifeline, measured from the anchor point, is short enough to keep the worker away from any fall hazard.
- Attaching a lanyard to the D-ring of the worker's full body harness and then to a rope grab on an adequately anchored lifeline. There must be some means—such as a knot in the lifeline—to prevent the rope grab from sliding along the lifeline to a point where the worker is no longer prevented from falling.

Regardless of the method used, the system must be adjusted so that when all the components are fully extended, they prevent the worker from reaching a fall hazard. The system must also be securely anchored.

FALL-ARREST SYSTEMS

Where workers cannot be protected from falls by guardrails or travel restraint, they must be protected by at least one of the following methods:

- fall-restricting system
- safety net
- fall-arrest system.

In the event of a fall, these systems must keep a worker from hitting the ground, the next level below, or any other objects below.

A fall-restricting system is designed to limit a worker's free fall distance to 0.6 metres (2 feet). One type uses a belt grab or belly hook that attaches to a safety rail on a fixed ladder.

A safety net system must be designed by a professional engineer. The system is installed below a work surface where a fall hazard exists.

A fall-arrest system

- must include a CSA-approved full body harness
- must include a lanyard equipped with a shock absorber unless the shock absorber could cause a falling worker to hit the

ground or an object or a level below the work

- must include an adequate fixed support; the harness must be connected to it via a lifeline, or via a lanyard and a lifeline
- must prevent a falling worker from hitting the ground or any object or level below the work
- must not subject a falling worker to a peak fall-arrest force greater than 8 kilonewtons.

The construction regulation (O. Reg. 213/91) requires that

- all fall protection equipment must be inspected for damage, wear, and obvious defects by a competent worker before each use
- any worker required to use fall protection must be trained in its safe use and proper maintenance.

Any defective component should be replaced by one that meets or exceeds the manufacturer's minimum performance standards for that particular system.

The regulation also requires that any fall-arrest system involved in a fall be removed from service until the manufacturer certifies all components safe for reuse.

For any worker receiving instruction in fall protection, the manufacturer's instructions for each piece of equipment should be carefully reviewed, with particular attention to warnings and limitations.

ANCHOR SYSTEMS

There are three basic types of anchor systems for fall protection.

1) Designed fixed support: Load-rated anchors specifically designed and permanently installed for fall protection purposes as an integral part of the building or structure (for example, roof anchors on high-rise buildings).

2) Temporary fixed support: Anchor systems designed to be connected to the structure using specific installation instructions (for example, stanchions for horizontal lifelines).

3) Structural features or equipment not intended as anchor points but verified by a professional engineer or competent person as having adequate capacity to serve as anchor points (for example, structural steel or reinforced concrete columns).

Designed fixed support can be used to anchor a fall-arrest system, fall-restricting system, or travel-restraint system if the support has been installed according to the Building Code and is safe and practical to use.

Temporary fixed support can be used as anchorage if, without exceeding the allowable unit stress for each component used,

- it can support at least 8 kilonewtons (1800 pounds), or
- when used with a fall-arrest system incorporating a shock absorber, it can support at least 6 kilonewtons (1350 pounds), or
- when used with a travel-restraint system, it can support at least 2 kilonewtons (450 pounds).

In all cases, use a safety factor of at least two when calculating the minimum load that an anchor point must support.

As a general rule with fall-arrest systems, choose an anchor capable of supporting the weight of a small car (about 3600 pounds).

When structural features or equipment are used as anchor points, avoid corners or edges that could cut, chafe, or abrade fall-protection components. Where necessary, use softeners

such as wood blocking to protect connecting devices, lifelines, or lanyards from damage.

Beam Clamps

Beam clamps can make effective anchors when used properly with a correct lanyard. There are many different types of beam clamps. The most common are plate clamps, trolley clamps, or glider clamps. The pin set must be inserted the full length of the pin, or if the clamp has a locking device, the device must be in the locked position. Always check that the clamp is set for the correct beam size and that it is tight. Always check the manufacturer's instructions before use.

