OPERATIONS HANDBOOK
FOR THE
ASSESSMENT
OF POTENTIAL TRAM INSTALLATIONS

GET HOME
SAFELY

SECTION 1 GENERAL PRINCIPLES

We only install tram on parent equipment (trucks, trailers, gantries, cranes, elevated walkways, etc) when we know that:

- TRAM provides the safest reasonably practicable solution to the risk of falling to a lower level
- The parent equipment is in a safe condition
- The parent equipment either complies with the relevant requirements, or there is a defensible reason why it does not

The flow chart at Figure 1 is to be followed when considering new TRAM applications or installations.

How to use the flow chart →

There are four key questions down the left hand side of the chart:

1. **Is TRAM the safest reasonably practicable solution?**

   To answer this requires the application of a risk management process. Go to Section 2 for guidance on how to do this.

2. **Is the parent equipment in a safe condition?**

   This requires a brief check of the parent equipment along the guidelines given at Section 3 of this Handbook.

3. **Is the parent equipment compliant?**

   Look to Section 4 of this Handbook for guidance on the relevant aspects of the applicable Standards.

4. **Have all safety and compliance issues been resolved?**

When the answer to questions 1 and 4 is “yes”, we can proceed with the installation of TRAM.

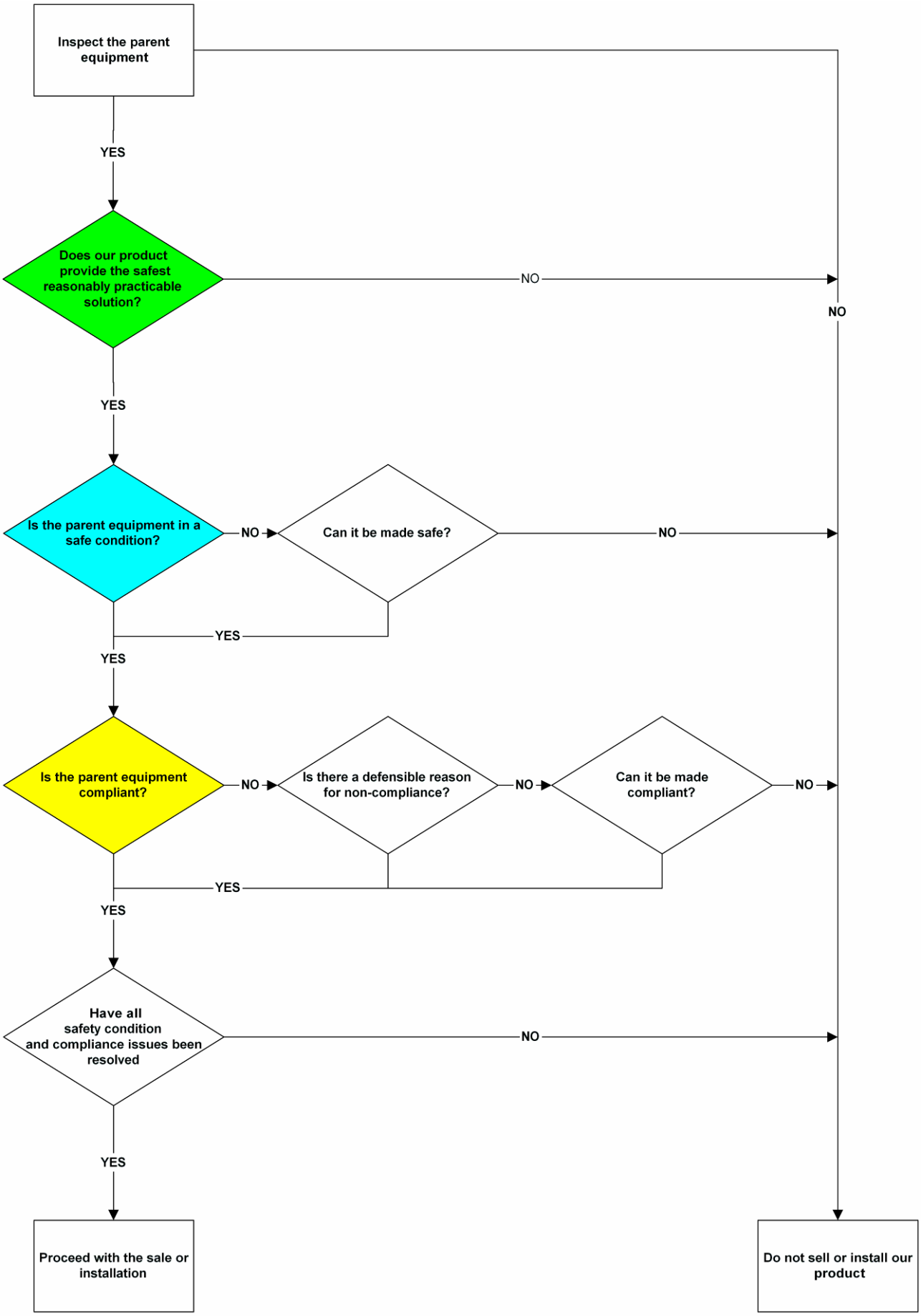

Figure 1. Flow Chart for Determining Whether or not to Apply or Install TRAM

SECTION 2 RISK MANAGEMENT FOR FALL HAZARDS

2.1 The Client's Responsibility

To determine if TRAM is the safest reasonably practicable solution, we need to assess the level of risk and determine and apply appropriate control measures. This is the client's responsibility. It is a statutory requirement in every state and territory of Australia, and in New Zealand. If the client does not follow a suitable risk management process and chooses an inappropriate risk control, they may be found negligent.

2.2 The Potential Impact on Standfast

We may also be found negligent if an accident occurs as a result of a hazard for which we both:

- provided fall-protection equipment as a control, and
- knew that the client had not gone through this process..

2.3 How to Proceed

There are numerous methods for identifying hazards and assessing risk. The process shown in *AS/NZS 1891.4:2000 Industrial fall-arrest systems and devices Part 4: Selection, use and maintenance* (AS/NZS 1891.4) is one of them. It gives good guidance for controlling fall hazards and will be used in this handbook.

If the client has not gone through this, or a similar process, encourage them to do so and offer our assistance.

The process for managing the risk of a fall to a lower level starts on the next page.

Process for Managing the Risk of a Fall to a Lower Level

STEP	ACTIVITY

1 Ask the question – "Can we eliminate the need to work at height?"

Eliminating the need for people to work at height is the ultimate goal. Consult with the client to see if it is possible to eliminate tasks that require people to work at height.

If elimination is not possible

If it is not possible to eliminate the need to work at height, we then need to analyse the task itself to identify the hazards, calculate the risk, and then control the risk.

To analyse a task, or job, a Job Safety Analysis (JSA) form is used (clients may use different forms and different names, but the principles are the same). We will follow the remaining Steps in the risk control process compiling the JSA form shown on the opposite page as we go.

Small teams - two to four people – give the best result for a JSA. It is favourable to have a mix of a people – at least one who is familiar with the job, and at least one who is not, but who understands the risk management process. This gives a balanced approach to breaking the job up into meaningful activities, to determining risk scores, and to identifying control measures.

2 List the activities

Break the job down into key activities, and then list them in order on the form.

An "activity" is hard to define in this sense, but what you are looking to do is to separate the job into areas that are significantly different by nature of such things as:

- Physical demands (e.g. climbing versus walking, or lifting a hatch versus dipping a tank)
- Changes in location (e.g. being on the ground versus on a ladder, or being on a ladder versus being on an elevated walkway)

The idea is to record sufficient detail for as many real hazards as possible to be identified in the next Step. It is better to have too much detail than too little because if the detail is scant, it is possible that real hazards will be missed.

3 List the hazards

Each activity may have more than one hazard. List the hazards (these may be existing or potential) to each activity, and the effects of the hazard.

E.g. A hazard for climbing a ladder may be that the ladder is, or has the potential to be, in a poor condition. The effect of this is that the user might fall from the ladder.

A client's JSA would normally show all of the hazards associated with each activity. The example here only shows those hazards that may result in a fall. This will normally be sufficient for Standfast's needs.

If you have doubts about the safety of the client's operation (see Section 3), then ask to do a complete JSA with them. Using an approach like "wanting to ensure that TRAM will not interfere with other activities", is a reasonable request that should be met. The information gained will help Standfast to determine whether or not to proceed with the installation.

EXAMPLE - STEPS 2 AND 3

(The complete list of work activities is not shown here – a completed example is shown at the end of this Section)

Analysis of the task with current control measures			Analysis of task using newly determined control measures		
STEP 2 ▼	**STEP 3** ▼	STEP 4 ▼	STEP 5 ▼	STEP 6 ▼	STEP 7 ▼

JOB SAFETY ANALYSIS – WORKING AT HEIGHT ON A PLATFORM ACCESSED BY LADDER									
Work Activity	**Hazards & Effects**	L	C	R	Possible Elimination / Mitigation Measures	**Residual Hazard** (How can people still hurt themselves)	L	C	R
1. Ascend ladder to the level of the work platform.	Fall to a lower level after a slip/trip due to physiological reasons.								
	Fall to a lower level due to poor ladder design, manufacture or condition.								
2. Make transition from ladder to work platform	Fall to a lower level from a slip/trip due to physiological reasons.								
	Fall to a lower level due to the design, manufacture or condition of the ladder-platform interface.								
3. Perform required work on platform	Fall to a lower level after a slip/trip due to physiological reasons.								
	Fall to a lower level due to the design, manufacture or condition of the platform.								

STEP	ACTIVITY

4 Determine the risk score for each hazard

At this stage, we are only looking at the job as it is done now – we will apply additional control measures later.

We have two areas to look at – *likelihood* and *consequence*. We score these using the following table:

Risk Scoring System (adapted from Standards Australia OHS Risk Management Handbook HB 205-2004)

	Consequence →	**1**	**2**	**3**	**4**	**5**
	Likelihood ↓	**No Injuries**	**First aid treatment**	**Medical treatment**	**Extensive injury**	**Death**
A	**Almost certain** Everyday occurrence	**H**	**H**	**E**	**E**	**E**
B	**Likely** Happens occasionally	**M**	**H**	**H**	**E**	**E**
C	**Unlikely** Might be experienced some time in a working life	**L**	**M**	**H**	**E**	**E**
D	**Very unlikely** Not expected to happen but have heard of it happening elsewhere	**L**	**L**	**M**	**H**	**E**
E	**Extremely unlikely** Theoretically possible but not expected ever to occur	**L**	**L**	**M**	**H**	**H**

(L=low risk, M=moderate risk, H=high risk, E=extreme risk)

- First, determine the *likelihood* descriptor ("certain", "almost certain", etc.) that best describes the likelihood that the hazard will result in the *effect*.

  E.g. what is the likelihood that an employee will slip from a ladder? To work this out, take into consideration all relevant factors such as the condition of the ladder, the design of the ladder, what the employee will be wearing, what they will be carrying, and environmental conditions (heat, cold, wet, dry, windy, etc.).

  There is no "correct" response – it is a judgement call.

  Record the score (A, B, C, D or E) in the first "L" column of the form.

