

GUIDELINES FOR CONSULTATION PURPOSES – NOT  
YET INTENDED FOR INDUSTRY OR PUBLIC USE

# **OPERATION OF REAR LOADING COMPACTION COLLECTION TRUCKS**

## **SAFETY REQUIREMENTS**

NEW ZEALAND GUIDELINES FOR WASTE AND RECOVERABLE  
RESOURCE COLLECTION, PROCESSING AND DISPOSAL



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## PRIMARY SOURCE ACKNOWLEDGEMENT

New Zealand Guidelines for Refuse Collection, Processing and Disposal Equipment Stationary Compactors: Safety Requirements. Published by Occupational Safety and Health Service (OSH), Department of Labour, New Zealand.

### WasteMINZ – NOTICE 2002

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## FOREWORD

The rear-loading compaction collection truck is an efficient system for collecting waste for recycling and other connected purposes.

Use of rear-loading compaction collection trucks has occurred in New Zealand for over 50 years with a significant contribution to the national economy.

These guidelines have been generated to help owners and users of rear-loading compaction collection trucks. Other users might include companies undertaking modifications and suppliers. The guidelines set out to provide practicable steps to help members of the waste industry to gain further conformance with the Health and Safety in Employment Act 1992 and the Health and Safety in Employment Regulations 1995.

These guidelines are aligned with other industry initiatives including the NZ Road Transport and Logistics Industry Training Organisation development of competency based unit standards for training waste collection employees and contractors.

The guidelines identify methods to prevent injury and especially avoid a repeat of several fatalities involving rear loading waste collection trucks. The accidents are predominantly attributed to the operation of the rear-loading compaction collection trucks compactor.

In summary most accidents seem to occur when people (or a body part) enter a dangerous area. Guards found on any stationary compactor prevent most serious harm. Fitting inter-locked guards to any rear-loading waste collection compactor and operating this truck within a safety management system that includes competency-based training is recommended. This will help to prevent work-related injury.

## **PURPOSE/SCOPE**

To help those working in the New Zealand waste and recovery industry establish further practicable steps to protect the safety of employees with respect to the modification, maintenance, service, and operation of rear-loading compaction trucks.

### **SCOPE**

These New Zealand guidelines are applicable to all persons engaged in the modification, operation, cleaning, maintenance, service, or repair of any rear-loading compaction truck and the use of their compacting and other equipment.

Safety issues discussed in these guidelines aim to protect users with sections on:

1. The hazards associated with normal operation of rear-loading compaction trucks.
2. Maintenance, repairs and modifications.
3. Audits, inspections and training used to improve quality and safety assurance.

The guidelines are intended to supplement the stationary compactor guidelines and to be used within a safety management or similar quality assurance programme.

Health issues arising from waste disposal are beyond the scope of these guidelines, although managing occupational health is part of any safety management system.

Users of rear-loading compaction trucks should appreciate that the contents of any waste collection may include potential sources of infection and other causes of ill-health.

These sources of ill-health may include noise, inorganic and organic particulate dusts.

Managing the health of individuals should include minimising the effects of direct contact with waste. Operators should use good hygiene techniques when handling food and drink during breaks, and avoiding smoking, chewing gum, and the use of any body piercing, etc.

### **ASSUMPTIONS**

The cab and chassis shall meet any Land Transport Safety Authority requirements for certificate of fitness.

These guidelines do not contradict any other documented safety guidelines.

## REFERENCES

The following documents contain provisions which, through reference in this text, constitute provisions of New Zealand guidelines. At the time of publication, the editions indicated were valid. Where the guidelines appear to impose a higher duty of care than a reference appears to, the provisions of the guidelines should apply.

**Guidance Notes for Electrical Interlocking For Safety in Industrial Processes.** OSH. September 1994. Methods of switching electric current to control motion/safety.

**The Ergonomics of Machine Guarding** OSH. Describes sections 15, 16 and 17 of Machinery Act 1950 requiring moving parts of prime movers, every part of transmission machinery and every dangerous part of any machinery to be securely fenced unless it is in such a position or of such construction as to be as safe to every person employed or working on the premises as it would be if securely fenced.

**The Guarding of Transmission Machinery** OSH. Examples of reach dimensions. Uses the term "safe by position". The Transmission is in such a position and location that it is virtually impossible for a person to reach it. For example, an overhead shaft would be deemed to be safe by position if it was located 2.5 metres from ground level.

**Wire Mesh Guards for Machinery** Specification for the construction and fitting.

**Guidelines for Guarding Principles and General Safety for Machinery** OSH. Guidelines apply to machinery in places of work.

**BS EN 1501-1: 1998 Refuse Collection Vehicles and their associated lifting devices – General requirements and safety requirements – Part 1: Rear-end loaded refuse collection vehicles**

**Guidelines for Refuse Collection, Processing and Disposal Requirements: Stationary Compactors – Safety Requirements** \* See Note 1 below. The guideline identifies ANSI Z245.1 – 1999. Refuse collection, processing and disposal equipment – mobile refuse collection and compaction equipment safety requirements.