Before using a beam clamp, check for coped ends on the beams. A beam clamp could easily slide off the end of a coped beam through the gap between the two members.

Fig. 16. Danger: Beam clamp near coped end

Lifelines

There are three basic types of lifelines.

1) vertical

2) horizontal

3) retractable.

All lifelines must be inspected daily to ensure that they are free of

- cuts, burns, frayed strands, abrasions, and other defects or signs of damage
- discolouration and brittleness indicating heat or chemical exposure.

Vertical lifelines

Vertical lifelines must comply with the current edition of the applicable CSA standard and the following minimum requirements:

- Only one person at a time may use a vertical lifeline.
- A vertical lifeline must reach the ground or a level above ground where the worker can safely exit.
- A vertical lifeline must have a positive stop to prevent the rope grab from running off the end of the lifeline.

Vertical lifelines are typically 16-millimetre (5/8-inch) synthetic rope (polypropylene blends).

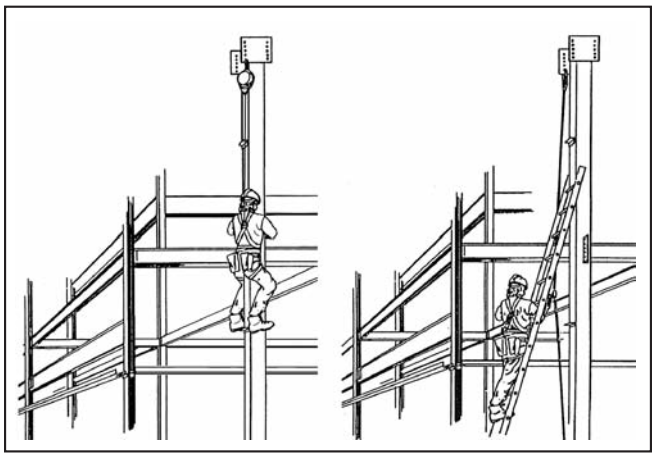

Fig. 17. Vertical Lifeline

CLIMBING THE COLUMNS FOR STEEL CONNECTIONS

The first choice of a means of access for making steel connections must be a ladder, powered elevating work platform, or a crane with a platform suspended from the boom. You should only climb columns when these options are not practical due to

- characteristics of the location
- poor soil conditions.

Further to this, written notice must be given to the Joint Health and Safety Committee or Health and Safety Representative on the project before a worker can climb the column. The worker must also be competent to climb and must be protected by a fall arrest system at all times.

Horizontal Lifelines

The following requirements apply to any horizontal lifeline system.

- The system must be designed by a professional engineer according to good engineering practice.
- The design can be a standard design or specifically engineered for the site.

The design for a horizontal lifeline system must

- clearly indicate how the system is to be arranged, including how and where it is to be anchored
- list and specify all required components
- clearly state the number of workers that can safely be attached to the lifeline at one time
- provide instructions for installation, inspection, and maintenance
- specify all of the design loads for the system.

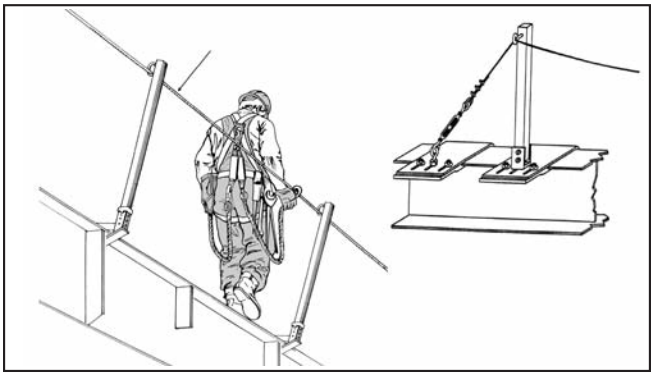

Fig.18. Horizontal Lifeline

The system must be installed, inspected, and maintained in accordance with the professional engineer's design.