- Next, determine the *consequence* of the *effect* (e.g. a fall from a platform). Again, this is a judgement call and the consequence descriptors are for guidance purposes only.

  Record the score (1,2,3,4 or 5) in the first "C" column of the form.

- Lastly, cross reference the likelihood and consequence scores on the table above to get the risk score (L, M, H or E). Record the risk score in the first "R" column on the form.

  What the risk scores mean in practical terms is this:

E - The risk is intolerable – stop performing the task until the risk is lowered
H – The risk is barely tolerable - requires immediate attention
M – The risk level is tolerable, but could be lower - address as soon as possible
L – The risk level may be as low as is reasonably practicable

EXAMPLE - STEP 4

(The complete list of work activities is not shown here – a completed example is shown at the end of this Section)

Analysis of the task with current control measures			Analysis of task using newly determined control measures		
STEP 2 ▼	STEP 3 ▼	**STEP 4** ▼	STEP 5 ▼	STEP 6 ▼	STEP 7 ▼

JOB SAFETY ANALYSIS – WORKING AT HEIGHT ON A PLATFORM ACCESSED BY LADDER

Work Activity	Hazards & Effects	L	C	R	Possible Elimination / Mitigation Measures	Residual Hazard (How can people still hurt themselves)	L	C	R
1. Ascend ladder to the level of the work platform.	Fall to a lower level after a slip/trip due to physiological reasons.	**C**	**4**	**E**					
	Fall to a lower level due to poor ladder design, manufacture or condition.	**D**	**4**	**H**					
2. Make transition from ladder to work platform	Fall to a lower level from a slip/trip due to physiological reasons.	**C**	**5**	**E**					
	Fall to a lower level due to the design, manufacture or condition of the ladder-platform interface.	**D**	**5**	**E**					
3. Perform required work on platform	Fall to a lower level after a slip/trip due to physiological reasons.	**C**	**5**	**E**					
	Fall to a lower level due to the design, manufacture or condition of the platform.	**D**	**5**	**E**					

STEP	ACTIVITY

5 Determine Potential Control Measures

Now that the risks have been scored, we need to look at reducing the level of risk for any hazard with a risk score of *Medium* to *Extreme*. Again, we are focusing on fall hazards.

AS/NZS 1891.4 gives guidance on how to determine control measures for fall hazards. The first step is to go through the hierarchy of controls with the goal of finding the safest reasonably practicable control measure. We will do this in three parts:

- In Step 5a, we will look at the general hierarchy of risk controls using a flow chart from *AS/NZS 1891 Industrial fall-arrest systems and devices Part 4: Selection, use and maintenance* with additional guidance notes.
- In Step 5b, we will look at a subordinate hierarchy of controls to pick a *physical control* within the category of *fall protection*.
- In Step 5c, we will look at administrative control measures that might be used to supplement the primary *physical control*.

5a Initial Assessment of Control Measures

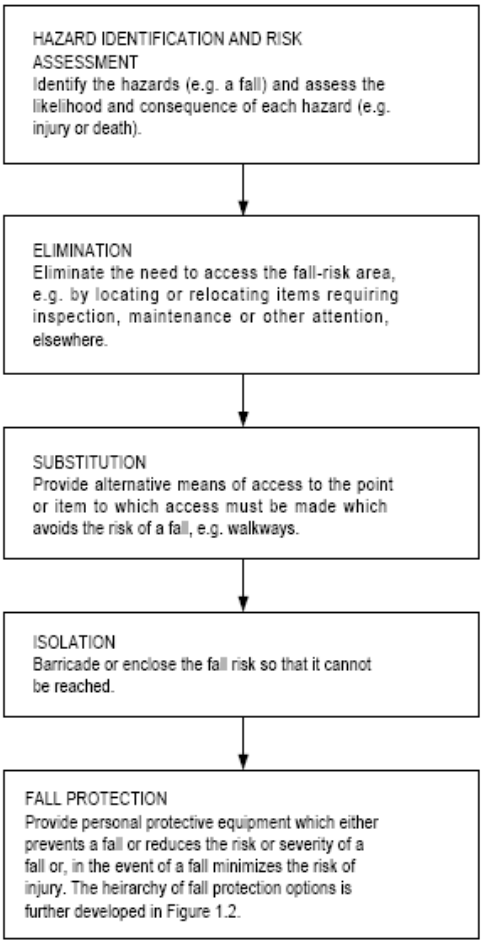

Figure 2. Hierarchy of Risk Controls
(From AS/NZS 1891.4:2000 Figure 1.1)

We have already completed this task (the initial hazard identification and risk assessment) by performing Steps 2 to 4 of our process.

The remainder of the diagram refers to Step 5 of our process.

Elimination, *substitution* and *isolation* of the fall hazard, in that order, are the highest forms of control measure. The client should apply one of these controls wherever possible. *Fall protection* is the last resort.

We have already ruled out *elimination* as a possibility (see Step 1), so consider *substitution* and *isolation* before going to the last option of *fall protection*.

Note that pop-up guardrails fall into the category of *isolation*, which places them higher than TRAM, a *fall protection* device, in this hierarchy. The issue here is that pop-up guardrails provide an ineffective barrier, so they are an ineffective control measure. TRAM is far more effective than pop-up guardrails and this is shown in the comparative risk assessment at the end of this Section of the Handbook.

If *fall protection* is the only reasonable option left, go to the next chart to select the right fall protection system. (Note that the next chart is the "Figure 1.2" referred to at the end of the "FALL PROTECTION" box).

STEP	ACTIVITY

5b Assessment of Physical Control Measures for Fall Protection

The chart below shows the hierarchy of controls within the category of *fall protection* shown in the previous chart. Use the chart below if it was identified that *fall protection* is the safest reasonably practicable solution to a risk identified in the JSA.

The chart has two columns – *physical controls* and *supplementary administrative controls*. *Physical controls* refer to the actual *fall protection* system. *Supplementary administrative controls* are specific measures for making the *physical control* more effective.

The chart shows the *physical controls* in descending order of priority. *Fall restraint* is the highest control measure on the list. This means that when TRAM is properly installed in a manner that provides *fall restraint*, it is the safest *fall protection* system possible.

If TRAM is to be used in *fall restraint*, there is no need to look further for a *physical control*. The example JSA assumes that is the case and is filled out accordingly. If there is a need to consider other *physical controls*, an example comparative JSA is shown at the end of this Section of the Handbook.

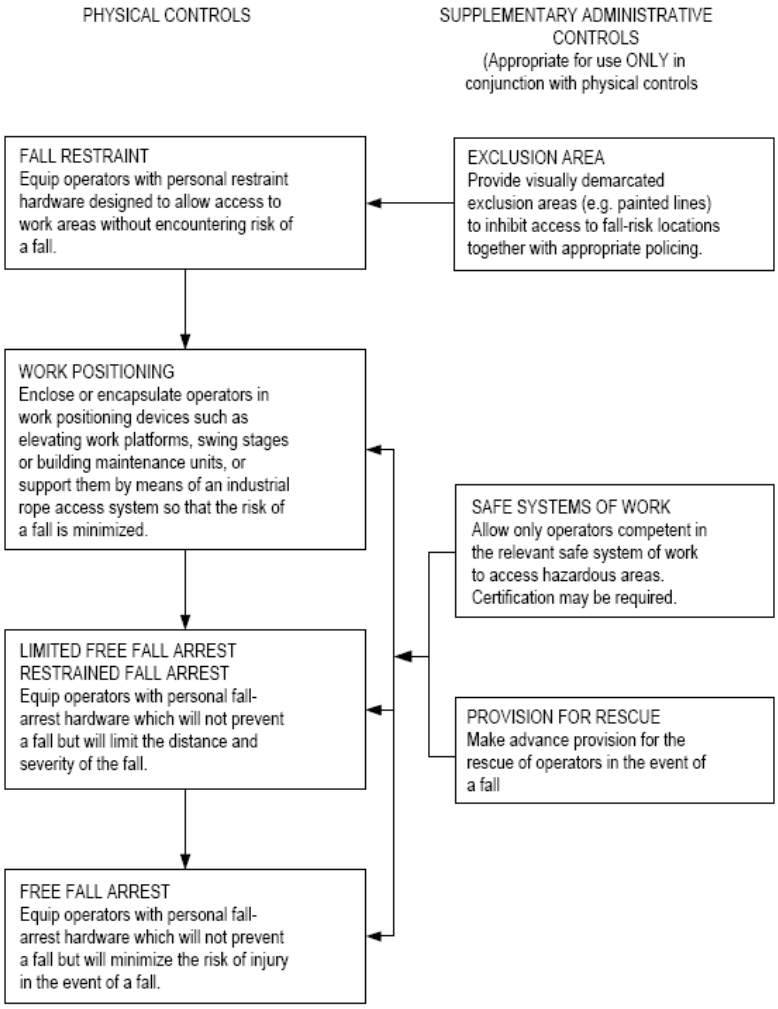

Figure 3. Hierarchy of Fall Prevention Options
(From AS/NZS 1891.4:2000 Figure 1.2)

STEP	ACTIVITY

5c Additional Administrative Control Measures

Once the *fall protection* control measures have been determined, consideration should be given to additional administrative control measures, if you have not already done so. These should not be confused with the specific *supplementary administrative controls* covered in Figure 3.

Additional administrative control measures include anything that can reasonably be employed to make the job safer. These include:

- Inspection and maintenance regimes to ensure that ladders, platforms, walkways, and fall protection devices remain serviceable.
- Training of employees in general height safety and in using the fall protection equipment.
- Ensuring that employees are physically capable of undertaking the required work with the required equipment.
- Ensuring that employees are fit for work.

Record any additional administrative controls on the JSA

6 Assess the Residual Hazards

Apply the determined control measures to the activities and assess any residual hazards, as shown in the example JSA.

7 Recalculate the Risk Score

Applying the same system as in Step 4, recalculate the risk score for each hazard under the newly determined control measures and record it on the JSA in the right-hand *Likelihood*, *Consequence* and *Risk Score* columns.

Important

Be mindful that when one activity can take place in different locations, the different locations may well have a different effect on the hazards and the controls.

For example, a driver may work on the top of the same truck in different gantries. The design of those gantries may differ, and this may impact on the way the driver works. It may also impact on the effectiveness of control measures.

Also be mindful that control measures may generate new hazards. E.g:

> If TRAM is installed on a platform or walkway that may be accessed at times without using TRAM, the TRAM arm or TRAM rail may constitute trip hazards that may result in a fall to a lower level.