**Note OSH documents are available from: [www.osh.dol.govt.nz](http://www.osh.dol.govt.nz)**

Notes: \* The US compactor standard describes that safeguarding is only required if the loading height is less than 42in (1067mm) possibly meaning above 1100 mm in height, you do not need guarding. This does not comply with the OSH booklet "The Ergonomics of Machine Guarding" because a person can reach into the danger area if no guarding is provided during operation at this height.

## DEFINITIONS

For the purposes of these guidelines, unless the context provides otherwise, the words listed below have the meaning in the guide attributed to them in this section.

**Body:** that part of the bodywork in which the collected and compacted waste is stored.

**Closed systems:** If the rave rail is 1400 mm or more above the level on which the operator is standing, and any pinch point is at least 850mm away from the operator it shall be deemed to be a closed system. Alternately where the height is less than 1400 mm the system shall meet the requirements of Figure 3 in the Booklet “The Ergonomics of Machine Guarding” Published by the Department of Labour. A system that is also fully guarded and physically prevents access to the compaction mechanism while compaction is underway shall also be deemed a closed system.

**Compaction mechanism:** the mechanism used to compact and transfer the waste from the hopper into the body – either by a single or double rotational paddle movement, or by a sweeping backward and forward movement of a moving plate.

**Compactor operating cycles:** a number of possible compactor operating cycles are evident. The following are the main definitions used:

- **AUTO** (Continuous cycle) is one that continually cycles until stopped by an independent action. This is only acceptable in a closed system.
- **SINGLE** cycle is one that cycles once and then stops automatically.
- **MULTI** cycle is one that cycles for a given number of times and then stops automatically.
- **CTRL** (Controlled cycle) is a single cycle controlled by the operator, by depressing one single button or lever from the start until any pinch point has been passed. Thereafter the cycle will be completed automatically, even if the button or lever is released.
- **SEMI** (Intermittent cycle) is a cycle where the compaction mechanism is automatically stopped at least 500 mm before the rave rail. A hold to run control is required to run the compaction mechanism for that part of the cycle where a pinch point is created up to the end of the cycle.

**Control panel:** the panel normally located at the rear of the rear-loading compaction truck where the compaction equipment can be operated once power has been applied.

**Discharge system:** a system whereby the hopper and compaction equipment fitted on the tail-gate is raised hydraulically to allow the compacted load to be ejected.

**Guarding:** system to protect people from harm or serious harm. Usually involves selecting and purchasing machinery or equipment already containing factory fitted guards or fitting after-market guards with interlocks to protect people from harm.

**Hold-to-run:** A control that requires continuous pressure by the operator. The control can be

found as a two-handed control on some rear-loading compaction trucks. May also be referred to as deadman control. This system is not considered to be best practise and does not meet the recommendations of this document.

**Hopper:** the lower part of the tailgate into which the waste is loaded via containers or by hand. The capacity of the hopper will often vary between vehicles.

**Interlocking:** Interlock guard may operate mechanically, hydraulically, pneumatically, electrically (or a combination of these ways) and make the machinery safe by ensuring that the hazard is not present when the guard is opened. This is achieved by disconnecting the machine from its power source so that it cannot be started if the guard is open. If the machine is running and the guard is opened, the power to the machine will be disconnected and the machine stops immediately.

**Lock out:** The manufacturer shall provide instructions for a lockout procedure in which the power shall be shut off, except during maintenance testing. The lockout procedure shall isolate and render safe all energy sources, including electrical, hydraulic, potential, and kinetic. When energy sources within the compactor have reached the zero energy state, then the compactor can be worked on.

### **MGB: Mobile garbage bins**

**Mobile Garbage Bins:** Bins with wheels and handle which are easily mobile and usually plastic, in which waste and recoverable resources are placed prior to removable for disposal or processing

**Open systems:** If the rave rail does not meet the criteria described under “Closed System” then it shall be deemed to be an open system. Open systems are not considered to be best practise and therefore do not comply with this document.

**Rave rail:** the loading edge of the hopper and produced as a cross-beam or the edge of a guide flap.

**Safe-by-position:** means so positioned that any person cannot reach or gain access to the dangerous parts. A dangerous part that is beyond an upward reach of 2.5m is regarded as notionally safe by position unless the particular facts destroy that possibility.

**Safety sign:** a sign communicating safety information to any operator often referred to as an administrative control. Considered a weak and often ineffective significant hazard control.

**Serious Harm:** harm or serious harm has the same definition found in the Health and Safety in Employment Act 1992.

**Pinch Point (Shear trap):** the point where two surfaces present a shear hazard and may cause possible serious harm to any operator’s body, body part, or may snag their clothing.

**Shall and Should:** In this document, shall is used in places where there is a requirement to achieve the desired result. It is used to alert the reader to the need for that element to be included. Should is used as a way of indicating a preference. It does not indicate a mandatory requirement as other alternatives could achieve an equivalent result.

**Tailgate:** the rear section of the bodywork which is hinged to the body, the tailgate can be opened to discharge the waste from the body. The tailgate normally contains both the hopper and the compaction equipment.

**Waste:** Any type of solid waste (except human wastes), including garbage, rubbish, ashes, incinerator residues, street cleanings, plant trimmings, and residential, commercial, and industrial solid wastes, including recyclable materials.