Before each use, the system must be inspected by a professional engineer or competent worker designated by a supervisor. A complete and current copy of the design must be kept on site as long as the system is in use.

CAUTION: The construction regulation requires that "a horizontal or vertical lifeline shall be kept free from splices or knots, except knots used to connect it to a fixed support." Knots along the length of either a horizontal or vertical lifeline can reduce its strength by as much as 40%.

Retractable Lifelines

Retractable lifelines must comply with the standard CAN/CSA-Z259.2.2-M98. In general, retractable lifelines

- are usually designed to be anchored above the worker
- employ a locking mechanism that lets line unwind off the drum under the slight

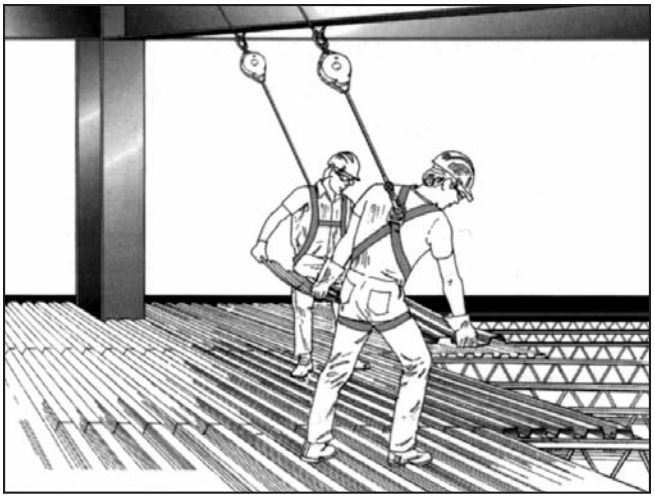

Fig.19. Retractable lifeline

tension caused by a user's normal movements

- automatically retract when tension is removed, thereby preventing slack in the line
- lock up when a quick movement, such as that caused by a fall, is applied
- are designed to minimize fall distance and the forces exerted on a worker's body by fall arrest.

Anchor your lifeline as close to overhead as possible. This will minimize swing distance if you fall.

Always refer to the manufacturer's instructions regarding use, including whether a shock absorber is recommended for the system.

A retractable lifeline that has stopped a fall must be removed from service until the manufacturer or a qualified testing company has certified it for reuse.

Lifeline Hazards

Ultraviolet (UV) light — Exposure to the sun may damage or weaken lifelines. Ensure that material being considered for lifelines is UV-resistant.

Temperature — Extreme heat can damage lifelines, and extreme cold can make them brittle. Ensure that the material being considered for lifelines can stand up to the most extreme conditions expected.

Friction and abrasion — Normal movement may wear, abrade, or otherwise damage lifelines in contact with sharp or rough surfaces. Use protection such as wood softeners or rubber mats can at contact points to prevent wear and tear.

Sparks or flame — lifeline can be damaged when hot work such as welding or flame cutting is done nearby. Sparks, flame, or heat can melt, burn, cut, or otherwise damage the lifeline. Ensure that material being considered for lifelines is flame-resistant or provide appropriate protection when hot work is done nearby.

Chemicals — Chemical exposure can burn or degrade a lifeline very quickly. Ensure that material being considered for lifelines will resist any chemicals encountered on the job.

Storage — Always store lifelines separately. Never store them where they may contact hazards such as sharp objects, chemicals, or gasoline.

Ladders

Ironworkers use ladders extensively to access elevated work areas, and in some cases they're used for short-duration work. Portable extension ladders are the most common in the ironworker trade, but they have been responsible for numerous injuries. Falls, electrical contact and material handling are the main injuries associated with ladders. If ladders are being used as work platforms, check the Construction Regulation for whether fall protection requirements apply in your case. For example, you may require a method of fall protection such as the vertical lifeline shown in Figure 17.