EXAMPLE - STEPS 5, 6 & 7

(The complete list of work activities is not shown here – a completed example is shown at the end of this Section)

Analysis of the task with current control measures			Analysis of task using newly determined control measures		
STEP 2 ▼	STEP 3 ▼	STEP 4 ▼	**STEP 5** ▼	**STEP 6** ▼	**STEP 7** ▼

JOB SAFETY ANALYSIS – WORKING AT HEIGHT ON A PLATFORM ACCESSED BY LADDER

Work Activity	Hazards & Effects	L	C	R	**Possible Elimination / Mitigation Measures**	**Residual Hazard** (How can people still hurt themselves)	L	C	R
1. Ascend ladder to the level of the work platform.	Fall to a lower level after a slip/trip due to physiological reasons.	C	4	E	Ensure users are fit for work. Maintain a minimum three-point contact when climbing. Ensure users are trained.	Fall to a lower level due to failure to maintain a minimum three-point contact.	D	4	H
	Fall to a lower level due to poor ladder design, manufacture or condition.	D	4	H	Ensure that a compliant ladder is fitted. Ensure that ladder is free of obstacles to the climber. Pre-use and periodic maintenance inspections of the ladder for structural failure Maintain a minimum three-point contact when climbing.	Fall to a lower level due to failure to maintain a minimum three-point contact.	E	4	H
2. Make transition from ladder to work platform	Fall to a lower level from a slip/trip due to physiological reasons.	C	5	E	Ensure users are fit for work. Maintain a minimum three-point contact. Use **TRAM** system as fall prevention. Use **TRAM** system to assist the user in the climb Ensure users are trained.	Restrained fall.	E	1	L
	Fall to a lower level due to the design, manufacture or condition of the ladder-platform interface.	D	5	E	Ensure that the design and construction allow for an unobstructed transition. Pre-use and periodic maintenance inspections of ladder-platform interface for structural failure.	Restrained fall.	E	1	L
3. Perform required work on platform	Fall to a lower level after a slip/trip due to physiological reasons.	C	5	E	Ensure users are fit for work. Use **TRAM** system as fall prevention. Ensure users are trained.	Restrained fall.	E	1	L
	Fall to a lower level due to the design, manufacture or condition of the platform.	D	5	E	Ensure that the platform is compliant with relevant requirements. Pre-use and periodic maintenance inspections of platform for structural failure. Use **TRAM** system as fall prevention.	Restrained fall.	E	1	L

Example Job Safety Analyses follow overleaf

EXAMPLE COMPLETED JOB SAFETY ANALYSIS – WORKING AT HEIGHT ON A PLATFORM ACCESSED BY LADDER

Work Step	Hazards & Effects	L	C	R	Possible Elimination / Mitigation Measures	Residual Hazard (How can people still hurt themselves)	L	C	R
4. Ascend ladder to the level of the work platform.	Fall from height after a slip/trip due to physiological reasons.	C	4	E	Ensure users are fit for work. Maintain a minimum three-point contact when climbing. Ensure users are trained.	Fall from height due to failure to maintain a minimum three-point contact.	D	4	H
	Fall from height due to poor ladder design, manufacture or condition.	D	4	H	Ensure that a compliant ladder is fitted. Ensure that ladder is free of obstacles to the climber. Pre-use and periodic maintenance inspections of the ladder for structural failure Maintain a minimum three-point contact when climbing.	Fall from height due to failure to maintain a minimum three-point contact.	E	4	H
5. Make transition from ladder to work platform	Fall from height from a slip/trip due to physiological reasons.	C	5	E	Ensure users are fit for work. Maintain a minimum three-point contact. Use **TRAM** system as fall prevention. Use **TRAM** system to physically assist the user in the climb Ensure users are trained.	Restrained fall.	E	1	L
	Fall from height due to the design, manufacture or condition of the ladder-platform interface.	D	5	E	Ensure that the design and construction allow for an unobstructed transition. Pre-use and periodic maintenance inspections of ladder-platform interface for structural failure.	Restrained fall.	E	1	L
6. Perform required work on platform	Fall from height after a slip/trip due to physiological reasons.	C	5	E	Ensure users are fit for work. Use **TRAM** system as fall prevention. Ensure users are trained.	Restrained fall.	E	1	L
	Fall from height due to the design, manufacture or condition of the platform.	D	5	E	Ensure that the platform is compliant with relevant requirements. Pre-use and periodic maintenance inspections of platform for structural failure. Use **TRAM** system as fall prevention.	Restrained fall.	E	1	L

7. Make transition from work platform to ladder	Fall from height from a slip/trip due to physiological reasons.	B	5	E	Ensure users are fit for work. Use **TRAM** system as fall prevention. Use **TRAM** system to physically assist the user in the climb Ensure users are trained.	Restrained fall.	E	1	L
	Fall from height due to the design, manufacture or condition of the ladder-platform interface.	D	5	E	Ensure that the design and construction allow for an unobstructed transition. Ensure that ladder is free of obstacles to the climber. Pre-use and periodic maintenance inspections of ladder for structural failure Use **TRAM** system as fall prevention.	Restrained fall.	E	1	L
8. Descend ladder	Fall from height from a slip/trip due to physiological reasons.	C	4	E	Ensure users are fit for work. Maintain a minimum three-point contact when climbing. Ensure users are trained.	Fall from height due to failure to maintain a minimum three-point contact.	D	4	H
	Fall from height due to poor ladder design, manufacture or condition.	D	4	H	Ensure that a compliant ladder is fitted. Ensure that ladder is free of obstacles to the climber. Pre-use and periodic maintenance inspections of the ladder for structural failure Maintain a minimum three-point contact when climbing.	Fall from height from a due to failure to maintain a minimum three-point contact.	E	4	H

Example Comparative Job Safety Analysis

The following table provides a comparative analysis of the same job using three separate controls measures: horizontal lifelines and TRAM, being fall protection controls; and pop-up guardrails, being an isolation control.

RISK ANALYSIS – FALL FROM HEIGHT ON A ROAD TANKER ACCESSED BY LADDER
COMPARISON OF TRAM, HORIZONTAL LIFELINE AND GUARDRAIL SYSTEMS AS RISK CONTROL MEASURES

Activity		Option 1: Horizontal lifeline L = likelihood. C = consequence. R = risk score					Option 2: TRAM L = likelihood. C = consequence. R = risk score					Option 3: Guardrails L = likelihood. C = consequence. R = risk score				
Work Step	Potential Hazards & Effects	Possible Elimination / Mitigation Measures	Residual Hazard	L	C	R	Possible Elimination / Mitigation Measures	Residual Hazard	L	C	R	Possible Elimination / Mitigation Measures	Residual Hazard	L	C	R
1. Climb ladder to the level of the work platform.	Fall from height after a slip/trip	Ensure users: -Are fit for work. -Are trained. -Maintain a minimum three-point contact when climbing.	Fall from height due to failure to maintain a minimum three-point contact.	D	4	H	Ensure users: -Are fit for work. -Are trained. -Maintain a minimum three-point contact when climbing.	Fall from height due to failure to maintain a minimum three-point contact.	D	4	H	Ensure users: -Are fit for work. -Are trained. -Maintain a minimum three-point contact when climbing.	Fall from height due to failure to maintain a minimum three-point contact.	D	4	H
2. Move from ladder to work platform	Fall from height from a slip/trip	Ensure users: -Are fit for work. -Are trained. -Maintain a minimum three-point contact. Use **handrail** system to physically assist the user in the climb*	Unarrested/ unrestrained fall from height.	C	4	E	Ensure users: -Are fit for work. -Are trained. -Maintain a minimum three-point contact. -Use **TRAM** system as fall prevention and to assist the user in the climb *	Fall whilst restrained on ladder	E	1	L	Ensure users: -Are fit for work. -Are trained. -Maintain a minimum three-point contact. Use **handrail** system to physically assist the user in the climb*	Unarrested/ unrestrained fall from height.	C	4	E
3. Perform required work on platform	Fall from height after a slip/trip	Ensure users are fit for work. Ensure users are trained. Use **lifeline** system as fall prevention.*	Fall on tanker top. Potential for user to be hindered in avoiding objects when falling due to lifeline snagging and tension	E	1	L	Ensure users are fit for work. Ensure users are trained. Use **TRAM** system as fall prevention.*	Fall whilst restrained on tanker top.	E	1	L	Ensure users are fit for work. Ensure users are trained. Use **handrail** system as fall prevention.*	Unarrested/ unrestrained fall from height.	D	5	E

4. Move from work platform to ladder	Fall from height from a slip/trip.	Ensure users: -Are fit for work. -Are trained. -Maintain a minimum three-point contact. -Use **handrail** system to physically assist the user in the climb.*	Unarrested/ unrestrained fall from height.	B	5	E	Ensure users: -Are fit for work. -Are trained. -Use **TRAM** system as fall prevention and to physically assist the user in the climb	Fall whilst restrained on ladder.	E	1	L	Ensure users: - Are fit for work. -Aare trained. -Maintain a minimum three-point contact. -Use **handrail** system to physically assist the user in the climb.*	Unarrested/ unrestrained fall from height.	B	5	E
5. Descend ladder	Fall from height from a slip/trip.	Ensure users: -Are fit for work. -Are trained. -Maintain a minimum three-point contact when climbing.	Unarrested/ unrestrained fall from height from height due to failure to maintain a minimum three-point contact.	D	4	H	Ensure users: -Are fit for work. -Are trained. -Maintain a minimum three-point contact when climbing.	Unarrested/ unrestrained fall from height from height due to failure to maintain a minimum three-point contact.	D	4	H	Ensure users: -Are fit for work. -Are trained. -Maintain a minimum three-point contact when climbing.	Unarrested/ unrestrained fall from height due to failure to maintain a minimum three-point contact.	D	4	H

*See discussion on previous pages

Likelihood descriptors		
A	Almost certain	Everyday occurrence
B	Likely	Happens occasionally
C	Unlikely	Might be experienced some time in a working life
D	Very unlikely	Not expected to happen but have heard of it happening elsewhere
E	Extremely unlikely	Theoretically possible but not expected ever to occur

Risk Scoring System						
Consequence →		1	2	3	4	5
Likelihood ↓		No Injuries	First aid treatment	Medical treatment	Extensive injury	Death
A	Almost certain	H	H	E	E	E
B	Likely	M	H	H	E	E
C	Unlikely	L	M	H	E	E
D	Very unlikely	L	L	M	H	E
E	Extremely unlikely	L	L	M	H	H

SECTION 3 PARENT EQUIPMENT SAFETY CHECK

Standfast cannot be seen to condone poor safety management practices by installing TRAM on plant equipment that is not safe, or that is operated recklessly. The following checklist gives guidance on what to look for when assessing a potential TRAM application.