**Working area:** the vicinity of the tailgate used for loading and servicing the rear-loading compaction trucks compactor or other equipment.

## THE HAZARDS OF NORMAL OPERATION

Waste is collected and normally loaded into the hopper. The compaction mechanism, located within the hopper area, is operated by a trained employee. The waste materials collected are compacted and placed into the transfer body (normally part of the truck).

The compactor operator can select from several compactor operating cycles.

Once the body is full, the compacted waste materials can be removed by raising the tailgate and operating an ejection plate or tipping to empty the body.

A number of potential hazards are created during the normal operation of a rear-loading compaction truck. Other hazards may be created by incorrect adjustment, for example, setting the main hydraulic pressure above the manufacturer's specification.

A range of common operation hazards are identified below:

### 1. Placing the truck

The truck is positioned near the load to be compacted and transported.

Sometimes employees may assist the driver to position the truck or remain on running boards for short distances whilst the truck is placed into position. For any employee riding outside the cab of the truck whilst the truck is moving the maximum speed travel shall be no more than 16 kph for a maximum distance between pick-ups of 320 metres

Using a combination of rear-loading compaction collection trucks with trailers for collection creates a significant hazard for employees accessing the rear of the truck; appropriate controls need to be considered if this practise is used.

Maintaining visual contact between the driver and employees on foot is important in these circumstances. Other safety guidelines may apply. For example, Land Transport Safety Authority and the Transit guideline for temporary traffic control.

These and other requirements may require the use of cones and hi-viz clothing.

Employees working close to the vehicle can be struck when the vehicle is reversing or manoeuvring. In addition, the driver needs to maintain control over the operation of the compactor control panel, especially if the panel has been enabled through use of the power take-off switch or similar control system.

Rear visibility can be improved by the truck having two large side mirrors, using a spotter or using reversing cameras

Reversing lights and audible reversing secondary warning alarms are commended.

#### **Possible Hazards include:**

- Falls – an employee falls off the truck during travel at any speed; higher speed will result in a more severe injury.
- Illumination – the driver cannot place the vehicle safely.

- Truck – the hand-brake is not operated or is faulty.
- Visibility - the driver’s spotter is run over during reversing of the truck.
- Visitors – visitors to the working area being unintentionally injured.

## 2. **Loading the hopper.**

The hopper is loaded by placing the waste materials into the hopper. The materials can range from relatively light materials (such as shredded papers) to dense materials and even relatively long materials (such as old paper rolls).

The hopper can be fully loaded or be partially loaded; if fully loaded the hopper contents can sometimes spill increasing the potential for injury whilst reloading. These loads have the potential for a person to be caught and dragged in or injured whilst loading the hopper

In some models a guide flap extends the rave rail. This is normally found in a welded up position if a bin lifter has been fitted.

The hopper design shall prevent access to any pinch point caused by movement of the packer blade. A distance of 850mm is considered to be an acceptable isolation distance between the rave rail and any pinch point. The lower edge of the hopper loading area shall be a minimum of 1400 mm above the operator’s working surface. Where the height is less than 1400 mm the system shall meet the requirements of Figure 3 in the Booklet “The Ergonomics of Machine Guarding” Published by the Department of Labour.

When any hopper design allows the operator to be in a position to reach pinch points caused by movement of the packer blade, then a partially or preferably a fully enclosed and guarded hopper with a latched, interlocked door shall be fitted to prevent access to the danger area.

### **Possible Hazards include:**

- Hopper pinch points - employees may inadvertently place limbs into the hopper or be tempted to retrieve interesting items from the hopper before compaction occurs.
- Loads – an employee can be cut or struck by the load or its contents.
- Loads – manual handling can lead to chronic musculo-skeletal harm. This needs to be considered when identifying and controlling hazards associated with the operation of rear load compaction trucks. The Manual Handling Code of Practise published by OSH and ACC shall be considered when assessing these hazards.

## 3. **Operation of a bin lifter**

Bin lifters present a number of significant hazards. The most common bin lifting devices pick up 120 and 240 mobile garbage bins which weight up to 100 kgs with variations that can pick up 1100 litre MGB’s which weigh up to 750 kg.

### **Possible hazards include:**

- Hopper pinch points – an employee entering the compactor area to clear the contents of the bin when it is being lifted and tipped into the hopper.

- Lifter pinch points - employees may get body parts or clothing caught in the lifter mechanism or on the lifter when it is being lifted and tipped into the hopper.
- Impact by mobile plant – employees may be struck by the lifter while it is in operation.

#### 4. **Compacting hopper contents**

To compact the load the driver enters the cab of the vehicle, starts the engine, and then operates a power-take off switch or lever to power the compacting equipment located at the rear of the vehicle.

A control lamp or light will normally operate on the compaction control panel. This panel is normally located at the rear of the truck and is designed to be safely operated only by a trained employee.

The control lever shall be tamper proof. Hydraulic accumulators may be used in some bin lifter systems to automatically lift the bin-lifter in the reverse mode.

Where an accumulator is used provision should be made to release the stored energy. Suitable warning notices shall be provided, e.g. “Release stored energy in accumulator before carrying out any service or maintenance work”.