See the chapter on Ladders in this manual for more information.

Construction Hoists

Construction hoists are used on construction sites to move workers and light materials to upper floors. Normally they are operated by a designated operator, but all workers should follow some basic safety precautions.

The landing gates on hoists are for your protection. Make sure that the gates are closed properly before the car leaves the floor. Don't try to bypass gate contacts.

Removable guardrails at landings are an important safety feature. If they must be removed at any time during construction, replace them before you leave the area. When you're working in an area where guardrails have been removed, you must have another method of fall protection.

Landing areas must be kept clear of materials, tools, and debris to ensure safe access to the hoist entrance.

Do not tamper with shoring under ramps or other parts of the hoist. In particular, shoring under the hoist must be kept intact until the tower is removed.

Don't remove a brace or anchor connecting the tower to the structure unless it's absolutely necessary. It must be replaced immediately. The hoist must be taken out of service whenever a brace is removed.

Angel Wing Scaffolds

Angel wing scaffolds are a lightweight construction platforms used for applications such as steel erection, bridgework, shipbuilding, welding and cutting, and tank inspection and repair. They are normally made from a light aluminum alloy that is easily installed, dismantled, and carried by one person. Angel wings have a compact, folding design. Each component must be designed so that the stage can hold the minimum load for a work platform as specified in the Construction Regulation. They normally accommodate one or two workers—but all workers on the platform must wear fall protection.

Mobile Welding Rigs

This section describes some basic requirements for drivers of mobile welding rigs. If you have any questions or concerns, speak with the appropriate association or ministry to ensure that you understand the responsibilities of all personnel.

Legislation

Highway Traffic Act

On public roads and highways all vehicles must operate in compliance with the *Highway Traffic Act*. The Transportation Health and Safety Association of Ontario (THSAO) provides information and training on the *Act*.

Commercial Plates

You need commercial plates on any motor vehicle having a permanently attached truck or delivery body. The requirement for commercial plates on a van or pickup, however, does not automatically classify them as commercial vehicles.

Commercial Vehicles

Loading a vehicle with equipment and supplies can increase its weight. Whenever the gross vehicle weight rating, registered gross weight, or actual weight, loaded or empty, exceeds 4500 kilograms, the vehicle and operator are subject to the regulations under the *Highway Traffic Act* applying to commercial motor vehicles and commercial motor vehicle operators. You must add a trailer's weight to the weight of the vehicle when determining total weight.

Under the *Highway Traffic Act*, commercial vehicle operators must obtain a Commercial Vehicle Operator's Registration (CVOR). They must also comply with the additional restrictions and obligations (such as annual inspections) described in the *Act*.

According to the *Highway Traffic Act,* the operator is the "person responsible for the operation of a commercial motor vehicle including the conduct of the driver and the carriage of goods or passengers, if any, in the vehicle or combination of vehicles." The operator does not have to be the vehicle owner. If the vehicles are leased or contracted, the operator must hold a valid CVOR.

> If you have any questions about how the *Highway Traffic Act* is applied, contact the local Ministry of Transportation enforcement office. For a CVOR application form, contact the Carrier Sanctions and Investigation Office.

Gross Axle Weight

For any commercial or passenger vehicle, the gross weight of the vehicle or combination of vehicles (e.g., van and trailer) must not exceed the manufacturer's gross axle weight rating. This

rating is usually written on a sticker on the driver's door.

There are two consequences of exceeding the manufacturer's gross axle weight rating. First, it is an offence under the *Highway Traffic Act*. Second, if the gross weight is more than 4500 kilograms, the vehicle can be classified as a commercial vehicle.

Trailers

If a vehicle is towing a trailer such as a utility trailer, the trailer's weight must be added to the weight of the vehicle when determining total weight. Add the highest weight of the vehicle to the highest of the trailer's gross vehicle weight rating (if provided on trailer) or the actual weight, empty or loaded, to determine whether the combined weight exceeds 4500 kilograms.