Item	Guidelines	Comments
Access and Egress Can users safely gain access to and egress from TRAM?	Look at the approach route, including any ladders and stairs, and check for: • **Structural problems** such as: o Rust o Cracked welds o Missing fixtures (e.g. bolts, hinges) • **Slip / trip hazards**, including: o Loose flooring o Unsecured cables o Slippery walking surfaces o Slippery handholds • Obstructions (the access route needs to be free of obstructions) • **Fall hazards** (i.e. are there uncontrolled fall hazards on the access/egress route which TRAM is not being used to address)	
Walkways and Platforms Is the walkway/platform that the users will walk/work on with TRAM safe?	Check for: • **Structural problems** such as: o Rust o Cracked welds o Missing bolts, etc • **Slip / trip hazards***, including: o Loose flooring o Unsecured cables o Slippery walking surfaces o Slippery handholds • **Obstructions** (the walkway/platform needs to be free of obstructions) * Though TRAM will prevent a fall in the event of a slip or trip, every reasonable effort should be made to minimise these hazards	

General User and Public Safety Is there any aspect of the design, construction or use of the parent equipment that might have an inordinate impact on the safety of the user or members of the public?	Things to consider include: • Are the client's **work practices** appropriate? The Standfast assessor should make a determination as to whether or not the client company's method of operation is appropriate. If reckless operation is suspected, then the assessor should ask to see the client's safe-work system for the plant equipment. Note that a lack of a safe system of work does not necessarily mean that the equipment is not operated safely, nor does it prevent Standfast from fitting the TRAM system. However, where reckless operation is evident and there is no safe system of work, the assessor should consult with Standfast executive management to determine whether or not to fit TRAM. (See the Guidance Notes at Section 5 for an example of a safe system of work.) • Are **warning/hazard devices** working appropriately? The lack of working warning/hazard devices does not prevent Standfast from fitting the TRAM system, but the assessor should attempt to determine the appropriateness of the client's work practices, and checking the serviceability of the safety equipment on the parent equipment is one means of doing this. If there is any concern over the client's work practices, consult with Standfast executive management to determine whether or not to fit TRAM. • If **dangerous goods** are stored/transported on the equipment, are they appropriately managed? The poor management of dangerous goods does not prevent Standfast from fitting the TRAM system, but this is another means of checking the clients work practices, as above. If there is any concern over the client's work practices, consult with Standfast executive management to determine whether or not to fit TRAM.	

Additional guidance on safety checks can be gained from the Workplace Health and Safety Queensland document *Rural Mobile Plant Safety Tool*, which is shown on the following pages.

Workplace Health and Safety Queensland

Rural Mobile Plant Safety Tool

February 2004

Mobile rural machinery is vital to the rural industry. However it can pose many health and safety risks for workers, managers and visitors to farms.

More than 150 people have been killed or sustained serious injury on tractors alone in Queensland since 1990. This has often resulted because a tractor has rolled over or flipped back. In July 2003, a new Regulation was introduced requiring rollover protective structures (ROPS) to be fitted on tractors manufactured from January 1, 1981; is a non-earthmoving, wheeled tractor; and weighs between 560kg and 15,000kg.

A further 11 people have been killed on all terrain vehicles in the same time, 10 others killed while riding agricultural motorcycles and two people killed using power driven equipment like post-hole diggers. These statistics indicate that there are many life-threatening risks associated with using mobile rural plant and the cost in terms of human life is too high.

On October 8 2003 the Minister for Industrial Relations stressed the need for the industry to adhere to strict new regulations requiring ROPS to be fitted to new tractors and to tractors that are leased, hired or borrowed.

The Minister said that rural workplaces can be made safer with the correct use of tractors, post-hold diggers, elevated work platforms, all terrain vehicles and agricultural motorcycles.

The following points outline some of the areas obligation holders in the rural sector should pay attention to when ensuring the safety of rural workplaces.

TRACTORS

Operators platform clean/ uncluttered

- Remove items of trash, mud, oil, grease and foreign objects

Lights

- Working(if driving at night)
- Wiring not exposed and casing not broken

Tyres/ wheels/ rims

- Wear and tear, exposed tubes, tyre pressure

Seats

- No damage, seat can be adjusted and seat springs are good

Hydraulic hoses and connections

- No leaks or damage to hoses or connections
- Internal wire core isn't showing damage

Stepping plates or pegs

- Structurally sound
- Easy access and egress
- No damage and rust

Grips on pedals

- Not slippery or worn

PTO master shield guard in place

- Top and two sides are covered

Other drive shaft/ belts/pulley's and hot parts

- Adequate guarding
- Refer to Rural Plant Advisory Standard s8 (c)

ROPS on new tractors comply with Australian Standard 1636 (purchased after 01/07/2003)

- Refer to Australian Standard 1636 and Workplace Health and Safety (WHS) Regs section 154
- Check if exemptions in WHS Regs s154 apply

Tractors hired, leased or borrowed have ROPS fitted complying with Australian Standard 1636 (effective from 1/07/2003)

- Refer to Australian Standard 1636 and WHS Regs section 153
- Check if exemptions in WHS Regs s153 apply

ROPS

- Comply with Australian Standard 1636
- No adjustments/modifications
- Not welded, cut or drilled
- If repaired, carry a label fixed by the repairer with name/ address and the type of repairs

Structural integrity of mounting bolts/ plates and frame of ROPS

- No rust or damage to u bolt (look in front and rear of back axle)
- Corrosion to bolts on ROPS base plate

Seatbelts in sound condition (where fitted)

- Not torn/ worn
- Can be clipped together
- Belt strength sound

Existing seatbelt mountings

- Belt rotates where mounted
- Not worn/ damaged

Modifications or attachments

- Stable
- Guarded

Brakes can be latched together for travel in high gear (roads)

- Check operation of locking device

Foot brakes working effectively and evenly

- Drive (8 – 10 km/h) and observe braking from rear to check if tractor pulls to one side or one wheel continues to turn

Handbrake operational

- Operate to check

Steering

- No excessive play
- Physical damage to the outside of linkage
- Steering rod not bent

Exhaust

- Working
- No rust and abnormal noise
- No increase in noise & fume levels due to faults

ATV'S and/or FARM BIKES

Lights

- Working (if driving at night)
- Casing not broken and wires not exposed

Tyres/ rims

- No wear and tear
- Even pressure
- No damage to tyre wall

Footpegs and footplates

- Structural soundness
- Check for fitting
- No rust or damage

Attachments

- Check documented weight limits
- Adequately secured
- Follow manufacturers/suppliers operating instructions

Trailed implements

- Size and weight of the trailer within manufacturers' recommendations
- Drawbar doesn't restrict turning or risk tyre damage
- Drawbar/ tongue weight considered

Suspension

- Evidence of wear from oil around piston shaft seals of shock absorber
- Bike on a lean
- Bottom out bumper for excessive wear (if fitted)
- Swinging arm supporting rear axle in sound condition

Modifications that affect safety

- Stable
- Guarded

Hand operated front and rear brakes operational

- Cabling in good order

ATV rear wheel footbrake operational

- Operate to check

Parkbrake operational

- Cable not damaged
- Parkbrake locks into place

Steering

- No excessive play
- Listen for grinding noise, may indicate worn ball joints

POWER TAKE OFF (PTO) DRIVEN IMPLEMENTS

Hydraulic hoses and connections

- No leaks or damage to hoses or connections
- Internal wire core isn't showing damage

Structure

- Check for holes or weakened structure of guards

Guarding on implement (eg chains, belt drives)

- No damage
- No holes in guarding
- No nip points unguarded

PTO shaft guard in place and in sound condition

- No damage
- Guards slide in and out of each other
- No nip points unguarded
- No holes in shaft

Power Implement Connector (PIC) guard in place and in sound condition

- No damaged
- No holes in guarding affecting its effectiveness
- No nip points unguarded

Modifications to PTO driven implement

- Guards removed or missing in part

NOISE ON TRACTORS, ATVs & FARM BIKES

Noise hazards can stem from the following:

1. Idling revolutions
2. Working revolutions (revving machinery to simulate working conditions)

Refer to the Advisory Standard for Noise

MAINTENANCE

ALL MOBILE PLANT

Schedule

- Refer to operators manual or safe work procedure
- Brakes, tyres, hydraulics etc.
- Fault reporting system
- Isolation procedures
- Next service scheduled

Records

Servicing and repairs

- To manufacturers specifications
- Date of service or repairs
- Competency of person or service
- Link to fault reporting system

Chemical Filters

- Maintained to manufacturers specification
- Date of maintenance
- Checked regularly

INFORMATION, TRAINING, PROCEDURES AND RISK ASSESSMENTS ALL MOBILE PLANT

TRACTORS

- Starting the tractor from the operators seat
- Guarding and replacement of guards
- Training in safe operation
- No passengers unless for driver instruction
- Daily pre-start checks completed
- Wearing seatbelts where fitted with ROPS
- Hitching implements as per manual
- Check the use and maintenance of PPE

ATV'S and/or FARM BIKES

- Wearing and maintenance of helmet and other PPE
- Training on safe operation
- No passengers
- Hitching implements (towbar)
- Carry weight limits on the ATV known and comply
- Policy on removal of tanks when not in use

PTO DRIVEN IMPLEMENTS

- Guarding (respecting damage and replacement)
- Training
- Hitching PTO driven implements and trailed equipment as per manual
- Excludes people around working implements

OTHER ISSUES TO CONSIDER

- Is there a documented induction program?
- Is there a recode of training for new operators?
- Is there a documented risk assessment for mobile plant?

SECTION 4 COMPLIANCE NOTES - LADDERS, STAIRS, WALKWAYS AND PLATFORMS

The information in this Section is presented to assist in assessing whether the ladders, stairs, walkways, platforms and guardrails on the parent equipment or facility are compliant.

The information is taken from *AS/NZS 1657 Fixed platforms, walkways, stairways, and ladders —Design, construction and installation*

Additional information regarding safe systems of work, the operation of various items of mobile plant, and the requirements of fall prevention systems is presented as Supplementary Information at the end of this Handbook

4.1 MATERIALS (From AS/NZS 1657-1992)

4.1.1 General

The materials used shall comply with the relevant Australian Standard specifications, where such exist, or in their absence with British Standard specifications, or with other recognized specifications.

All timber to be used for any purpose under the terms of this Standard shall either be non-lyctus susceptible or be treated against lyctus attack.

Where it is desired to use material not in accordance with a recognized Standard specification, the use of such material shall be subject to the approval of the regulatory authority.

NOTE: Attention is drawn to the corrosion that can occur when dissimilar metals are brought into close proximity with one another under certain conditions.

4.1.2 Piping

Where pipe is used for guardrails or posts, it shall be of seamless, welded, or drawn welded manufacture. Split pipe shall not be used.

4.1.2.1 Galvanized Pipe

Where galvanized pipe is used, the wall thickness shall be not less than 2.0 mm.

Pipe shall be hot-dip galvanized internally and externally.

Where galvanized pipes are welded, care shall be taken to minimize damage to the internal and external galvanizing. Damage to the galvanizing shall be made good by cold galvanizing, the application of a zinc-rich paint, or equivalent protection.

4.1.2.2 Ungalvanized pipe

The ends of ungalvanized pipe should be sealed to prevent the ingress of moisture.

Sealed pipe shall have a wall thickness of not less than 2.0 mm.

Unsealed pipe shall have a wall thickness of not less than 4.0 mm.

4.1.3 Bolts

Bolts of a diameter less than 12 mm shall not be used for attaching guardrailing posts, supports, or brackets to platforms, walkways, or stairways, or for attaching ladders to the main supporting structure. Where the form of

attachment places a tensile load on the bolts or where there is eccentricity of loading on the bolts, not less than two bolts shall be used in the connection.

For external applications, or hazardous environments, bolts and nuts for aluminium rails and posts shall be hot-dip galvanized, or be of austenitic stainless steel.