##### **Possible Hazards include:**

- Falls – an employee could fall into the hopper when it is operating resulting in injury ranging from harm to serious harm.
- Ergonomic– the operator may be affected by excessive manual handling creating the risk of acute or chronic musculo-skeletal disorders. This needs to be considered when identifying and controlling hazards associated with the operation of rear load compaction trucks. The Manual Handling Code of Practise published by OSH and ACC shall be considered when assessing these hazards.
- Health – the operator may be exposed to noise, inorganic or organic particulate dust or other hazards associated with waste material.
- Process Safety – an operator could fall, or instinctively reach into a hopper when the compactor is moving causing harm or serious harm. This is termed the “human factor.” Other examples might include an operator being familiar with the control on one truck and then whilst working on another truck, sub-consciously operating a differently placed button incorrectly.
- Mis-use – new or existing employees could skylark or mis-use equipment.
- Waste ejected from the hopper – during compaction waste may be ejected from the hopper due to the compaction pressure, e.g. bottles
- Trapping- a person could be dragged into the hopper by the waste material or a bag catching the hand of a person leading the trapping by the blade.

**Figure 1: Starting the rear-loading compaction truck**

### **Operating the compactor controls**

NOTE: All operator controls shall be identified in plain English (preferably with additional audio-visual aids, mimic signage or other ergonomic systems) and be supported by employee induction, competency based, and subsequent on-going training.

#### **a) STOP Buttons**

The compactor control buttons shall be normally arranged so the STOP button is found at the bottom of the Compactor control panel.

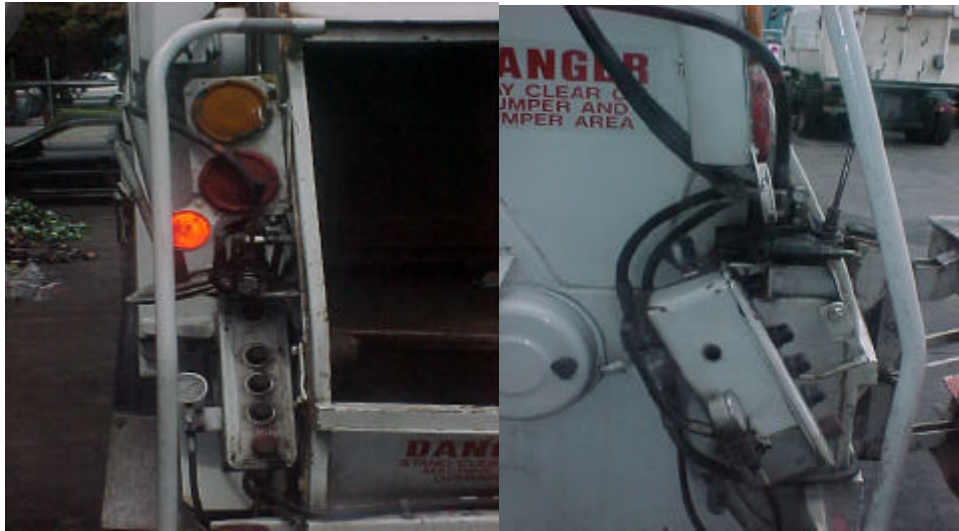
In most trucks an additional STOP button are found on both sides of the compaction equipment. These buttons shall be coloured red and be the largest button. Buttons should be inspected and tested regularly.

For emergencies, a means of stopping and controlling the movement of the ram at any point shall be provided. Emergency stop controls shall be readily accessible to the operator and shall be located within one metre of the point of operation. Emergency stop controls shall lock off the movement of the ram. Ram movement of automatic cycling compactors shall not be able to be restarted without the operation of a reset control.

Other variations include emergency rails (knock bars) or cords. These instantaneously stop any forward or reverse operation of the compactor mechanisms.

#### **b) MANUAL Operation**

The automatic, continuous cycle, single cycle or multi cycle operation of a compactor occurs by operating the manual forward button, normally found at the top of the compactor control panel. This operation shall only be used with closed systems.

**Figure 2: Rear-loading compaction truck - control panel**

In some machines the manual operation of the compactor is possible. The buttons used for manual operation shall be clearly labelled.

**NOTE:**

It has been reported some operators may use the manual operating switches to partially crush difficult loads and then use the emergency stop before entering the hopper to re-position the load. Using manual forward and reverse operation for possible partial loading of the hopper is an unsafe practice.

## **5. Unloading the Body**

Unloading the body normally involves placing the vehicle into a position to unload, operating the tail-gate and then the discharge system to eject the load.

In all cases the compaction equipment shall be isolated from operation whilst the tail-gate system is being raised, or the truck being moved.

Any safety equipment provided shall be used whilst the tailgate operation is underway.

The truck shall have an appropriate timeframe for raising or lowering the tailgate – ideally the time shall be not less than 20 seconds. Hydraulic pressure relief valve systems to avoid catastrophic tailgate failure and a sudden release shall be installed.

Hydraulically operated tailgate locking systems shall be positively locked in the closed position via pilot check valves or other control devices.

A “tailgate unlocked” warning system shall be fitted to indicate visually or audibly to the operator if the tailgate has started to leave the locked position.

Tailgate props, securely attached when in use, shall be fitted to mechanically hold the door in a position to allow access (1000 mm minimum gap) to the body cavity for maintenance and/or service activities.