Transportation of Dangerous Goods Act (TDG Act)

The *Transportation of Dangerous Goods Act (TDG Act)* applies whenever hazardous material is transported on a road or highway. Learn about the dangers involved. Learn also about the restrictions and obligations that the *TDG Act* applies to the driver and owner of the vehicle.

This section only identifies some of the regulations and exemptions which apply to mobile welding rigs, vehicle owners, and drivers under the *TDG Act*. For more information, contact the Transportation Health and Safety Association of Ontario (THSAO)—which provides training—or the local Ministry of Transportation Enforcement office.

When transporting propane, drivers must also follow the *Propane Storage and Handling Code*.

Read the material safety data sheet (MSDS) of each product you're transporting. It may describe specific information about transporting the product.

Special Provisions of the TDG Regulations under the *TDG Act*

Regulations under the *TDG Act* always apply when you're transporting dangerous goods such as compressed gases. There are, however, some exemptions.

You may, for example, be exempt from driver training, documentation, and placarding of the vehicle. (Placarding means putting signs on the vehicle to identify the material being transported.) There may also be exemptions when propane, acetylene, or oxygen is being transported in an open vehicle, and the amount is less than 500 kilograms gross mass or is contained in not more than five cylinders. In this situation, the *TDG Act* does require the label on the cylinder to be visible from outside the vehicle. Also see the *Propane Storage and Handling Code*. In all cases the cylinders must be securely stowed in the vehicle to prevent movement. You should have in the vehicle a dry-chemical fire extinguisher of at least 10BC rating — one that's listed by the Underwriters' Laboratories of Canada.

Depending on the hazardous material, the *TDG Act* could require the driver and others to receive training in the transportation of dangerous goods.

GENERAL PRECAUTIONS

Defensive Driving

Defensive driving means being prepared. Do not simply focus on getting to your destination. Think also about actions and events that can influence the way your trip unfolds. Be prepared to avoid or control hazards. Follow common-sense rules for defensive driving.

1. Understand the rules and regulations that apply to the vehicle and to driving. Ignorance of the law is not a valid defence in court.
2. Understand that human physical and emotional factors influence driving performance.
3. Ensure that the vehicle is well maintained and operating properly.

4. Consider how weather, road, and traffic conditions will affect driving abilities.
5. Assess how well you understand the previous four topics. Take steps such as enrolling in a defensive driving course to attain and maintain a level of knowledge necessary to practice defensive driving.

Trailer Safety

Before using a trailer, be sure it is in safe operating condition. Inspect

- lights
- tires
- brakes
- bearings
- safety chains
- hitch.

Use the correct class of trailer hitch on your vehicle.

- Class I – up to 2,000 lb
- Class II – up to 3,500 lb
- Class III – up to 5,000 lb
- Class IV – up to 10,000 lb

A trailer requires two separate means of attachment to the vehicle. A typical arrangement incorporates a ball hitch with two safety chains. The capacity of each chain should be equal to the gross weight of the trailer and should cross under the tongue to connect to the hitch.

Loose objects must be covered with a tarp. All loads on trucks and trailers must be secured or placed so that no portion of the load can become dislodged of fall from the vehicle.

Anchor points, rope, and slings used for tie-downs must be in good condition. Inspect them before each use. See CSAO's *Hoisting and Rigging Safety Manual* (M035) for more information.

Maintenance

Every employer should establish a system for periodical inspection, repair, and maintenance of all motor vehicles and trailers operated on the highway.

An employer must not permit a motor vehicle to be driven, or a trailer to be towed, on a highway if there is reason to believe that the vehicle or trailer will not meet safety standards.

A driver who reasonably believes or suspects that a vehicle or trailer does not meet safety standards should advise the employer.

Inspections

Before each shift, perform a basic vehicle inspection. The following "Daily Circle Check" is a good example:

Parking brake – adequate to hold vehicle.