4.1.4 Welding

All welding for attaching guardrailing posts, supports, or brackets to platforms, walkways, or stairways, or for attaching ladders to the main supporting structures, shall be continuous.

4.2 LIMITS OF SLOPE

The limitations of slope on the selection of walkways, stairways, steps and ladders in shown in Figure XX.

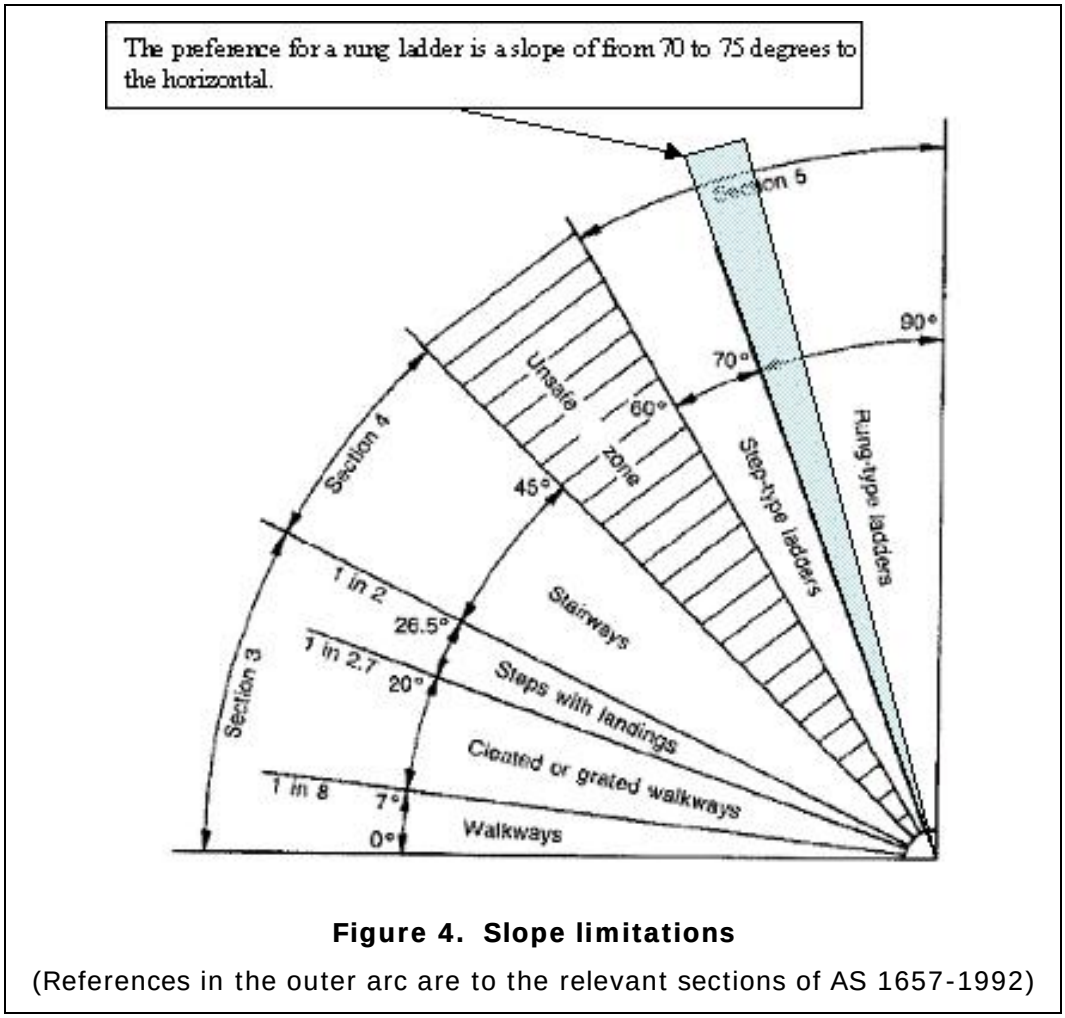

Figure 4. Slope limitations

(References in the outer arc are to the relevant sections of AS 1657-1992)

4.3 FIXED LADDERS (From AS/NZS 1657-1992)

4.3.1 Types

There are three types of fixed ladders – rung, individual-rung and step. These have general design requirements, covered in 4.3.2, and individual design requirements, covered in 4.3.3, 4.3.4 and 4.3.5.

Special requirements of ladders extending above landings (step-through and side-access ladders) are covered in 4.3.6.

4.3.2 General Requirements

Not for frequent use	The use of ladders for areas requiring frequent access should be avoided where practicable. Preference should be given to stairways.
Limitations on timber ladders	Timber ladders shall not be used in situations exposed to the weather or under other conditions liable to promote decay. They shall not be coated with a material that may disguise defects in the ladders.
Fastenings	Where flat metal stiles or timber stiles are used, the ladder shall be secured with fastenings at the top and at the foot of the ladder, and should be secured at intervals of not more than 3500 mm. For other types of stile, the design of the ladder shall determine the distance between the fastenings. The fastenings should be on the back of the rung ladders, and should be designed to provide the necessary hand clearance.
Rungs	**Dimensions** Rungs shall be of material giving equivalent performance to 20 mm diameter solid low-carbon steel, and shall be not less than 20 mm outside diameter. **Fastening** The rungs shall be securely fastened to the stiles (e.g. by welding or swaging). In corrosive areas, the rungs shall be completely sealed at the point where they enter into or contact the stiles. Where tubular rungs are used, they shall be swaged or welded into the stiles, and the ends of the rungs left open. The point of attachment to the stile shall be smooth and free from projections likely to cause injury to the hands. **Galvanizing** Where the ladder is of steel construction and tubular rungs are used, the completed ladder shall be hot-dip galvanized.
Stiles	**Width** The clearance between stiles shall be not less than 375 mm or more than 525 mm. **Cross-sectional dimensions** Stiles of flat material shall be not less than 50 mm nor greater than 80 mm wide and not less than 6 mm nor more than 30 mm thick. Circular stiles shall be not less than 40 mm nor greater than 65 mm outside diameter.
Design loading	Every ladder and its fixing shall be designed for a concentrated live loading of not less than 1 kN, or a number of concentrated live

	loadings of 1 kN, the number of loads and their spacing being dependent upon the expected usage of the ladder.

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4.3.3 **Rung Ladders** (From AS/NZS 1657-1992)

Rung ladders should be constructed as follows (see also Figure 5):

Slope	Between 60 and 75 degrees. Rung ladders beyond 75 are not disallowed, but they are not universally accepted and should have regulatory approval. Ladders with a slope of greater than 75 degrees should have regulatory approval.
Width	The ladder should not be less than 375 mm wide and not more than 525mm wide.
Rungs	Rungs should be spaced no less than 250 mm and no more than 300 mm apart, except in ladders shorter than 1.5 m, where the minimum spacing may be 200 mm. Spacing must be equal. Rungs should be of solid material not less than 20 mm diameter.
Ladders through openings	Where the ladder provides access to a platform or walkway through an opening, the stiles of the ladder should extend no less than 900 mm above the opening. The width between the extended stiles should be no less than 525 mm and the top rung should be level with the landing.
Ladder length and landings	No single ladder should be longer than 6m. Except where it is not reasonably practicable to provide an intermediate landing, the vertical distance between landings in a rung ladder installation shall not exceed 6.0 m. Where the vertical height of the installation exceeds 6.0 m, and the installation consists of more than one ladder, succeeding ladders shall change direction at each landing, or, if this is not practicable, be staggered at each landing level. The minimum length of this platform shall be not less than 900 mm from the front of the ladder. Where compliance with the requirements for staggering is not practicable, other suitable means such as a barrier or a landing not less than 1.5 m long shall be provided to prevent a person from falling more than 6.0 m. The vertical distance between landings in multiple-flight ladders shall be approximately equal. Where a person may fall 6 m or more, a ladder cage or a ladder fall-restraint device must be installed. Access to ladders where safety devices are provided should be restricted to authorised personnel
Clearance	The clearance behind ladders affixed to walls, should be no less than 200 mm

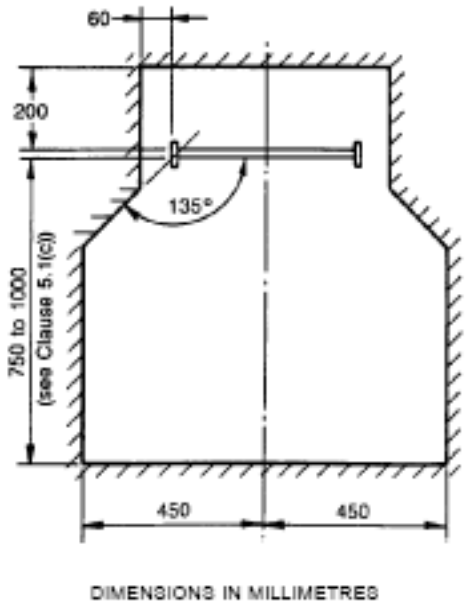
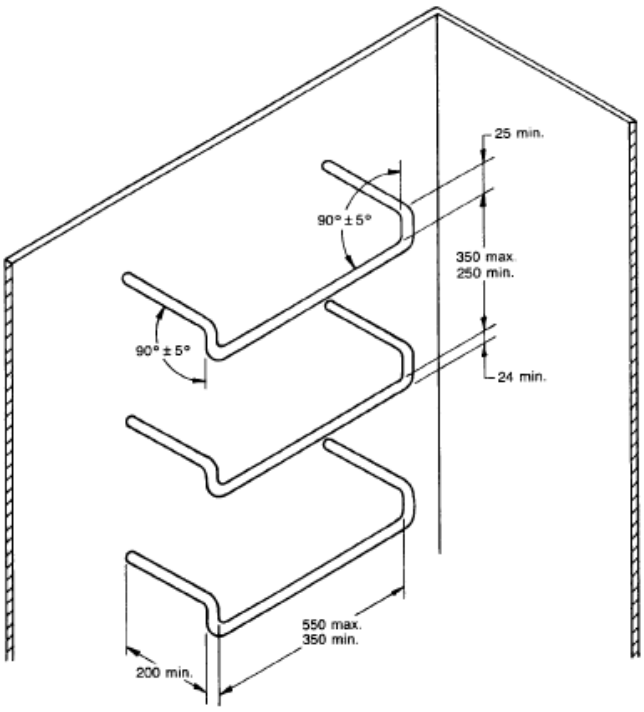


Figure 5. Clearances for Rung Ladders (plan view)

4.3.4 **Individual-rung Ladders** (From AS/NZS 1657-1992)