The props shall be capable of completely resisting the hydraulic pressure.

To prevent accidental tailgate movement, the control shall be totally shielded or a hold to run operation. All other employees shall remain in a safe area until the unloading is complete.

**Possible Hazards include:**

- Health – the operator may be exposed to noise, inorganic or organic particulate dust or other hazards associated with loads.
- Human factors – an employee could fall or instinctively reach into the raised tailgate to retrieve something or clear a blockage.
- Mis-use – new or existing employees could skylark or mis-use equipment.
- Tailgate – an employee could be crushed by a descending tail-gate.
- Vehicle – an employee could be crushed by a reversing vehicle.

**5. Cleaning, Maintenance and Repairs**

There are a wide range of hazards possible with the maintenance and repair of rear-loading compaction trucks. These range from possible ejection of high-pressure hydraulic fluid to a sudden and uncontrollable movement of a jammed compactor.

**1. Cleaning**

Employers shall ensure a zero energy state exists and at all times full lock-out procedures are designed and used, before any cleaning is undertaken..

Occupational health hazards shall be considered during cleaning operations with appropriate steps taken to eliminate, isolate or minimise.

**2. Maintenance**

Maintenance shall be undertaken at frequent and scheduled intervals.

Personnel undertaking maintenance should be trained and competent.

Employers shall ensure a zero energy state exists and at all times full lock-out procedures are designed and used, before any maintenance is undertaken.

The manufacturer shall develop and provide a minimum programme for maintenance including periodic and regular inspections of all rear loading compaction trucks.

**3. Modification**

Any person modifying rear loading compaction trucks shall furnish operating instructions establishing guidelines for the use, cleaning, and care of the unit or component associated with the reconstruction (where modifications occur) or modifications. Instructions shall include precautionary notices associated with the reconstruction or modification.

Modification shall only be undertaken by authorised and qualified personnel.



Accidents or incidents associated with any modification shall be investigated with both remedial action and improvement undertaken.

One useful modification used in New Zealand has been the shrouding of the automatic cycle control button.

The design attempts to halt accidental compactor operation.

**Figure 3: Sheathing of control buttons**

All modifications shall be logged and any variation between trucks and/or subsequent modifications should be explained to all relevant employees.

#### **4. Repair**

Repair shall be undertaken by qualified and approved service personnel.

A number of fatalities have occurred from failing to make equipment safe before clearing any blockage and attempting repair. Serious harm can result from accidental or intentional operation of faulty equipment!

## HAZARD CONTROLS

The Health and Safety in Employment Act 1992 requires that any hazard or significant hazard must be effectively controlled to ensure that no harm or serious harm occurs.

This involves a continuous process involving:

1. All hazards must be systematically identified.
2. Identified hazards must be regularly assessed to determine if they are significant, HSE Act Sec 7 [c].
3. Any accident or harm is to be investigated to see if it was caused or arose from a significant hazard.
4. If the hazard is significant then all practicable steps must be taken to eliminate the hazard.
5. If the hazard can not be eliminated then it must be isolated.
6. If elimination and /or isolation have not succeeded then minimisation and monitoring are the final steps in the hierarchy of controls.

### Hazard Control Hierarchy

Waste collection can complicate hazard controls used successfully elsewhere.

Reasons can range from the unknown nature of the load (e.g. glass), to the type of load (e.g. loads exceeding hopper dimensions), and even to the ability of employees employed to operate the waste collection truck.

Therefore, full reliance on current hazard controls used (e.g. safety signs) is not recommended. In fact the use of signs is often seen to be a relatively weak control.

While poor literacy and comprehension skills may help to explain the error associated with some injury, the use of signs does not halt someone entering a danger area, such as the hopper of a rear-loading waste-truck with an operating compactor.

Competency based training can be considered much more robust than signs:

1. Training provides knowledge of safe operating methods and helps to build skills.
2. Training results in increases in productivity and reduction in harm.

However, training is still not a fully robust control. Even an experienced and trained person can incorrectly enter danger areas, such as an operating waste compactor.

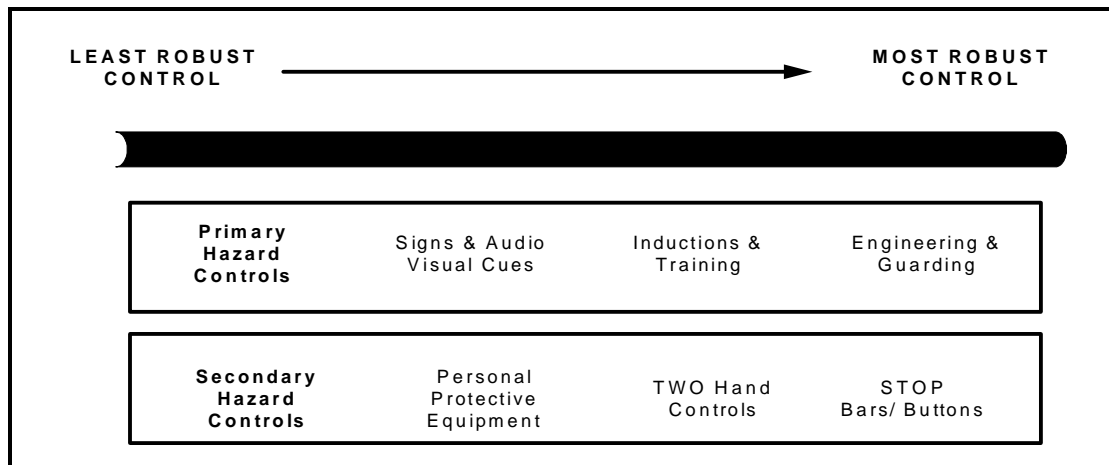
A continuum of hazard controls can be drawn starting with signs and training.