Fluid levels – oil, gas, brakes. Check for leaks.

Lights and turn signals – functioning.

Visibility check – mirrors properly adjusted, windows clean and intact.

Wiper/washer – functioning.

Tires – pressure, tread depth, damage.

Wheels and fasteners – defects in rim, loose or missing fasteners.

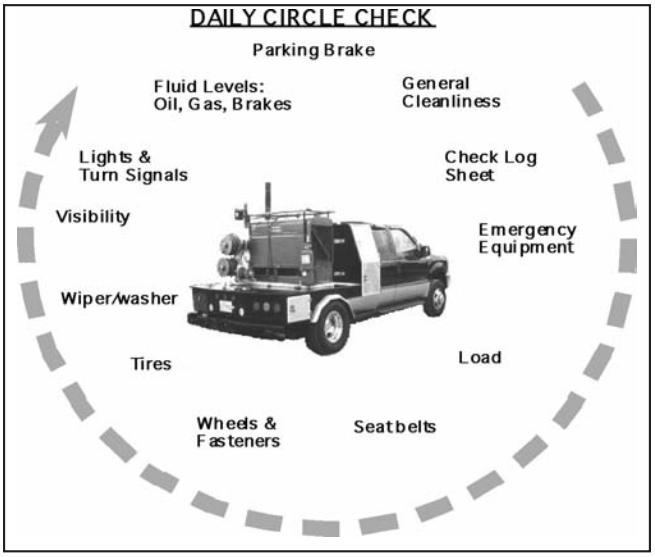

Fig. 20. Daily Circle Check

Seat belts – you must always wear them.

Load – secure.

Emergency equipment – install and inspect as required by law or company policy.

A more detailed inspection may be required for commercial vehicles.

Record and report any defects to your supervisor immediately!

Users should consult the *Transportation of Dangerous Goods Act*, applicable highway traffic acts, provincial regulations, local bylaws, etc., which may contain additional safety requirements.

Vehicle Layout

CSA standard CAN/CSA-W117.2 provides guidance for mobile welding rig design.

When a mobile oxygen/fuel gas welding system is assembled as a cutting/welding or heating unit, a person capable of competently operating the equipment should accompany the vehicle. This person must ensure that the system is being transported in compliance with the *Transportation of Dangerous Goods Act* and where applicable, the *Highway Traffic Act*.

When designing and laying out a welding rig, do the following.

- Secure any cargo that could shift during travel. Set up strong storage racks for tools and supplies to distribute the weight evenly and prevent shifting during sudden stops or sharp turns.
- Do not let scrap and debris accumulate inside the vehicle.
- Set up a designated location for the first aid station, MSDS information, and fire extinguisher.
- Install a strong reinforced divider to separate the driver compartment from the back.

Fig. 21

Compressed gases

- Ensure that cylinders are supported solidly and fit snugly into their designated locations. Restrain cylinders in a way that prevent them from rotating. Provide a cylinder-mounting location that is easily accessible, minimizes lifting, and permits the cylinders to be installed or removed without dragging or scraping them.
- Ensure that all cylinders are standing upright.
- Do not store fuel gas cylinders in cabinets. ***Ventilation holes in a cabinet may not be adequate to vent leaking fuel gas. For example, acetylene has an explosive range starting at 2.5%, so an explosive atmosphere can develop quickly.***

Warning

Gas can leak from stored fuel hoses and gauges, causing an explosive atmosphere.

- If you're concerned about theft or vandalism, you can build a screened cage to contain the cylinders. At least two sides of the cage must have an 80% or greater free area.
- Mount all cylinders vertically unless the manufacturer's MSDS says otherwise.
- Before you operate your vehicle on public roadways, or park it on publicly accessible

property, disconnect the regulators and hoses from the cylinders and put them away in storage. The valves must be closed on all cylinders and the protection caps must be in place.

- Close the cylinder valves when the equipment is unattended.