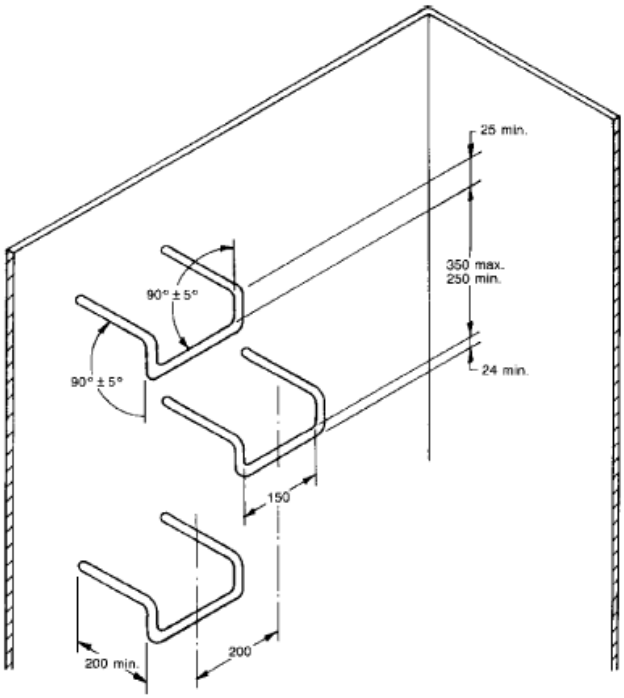
Rung ladders should be constructed as follows (see also Figures 6 and 7):

General	A step-iron ladder should only be used where the vertical rise does not exceed 6 m and it is not reasonably practicable to use any other type of ladder. Where a person could fall more than 6 m from such a ladder, a ladder cage complying with should be fitted. The dimensions and the spacing of the rungs shall be uniform throughout the ladder.
Rungs	The rungs shall be of material giving equivalent performance to 24 mm diameter solid low-carbon steel, and shall have a tread depth of not less than 24 mm. Rungs shall comply with the forced loadings given for fixed ladders at 4.2.2 and the maximum deflection shall not exceed 3 mm. The rungs shall be shaped so that the foot cannot slip off the end of the rung (see Figure 6).
Rung spacing	The rungs shall be evenly spaced not less than 250 mm nor greater than 350 mm apart, except that ladders having a length of less than 1.2 m may have spacings closer than 250 mm. The spacing of rungs in the same ladder should be uniform within a tolerance of ± 8 mm.
Width	The clear width of the tread of each rung shall be not less than 150 mm nor more than 550 mm.
Fixing	Every rung shall be permanently fixed to the adjoining structure or equipment and shall provide a clearance to the back edge of the rung as follows: (a) Where the ladder access is less than 750 mm; not less than 150 mm. (b) Where the ladder access is greater than 750 mm, not less than 200 mm. Rungs should be fixed so as to be coplanar (see Figure 7). The used of cranked rungs on circular or curved walls is permitted.



Dimensions in mm

Figure 6. Typical individual-rung ladder



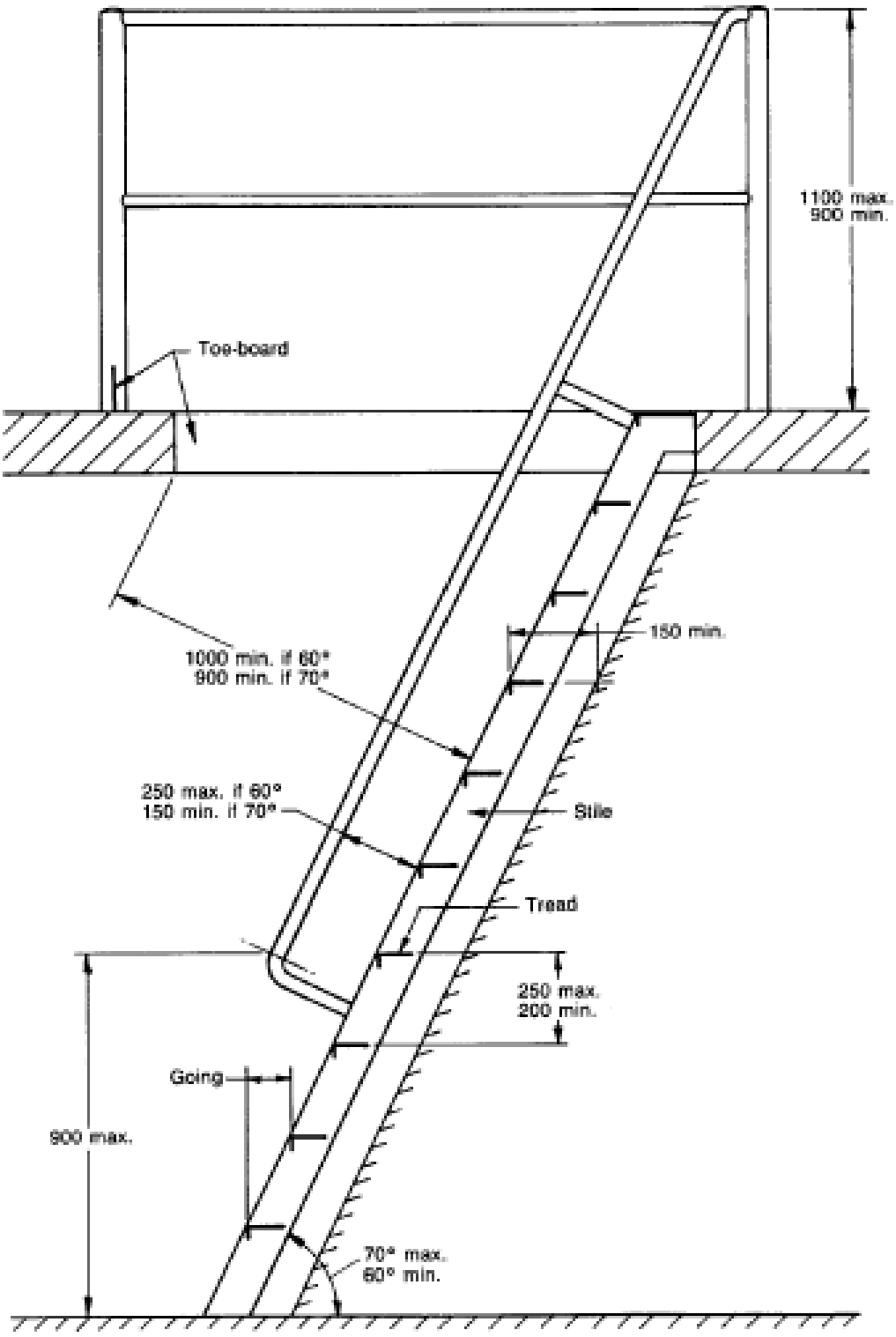
Dimensions in mm

Figure 7. Typical individual-rung ladder with coplanar rungs

4.3.5 **Step Ladders** (From AS/NZS 1657-1992)

Step ladders should be designed as follows (saa also Figure 8):

Material	Timber ladders should not be used in situations exposed to the weather or under other conditions likely to promote decay.
Slope	Not less than 60 degrees or more than 70 degrees to the horizontal. It is preferable that the angle of slope should not exceed 65 degrees.
Width	The width of the ladder between the stiles shall be not less than 450 mm.
Tread width	Treads shall be not less than 100 mm wide. The surface of every tread shall be slip-resistant. Multi-rung treads shall not be used. The dimensions of all treads in the same ladder shall be uniform and within a tolerance of ± 5mm.
Tread rise	The treads shall be equally spaced and not less than 200 mm, nor greater than 250 mm apart. The top tread shall be level with, and may be integral with, the landing. The dimensions of all rises in the same ladder shall be uniform and within a tolerance of ± 5mm.
Distance between landings	In a step ladder installation, the vertical distance between landings shall not exceed 6 m. Where the vertical height of the installation exceeds 6 m, and the installation consists of more than one ladder, succeeding ladders should change direction or, if this is not practicable, be staggered, at each landing level. Where compliance with the requirement for staggering is impracticable, other suitable means such as a guardrailing or a landing not less than 1.5 m long shall be provided to prevent a person from falling more than 6 m. The ladders shall not extend more than 12 m measured vertically without a change of direction. Where a ladder of greater length than 6m is installed, a ladder cage or a restraint system is required. If a ladder restraint system is employed instead of a ladder cage, a guard is to be fitted over the first 2.5m of the ladder to prevent unauthorized use. A sign is to be fitted stating, “This ladder shall only be used by people wearing the approved protective device”.
Direction of use	Provision shall be made to prevent persons from descending a step ladder in a forward direction, i.e. people should ascend and descend a step ladder facing towards the ladder.



DIMENSIONS IN MILLIMETRES

Figure 8. Clearances for Step Ladders (side view)

4.3.6 Extension above landings (From AS/NZS 1657-1992)

4.3.6.1 Step-through ladders

Where it is necessary for a person to step through a ladder, the stiles shall extend not less than 900 mm or to the height of the handrail, if provided, above the platform landing or top rung where the top rung is level with the platform. (See Figure 9.)

The width between the extended stiles shall, at the top, be not less than 525 mm and not more than 675 mm and the stiles shall be rigid. The top rung shall be level with, or one full rise below, the landing.

Where the top rung is level with the landing, the distance between the centre of the stile at the level of the landing and the edge of the landing shall be 60 mm to 100 mm, or there shall be no gap at all (see Figure 10 b).

Where the top rung is one full rise below the landing, there shall be a gap not greater than 50 mm between the centre of the stile at the level of the landing and the edge of the landing (see Figure 10 a).

Except where it is not reasonably practicable, a guardrail or gate shall be fitted across the access to a step-through ladder from a working platform. Typically, this would take the form of a landing platform not less than 1.5 m long leading to the opening guardrail or gate, and then to the working platform. The opening guardrail or gate may be either sliding or hinged.

Toe-boards shall not extend across ladder openings.

4.3.6.2 Side access ladders

Where it is necessary for a person to step sideways from a ladder, the ladder and its rungs shall extend not less than 900 mm, or to the height of the handrail, if provided, above the landing, and there shall be a rung level with the landing. (See Figure 11.)

The horizontal distance from the nearest stile to the landing shall be not less than 175 mm or more than 300 mm.

Toe-boards shall not extend across ladder openings.