Designers and consultants shall consider always using error tolerant systems to reduce the probability of human error. For example, you cannot easily change the behaviour of people, but adding engineering controls (e.g. interlocked guards) can help to ensure people are outside the danger area before any machinery is operated.

In addition, adequate warning given to the operator through signage, visual and audible cues can be used. The operator is helped to detect changes in the operating environment.

The more robust protection is partial or full interlocked guarding.

**Figure 4: Continuum of hazard Controls**



## MACHINE GUARDING

The Health and Safety in Employment Act 1992 (regulations 66 & 67) imposes duties on designers, manufacturers and suppliers to ensure that they have taken all practicable steps to ensure their plant will not be a source of harm to any person.

Hence using interlocked guards can reduce injury and be considered to be a practicable step.

Anyone using interlocked guards should comply with the accepted range of guarding and inter-locking standards. The interlock shall be designed for all circumstances of use, including normal operation, repair, maintenance and cleaning.

Another consideration is that some trucks and equipment manufactured to international standards may not meet the requirements of the New Zealand Health and Safety in Employment Act 1992. The latest state of the art or development shall always be used to seek compliance. The following information is provided to help guideline users understand some of the issues and concerns associated with guarding principles.

### OSH Recommendations

The New Zealand Occupational Safety and Health Service recommend anyone contemplating using guarding understand the need to also use effective and fail safe interlocking.

They recommend the use of several other guidelines and standards. These booklets may be obtained from an OSH office or from Standards New Zealand. These include:

1. British Standard BSEN 1501.1 – rear loading rubbish trucks.
2. Electronic Systems for Machine Operator Safety. The unit has to comply with certain standards and be installed by approved installers nominated by the vendors as described and listed in the guidelines. The approved installers apply to the application of photoelectric safety devices such as light curtains.
3. Guidelines for Guarding Principles and General Safety for Machinery.
4. The Ergonomics of Machine Guarding.
5. Guidelines for Refuse collection Processing and Disposal Requirements: Stationary Compactor Safety Requirements
6. Guidance Notes for Electrical Interlocking for Safety in Industrial Processes. The fitting of safety switches used in interlocking, the fail safe and other safety requirements as described in the booklet is to be followed by installers.
7. Australian Standard AS 4024.1. Guarding principles.
8. United States Standards including ANSI Z245.1 – 1999.

Note: Items Nos 3, 4 and 5 above can be downloaded from the OSH website:  
[www.osh.dol.govt.nz](http://www.osh.dol.govt.nz)

NOTE: The US compactor standard describes that safeguard is only required if the loading height is less than 42in(1067mm)and that means if it is 1100 mm height, you do not need guarding. This does not comply with the OSH booklet "The Ergonomics of Machine Guarding" because a person can reach into the danger area if no guarding is provided during operation at this height.

## GUARDING TYPES

Essentially, there are three basic types of machine guards. Guards work by placing a monitored barrier between people and dangerous machinery. They shall stop people from entering or penetrating the danger area (for example) of a waste compactor. Any type of guard shall be fixed using a screws, or nuts and bolts that require the use of a tool to remove.

### **Type A: Static fixed guard**

A static fixed guard is one that remains in a fixed position and can not be moved or adjusted while the machine is in use. The effectiveness of any fixed guard must always be judged by a test to see that fingertips cannot reach point of danger. They can include screens, covers or pieces of plastic.

Advantages include permanent guarding, low investment, long life, and no hazardous projections. Disadvantages include removal without detection.

**Figure 5: Rear- loading (twin paddle) Pinch-point**



### **Type B: Adjustable fixed guard**

An adjustable fixed guide is one that can be adjusted so as to allow the size of the feed opening to be increased to suit varying thicknesses of materials being fed into the machine. Moveable guards is another term used in the USA. Moveable guards are usually connected in an interlock arrangement to the machinery control mechanism.

Switches used include locking or fail safe type of interlocking switches.

Advantages include low investment, absolute protection if regularly maintained and protection from ejected material. Disadvantages include additional maintenance requirements and access for maintenance difficult.

### **Type C: Automatic guard**

An automatic guard is a guard with a rise and fall motion. In some cases the operation can trigger machinery to automatically reverse.

Safety light curtains containing photo-electric barriers are other automatic guards.

## Comparison of Guarding Methods

### 1. Drop-down cover

To protect people from entering the compactor danger zone whilst it is operating a pull-down or a powered drop down cover could possibly be installed. Some machines already have these pull-down screens fitted prior to purchase.

A pull-up cover does not seem possible and is not considered.

#### **Advantages**

Protects people from harm during any forward or reversing of compactor paddles and/or augers. Interlocking could be simply installed by routing all the rear switches 12 or 24 volt control through an interlocked relay contact. One part of the magnet is used to operate the relay being attached to the drop-down cover. Two magnets should be used. This 'redundancy' helps to prevent employees bypassing controls.

#### **Disadvantages**

An additional nip point may arise under the descending cover (although a rubber trip could easily be installed). The frequency of closure and operation may exceed the acceptable boundaries for practicality and increase other hazards.

For example, a sprung cover with a pull-down operating cord might suffice.

Operators shall ensure that any additional guarding installed does not create additional hazards.

### 2. Light Curtains

A light curtain could be installed. A light curtain is a two-part electronic guarding mechanism. This provides an instantaneous cut-off of the machine and any electrical drives if any body part, e.g. a finger was inserted into the controlled location.

#### **Advantages**

Covers the rear of the truck during any forward or reversing of the compactors paddles and augers. Interlocking could be simply installed by routing all the rear switches 12 or 24 volt control through an interlocked relay contact. One additional benefit is the light curtain units are self-alarming and are normally 'fail-safe'.

#### **Disadvantages**

Maintaining the surface of the mirrors in a clean condition and the reported need for continuous operation when collecting cardboards and other loads. Some solutions may create unknown effects in the timing board of the rear-loading compaction truck.

There may be some significant time delay in immediately stopping the forward movement of any hydraulic operated or heavy compaction equipment.

## **Control and Emergency Switches**

All control or emergency switches installed shall be inspected at regular intervals.

Furthermore, any switch found to be faulty shall be immediately replaced by a switch designed for the same function and reliability.

In all cases switches shall be clearly labelled – ideally in words and symbols.

### **Emergency stop systems**

In a number of rear-loading compaction trucks emergency stop bars or cords have been fitted. The purpose of these bars or cords, is in the case of danger, the machine stops its motion when the emergency stop button is pushed.

**Advantages** include it is easy to use, is quick and minimises the consequences.

**Disadvantages** include the need to install sufficient switches in easy proximity to the dangerous zone. Operators must be able to reach the cut-out under all conditions.

Furthermore, while emergency stop-bars or cords can limit injury severity, they typically do not prevent or guarantee that serious harm will not result.

Fitting an inter-lock would require the 12 or 24 volt power rail to become inactive simultaneously with the removal of any hydraulic pressure. However, there will almost always be some delay (hysteresis) between switching off the power and the paddle stopping. Therefore the use of emergency stop controls is weak.

The use of emergency bars or cords should not be used as a primary protection.

### **Emergency Restarting**

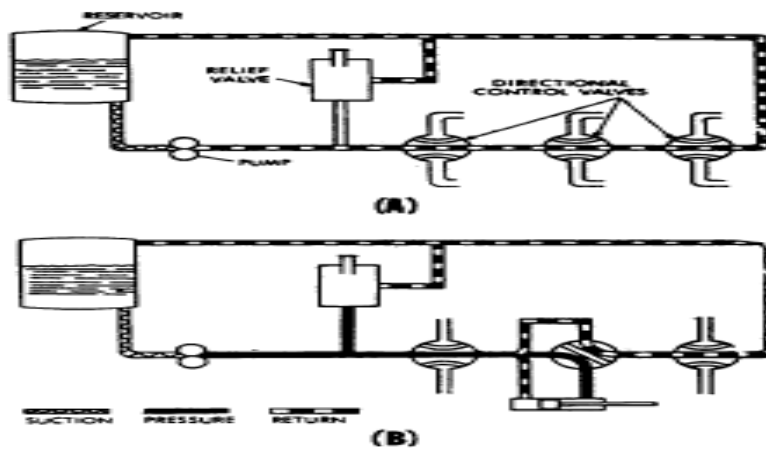
1. Emergency stops shall have manual reset after any interruption, operators shall assess the machine to ensure that it is safe to restart prior to resetting emergency stops.

### **Electrical and Hydraulic Operating Schematics**

A typical hydraulic system is shown below. The pump operates and increases the hydraulic pressure. The pressure is directed through a bi-directional control valve. The valve directs pressure to an auger – which either rotates or moves forward or back.

Off-normal micro-switches provide safety and control functions. These switches can require maintenance and are normally found under exterior inspection covers.

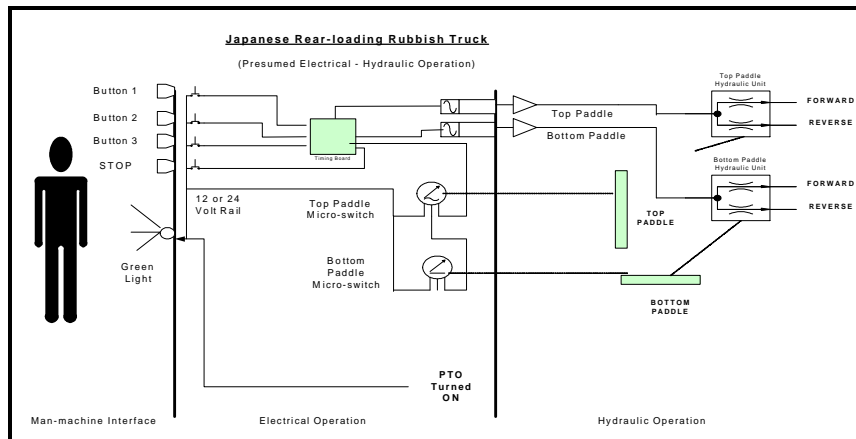
Figure 6: typical hydraulic operation



The electrical operating system is typically based on a 24 volt system. The operation of the power take-off unit provides power to the hydraulic pump and electrical power to the rear-loading compaction trucks control panel. The panel contains switches that control the bi-directional valves shown above.