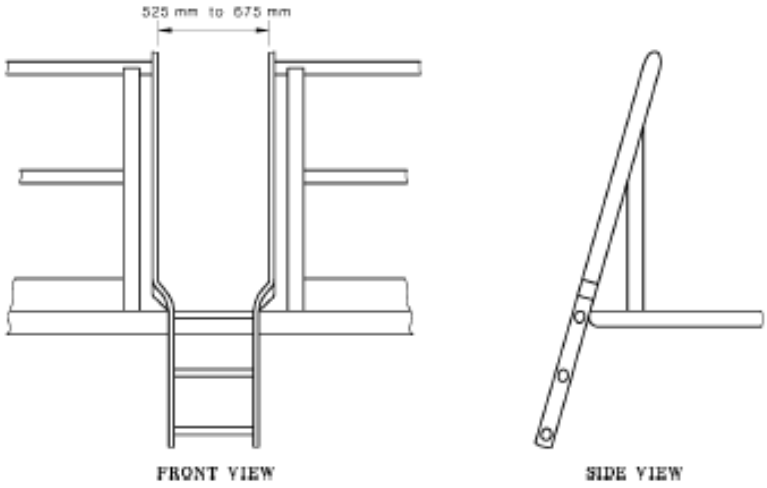


Figure 9. Stiles for Step-through Ladders

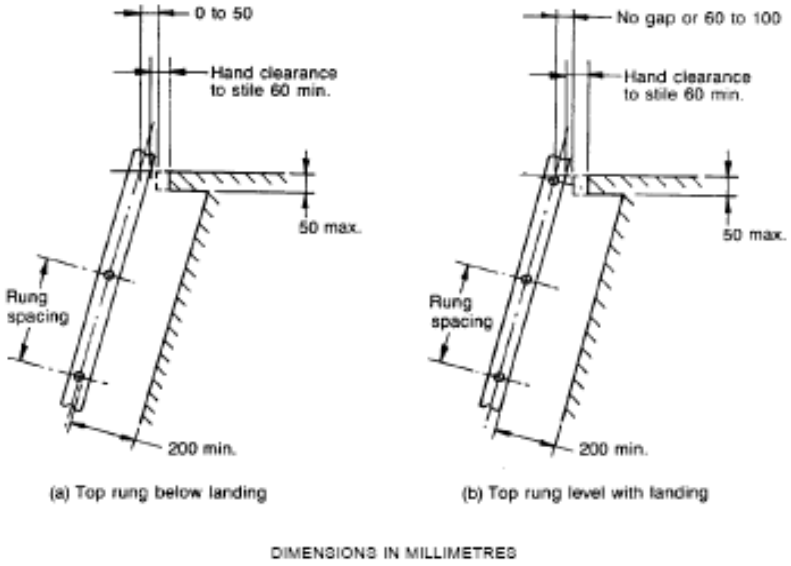


Figure 10. Gap between ladder and landing (side view)

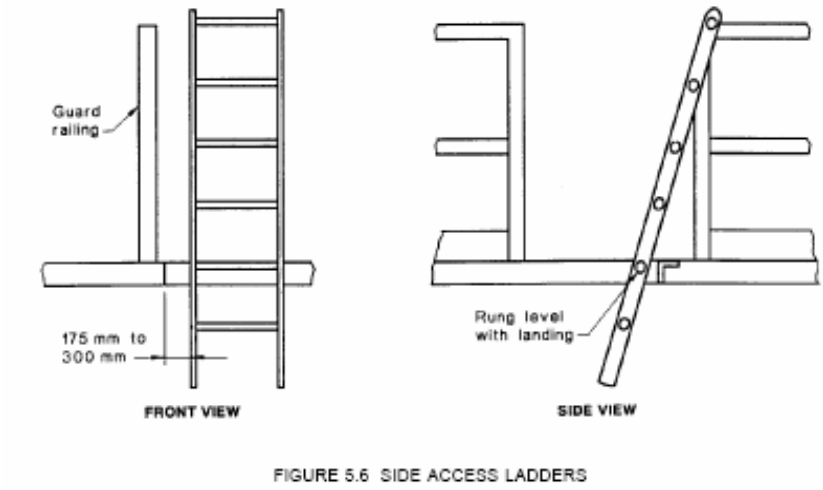


Figure 11. Side-access ladders

4.4 GUARDRAILS AND HANDRAILS (From AS/NZS 1657-1992)

Guardrails should be constructed as follows:

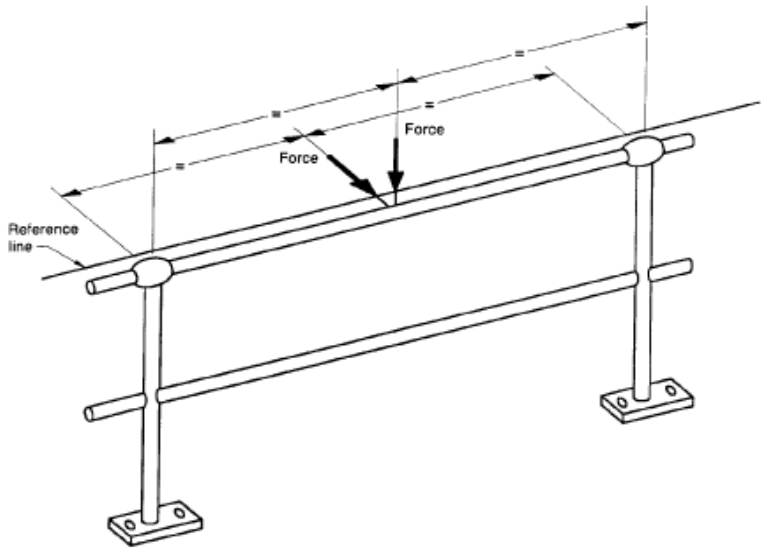
Design loading	**Guardrails** The guardrailing shall be designed to withstand whichever of the following live loadings produces the most adverse effect: (a) A force of 550 N acting outwards or downwards at any point on the top rail, edge or post. (b) A force of 330 N per linear metre acting outwards or downwards on the top rail or edge. **Handrails** Each handrail which is not part of a guardrail shall be designed to withstand the following non-simultaneous forces: (a) A force of 550 N applied outwards at the centre of the span. (b) A force of 550 N applied downwards at the centre of the span.
Design	Guardrailing may be monolithic or a framed structure, and shall be constructed in accordance with one of the following requirements; (a) A top rail, supported by posts, parallel to the floor or slope of a walkway at a vertical height of not less than 900 mm nor more than 1100 mm above the standing level of such platform or walkway. In such case, one or more intermediate rails shall be provided parallel with the top rail and the floor having a maximum distance of 450 mm between rails or between the lowest rail and the top of the toe-board where fitted. Where a toe-board is not fitted, the maximum distance between the lowest rail and the floor shall be not greater than 560 mm. Alternatively, the space between the top rail and the floor may be provided with suitable infill fixed to the top rail and to the floor, toe-board, or a bottom rail not more than 80 mm above the floor. (b) Welded mesh, supported by posts and provided with a reinforced top edge capable of withstanding the prescribed design loads. (c) Where curvature of a stairway is such that a falling person would not land on the platform below, the guardrailing shall— (i) have a maximum spacing between rails of 300 mm; or (ii) be fitted with infill.
Infill	Infill may be fabricated from pipe, bar, solid or perforated plate, expanded metal, metal mesh, or any other material. Pipes or bars may be arranged vertically, horizontally, or in any other configuration, provided that the smaller of the two maximum dimensions of any opening (or diameter in the case of circular openings) does not exceed 450 mm and the area of any opening does not exceed 0.2 m2. Expanded metal shall be not less than 3 mm in thickness and shall not have any sharp cutting edges. Metal mesh may be woven, chain, or welded wire of sizes not less than those specified in the Table below (Table 3.2 from AS/NZS 1657). Where metal mesh is used, a rigid rail shall be provided at the top edge except where the mesh is reinforced on the top edge to give performance equivalent to the top rail. Where metal mesh or expanded metal serves a dual purpose of edge protection and a guard for moving parts, such mesh or expanded metal shall be selected to prevent access to the danger points. (See AS 4024.1 (Int) for guidance.)
Toe board	The toe-board shall be firmly attached to the floor or posts, and any gap

	between the toe-board and the floor shall not exceed 10 mm. The top of the toe-board shall be not less than 100 mm above the top of the floor.

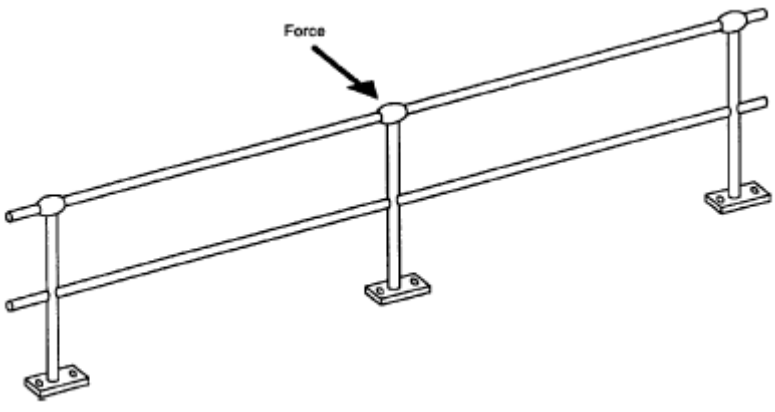
EXPANDED METAL, WOVEN OR WELDED WIRE MESH GUARD

Description	Minimum nominal diameter of wire or strand, mm	Maximum size of opening (length × width), mm
Woven or chain	2.5	80 × 80
Woven or chain	3.5	100 × 100
Welded	3.5	300 × 80 or 200 × 200
Expanded metal	3.0	80 × 80

NOTE: If the mesh is diamond-shaped, the specified dimensions are measured along the side of the diamond.



Typical guardrail test



Typical guardrail post test

4.5 **WALKWAYS AND PLATFORMS** (From AS/NZS 1657-1992)

At risk of stating the obvious - walkways are for walking on; platforms are for working on.

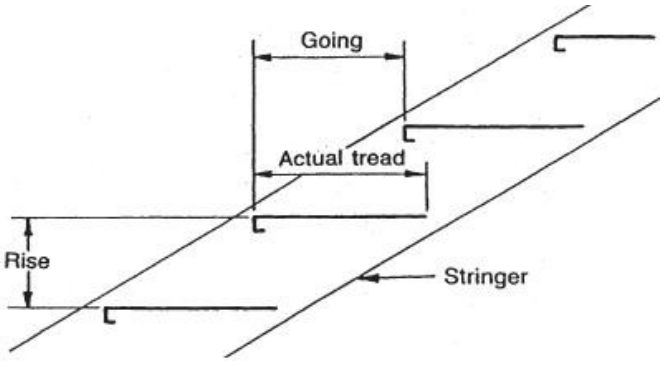
Some of the specific requirements that apply to walkways and platforms are:

Walkway width	Minimum clear widths: • 550mm if there are guardrails on both sides • 600mm otherwise Note: These dimensions are not relevant to TRAM being used on a walkway. For guidance on determining the width of walkways for use with TRAM, the following factors should be taken into account: UK HSE report HSL/2005/04 *Safety of workers when accessing the top of tank containers* discusses walkway width. It gives a minimum width of 300mm for footfall (i.e. anything less than this could not be walked on safely), and a suggested minimum width of 400mm with guardrails (you couldn't turn easily between the guardrails if it was any narrower). The 400mm width is also the minimum walkway width in British Standard BS ISO 1496. From this: • 300mm is the minimum width and allows for walking only • 400mm is the minimum width for walking/working • 500mm +/- 50mm is the optimal width
Design loadings	Floors shall be designed for the dead load of the structure plus a superimposed live loading of not less than 2.5 kPa uniformly distributed, or a concentrated loading of not less than 1 kN at any point, whichever produces the most adverse effect. Where the floor of the platform or walkway or landing is likely to be loaded in excess of the above requirements, the design loading shall be based on the requirements of AS 1170.1. In special cases, where large floor areas or concentrated loads (or both) have to be considered, variation of the design load specified above may be referred to the regulatory authority.
Platform width	The minimum platform width is 600mm
Guardrails	The Standard requires that walkways and platforms be fitted with guard railings of between 900 and 1100 mm in height. Permanent guardrails isolate a person from a fall edge, so are a higher form of control than TRAM (see Step 5a of Section 2). Where guardrails are not practicable, TRAM is the next highest form of control. Guardrails should be in place on any walkways or platforms accessed by the user either in connecting to, of after disconnecting from, TRAM
Considerations regarding slope	Without TRAM: Walkways with an angle of between 7 and 20 degrees should be constructed of expanded metal mesh or cleated. Where the angle exceeds 20 degrees, steps with landings should be

	installed With TRAM: The requirements for the surface material remain the same as for a sloping walkway without TRAM. TRAM is suitable for use on a slope of up to 20 degrees (this was tested in-house at Sunwood), so where steps with landings are not an option for the client, TRAM can be used. Example applications are dredge booms, conveyor access ways.
Toe boards	Toe boards are designed to prevent objects from falling onto people or equipment below the walkway or platform. They should be fitted to elevated walkways or platforms and extend for at least 100 mm in height from the floor. Toe-boards shall not extend across ladder openings.
Surface material	Elevated walkway and platform floors should be slip resistant, even, and be designed so that objects cannot fall through to the area below. Gaps in metal plates should not exceed 100 mm.