NB: Some variation may exist between different manufacturers. In addition new and unwanted variation may exist due to other modifications completed by previous owners.

**Figure 7: Typical electrical explanatory diagram**



The electrical diagram (see above) shows an older style twin-paddle rear-loading compaction truck, the majority of which have been imported from Japan. Other rear-loading compaction trucks may differ significantly from this diagram.

## TRAINING

Owners of compactors shall use or develop a competency based training scheme for drivers, employees and maintenance people who work with any waste trucks.

The training scheme shall include:

1. Use of appropriate NZQA unit standards or similar systems.
2. Safe operation including appropriate types of waste;
3. Normal and abnormal operation including use of emergency stop controls;
4. Limited fault recognition and emphasis upon recording and reporting faults;
5. Recognition of guarding principles, lockout/tag out and rules for use;

Employers of operators shall maintain a written record of training which may include certification of compactor operators, contractors and sub-contractors.

Owners of rear-loading compaction trucks shall provide operating instructions establishing guidelines for the safe use, cleaning, and maintenance of these units. Such instructions shall include precautionary notices and training associated with operation of the unit.

Instructions shall include inspections of equipment and checklists to record the outcomes of the inspections. Audits shall also be used to evaluate the outcomes of any safety system initiatives, for example, corrective actions following accidents.

## LOCK OUT PROCEDURES

The owner of rear-loading compaction trucks shall provide instructions for a lockout procedure in which the power shall be shut off, except during maintenance testing.

The lockout procedure shall isolate and render safe all energy sources, including electrical, hydraulic, potential, and kinetic energy. When energy sources within the compactor have reached the zero energy state, then the compactor can be worked on.

Instances requiring action might include:

1. Repairing any mechanical malfunctions or breakdowns that may affect the safe operation of the compaction or other equipment.
2. Establishing and following a programme of periodic and regular inspections of all rear-loading compaction trucks and their compactors.
3. Protecting the operator at the point of operation, by the installation of a point-of-operation guard that shall prevent entry into the point of operation.
4. Specifically inspecting safety interlocks, switches, and other protective devices to ensure the devices are not disabled or bypassed, and not to permit the rear-loading compaction truck to be operated unless these are fully functional.

## **OPERATORS RESPONSIBILITY**

Operators/employees who work on and around stationary compactors shall be responsible for the items listed below:

1. Using all applicable safety features provided on stationary compactors.
2. Using rear-loading compaction trucks and their compactors only after receiving instruction in the normal and any abnormal operating procedure.
3. Reporting any damage to, or malfunction of, compactors by submitting a report to the employer preferably when the damage or malfunction occurs.
4. Ensuring tailgates are closed and locked before operations begin.
5. Ensuring that all the areas of operation around rear-loading compaction trucks are clear of any persons during all phases of the operation.
6. Ensuring that all persons are clear of the compactor point of operation before actuating any compaction cycle controls or container dumping controls and be ready to stop the compaction cycle if necessary.
7. Ensuring that all persons are clear of the tailgate (on compactor container combinations so equipped) before the tailgate is opened or shut, and warning all persons not to cross under an open tailgate.
8. Using all compacting equipment in accordance with the manufacturer's and/or owner's instructions, including ensuring the proper position of all guards, etc.
9. Ensuring that no one disables or bypasses safety interlocks, switches, or other protective devices, and that the compactor is not operated unless these devices are fully functional.
10. Using inspections and auditing the resulting safety and/or quality management systems to ensure all rear-loading compaction trucks are operated safely.

## CONTROLS CHECKLIST

This example is provided to encourage the development of similar checklists. Checklists can be useful to help confirm that safety management systems remain implemented.

**Person:**

**Date Checked:**

**Vehicle:**

### Safety Checklist

	YES	NO
1. Each control is conspicuously labelled as to its correct function.		
2. Operating controls are designed and located to prevent unintentional activation.		
3. Start buttons are designed to prevent unintentional activation.		
4. Stop (including emergency stop) buttons are red and are distinguishable from all other controls by size and colour.		
5. For emergencies, a means of stopping and controlling the movement of the ram at any point has been provided and operates correctly.		
6. Emergency stop controls are readily accessible to the operator.		
7. Emergency stop controls lock off the movement of the ram.		
8. Emergency stops require manual reset		
9. A key lock switch has been provided to prevent the inadvertent and unauthorised activation of the compaction cycle.		
10. Guards are installed to prevent trapping hazards in accordance with this standard		
11. Operators have been trained in the correct and safe use of the compactor equipment		

### Comments: (Follow-up actions required)