4.6 **STAIRWAYS** (From AS/NZS 1657-1992)

Stairways should be constructed as follows:

Width	Have a minimum clear width of 600 mm
Angle	An angle of between 26.5 and 45 degrees
Rise	A rise of no less than 150 mm and no more than 215 mm
Going	A going of no less than 215 mm and no more than 305 mm
Tread depth	Have an actual tread depth of at least 10 mm greater than the going
Handrail	All stairs should be fitted with a handrail between 800 and 1,000 mm when measured from the nosing of any tread. Stairways greater than 1,000 mm in width should be fitted with a handrail to both sides
	

SUPPLEMENTARY INFORMATION

This section provides information to supplement the content of previous Sections.

SUPPLEMENT A FALLS AND FALL PROTECTION

1. Fall Situations

There are three fall situations described in AS/NZS 1891.4:

- Free fall
- Limited free fall
- Restrained fall

AS/NZS 1891.4 adds another category to the list that is effectively an "absence-of-fall" situation:

- Total restraint

These four categories are defined in the box below, and are covered in more detail over the following pages.

This is important...

Many people, including safety professionals, believe that you cannot use a lanyard length in excess of 600mm in total restraint, restrained fall-arrest or limited free fall-arrest situations. They base this argument on AS 1891.4, but the Standard does not say that. Here are the relevant definitions taken directly from the Standard:

1.4.5 Free fall, free fall-arrest

A fall or the arrest of a fall where the fall distance before the fall-arrest system begins to take any loading, is in excess of 600 mm either vertically or on a slope on which it is not possible to walk without the assistance of a handrail or hand line.

1.4.6 Limited free fall, limited free fall-arrest

A fall or the arrest of a fall occurring under the conditions described in Clause 1.4.5 except that under reasonably foreseeable circumstances the fall distance will not exceed 600 mm.

1.4.7 Restrained fall, restrained fall-arrest

A fall or the arrest of a fall where the person suffering the fall is partially restrained by a restraining device such as a pole strap, or is sliding down a slope on which it is normally possible to walk without the assistance of a handrail or hand line.

1.4.8 Total restraint

A control on a person's movement by means of a combination of a belt or harness, a line and a line anchorage which will physically prevent the person from reaching a position at which there is a risk of a free or limited free fall.

It can be seen that there is no mention of lanyard length in the definitions. What matters is the fall distance, not the length of the lanyard. This is explained further in the table on the next page, also taken from AS 1891.4.

CHARACTERISTICS OF RESTRAINT/FALL SITUATIONS

(From AS/NZS 1891.4:2000 Industrial fall-arrest systems and devices Part 4: Selection, use and maintenance, Table 2.1)

Restraint/fall situation (See definitions on previous page)	System description	Equipment and anchorage requirements (minimum) (See Note 1)	Typical application
Total restraint—a fall is not possible	A combination of anchorage placement and lanyard/line length which will not physically permit the operator to reach a fall-risk position (see Note 2).	Restraint belt. Fixed length restraint line. 6 kN ultimate strength anchorage.	Any situation where access to the work can be achieved entirely on a working surface with slope not exceeding15 degrees and without exposure to a fall.
Restrained fall only	A combination of anchorage placement and restraint line or pole-strap length which will permit only a restrained fall on a pole or a sliding fall on a roof (see Note 2).	Lineworker's body belt or work positioning harness. Fixed length restraint line or pole strap. 6 kN ultimate strength anchorage for restraint line.	Working on a pole where no free fall is possible, or on a sloping roof of slope greater than 15 degrees but where secure footing can be maintained without lateral support and from which a substantially vertical fall over an edge cannot occur.
Limited free fall	A combination of anchorage placement and lanyard length which will permit only a limited free fall (< 600 mm).	Work positioning harness. Fixed length lanyard. 12 kN ultimate strength anchorage or equivalent horizontal lifeline or rail.	Any situation where the use of either a short lanyard or a fall-arrest device (or both where applicable) will limit any free fall to 600 mm. May also be applicable to rope access systems, see AS/NZS 4488.2.
Free fall	Any suitable fall-arrest system.	Fall-arrest harness. Lanyard assembly or fall-arrest device which will limit free fall to 2 m max. (See Note 3). 15 kN ultimate strength anchorage or equivalent horizontal lifeline or rail.	Any situation in which a free fall greater than 600 mm is possible.

1.1 What to do in a given situation

Total restraint - TRAM and no free fall

To meet total restraint requirements, a person wearing the TRAM belt and anchored to the TRAM unit must not be able to reach a position of free fall. If this is the case, use TRAM with a TRAM belt and a minimum 6kN ultimate strength anchorage.

Lanyard length is irrelevant in this situation – lanyards can be as long as desired so long as the user cannot reach a free-fall position.

Restrained fall-arrest

A restrained fall-arrest device is employed to protect a user who falls on a sloping work surface (greater than 15^{o}) on which it is not normally possible to walk without the assistance of a handrail or hand line. A restraint belt is not permitted in these circumstances, so use TRAM with a fall-arrest harness and 6kN ultimate strength anchorage, with the following condition.

If the surface leads to a vertical drop *and* the lanyard length does not restrict the user from reaching it, TRAM must prevent the user from reaching the drop: If TRAM does not prevent the user from reaching the drop, then the applicable of the following two "TRAM and free fall" options must be applied.

Limited free fall-arrest - TRAM and free fall not exceeding 600mm

If the free fall does not exceed 600mm, use TRAM with a full body harness and minimum 12kN ultimate strength anchorage.

Free fall-arrest - TRAM and free fall exceeding 600mm

The use of TRAM with a restraint belt does not qualify as fall-arrest because the belt is not a free fall-arrest device. So if the fall exceeds 600mm, only use TRAM with a full body harness and minimum 15kN ultimate strength anchorage.

2. Strength Requirements for Anchorages

The following information regarding anchorage point ratings is taken from AS/NZS 1891.4, Section 3.1

STRENGTH REQUIREMENT FOR ANCHORAGES

kilonewtons

	Purpose of anchorage	Ultimate strength in direction of loading (minimum) (see Note 1)
(a)	*Single point anchorages*	
	Free fall-arrest—one person	15
	Free fall-arrest—two persons attached to same anchor	21
	Limited free fall-arrest (including rope access anchorages)	12
	Restrained fall-arrest—restraint line anchorage	6
	Total restraint only—no risk of a fall	6
(b)	*Horizontal lifelines* (see Note 2)	
	End anchorages	See Clause 6.2.4
	Intermediate anchorages	
	—diversion less than 15 degrees	12
	—diversion 15 degrees or more	12+ (see Note 3)

NOTES:

1 As far as practicable all single point one-person anchorages should meet the 15 kN requirement regardless of primary purpose.

2 Refers to fall arrest only. Lifelines used for total restraint only are not covered by this Standard. Advice should be sought from manufacturers. The designer of a horizontal life line that is to be used for total restraint purposes only is advised to adopt a horizontal force of 6 kN acting at right angles to the line as the basis for design and in particular for the calculation of end-anchorage forces, taking appropriate multiplying factors into account.

3 Horizontal component of forces induced during a fall-arrest (multiplied by a safety factor of 2.0) is to be added as indicated in Clause 6.2.5.

2.1 General Principle Regarding Load Rating

As far as practicable, all single-point anchorages for single-person attachment should have an ultimate strength of 15 kN even though Table 3.1 specifies a lesser strength for some categories. Wherever there is a possibility of a restraint line anchorage point being misused as a fall-arrest anchorage either it shall have the strength of a fall-arrest anchorage point or systems shall be put in place to prevent its misuse.

2.2 Strength Rating for Multiple Users

The anchorage and the structure to which it is attached shall be capable of sustaining an ultimate load equal to that shown in Table 3.1 for the corresponding anchorage purpose for single person use when loaded in the direction of the lanyard, anchorage line, or restraint line during a fall arrest or total restraint as appropriate. This load requirement shall be increased by 6 kN if two people are to use the one point. The maximum number of people connected to any one point shall be two.

3. Harnesses, belts and Lanyards

The following information comes from AS 1891.4 Section 4.1

3.1 Uses of Belts and Harnesses

USE OF HARNESSES (INCLUDING BELTS) AND ASSOCIATED DEVICES IN FALL-ARREST SYSTEMS

Device	Principal uses	Whether permitted for fall-arrest		
		Free fall	Limited free fall	Restrained fall
Restraint belt	Total restraint	No	No	No
Restraint line	Part of horizontal restraint system	No	No	Yes
Lineworker's body belt	Work positioning with pole strap	No	No	Yes
Pole strap	Part of work positioning system on a pole	No	No	Yes
Work positioning (sit) harness	Work positioning Total restraint Rope suspension	No	Yes	Yes
Ladder belt	In a ladder fall-arrest system in conjunction with a Type 1 fall-arrest device (see AS/NZS 1891.3)	No	Yes	Yes
Fall-arrest harness	Any situation with risk of free fall	Yes	Yes	Yes
Confined space fall-arrest harness	Risk of free fall in a confined space where provision for rescue is also required	Yes	Yes	Yes
Lanyard assembly	Part of fall-arrest system	Yes	Yes	Yes

3.2 Advice Regarding Belt / Harness Selection

Consideration should be given to selecting a single harness to cover all of the work situations in which a particular user may need to operate. Apart from the economic advantage it will tend to ensure that the user does not wear a device that gives a lower standard of protection than required in a particular case, e.g. use of a lineworkers body belt to protect against a potential free fall.

Selection of a suitable fall-arrest harness should take into account the following:

(i) Ease of putting on and taking off.

(ii) Wearer comfort during normal work including where suspended whilst performing rope access work or work in confined spaces.

(iii) Ability to adjust components to fit the various body shapes likely to use it.

(iv) Ability to spread the load of a fall arrest on the wearer's body and provide a measure of comfort whilst the wearer is suspended after a fall.

3.3 Requirements of Lanyards

The purpose of a lanyard assembly is to connect a harness to an anchorage point, horizontal life line or rail, or other acceptable form of anchorage. A lanyard assembly shall be designed to limit the force on the harness attachment point during a fall arrest, to 6 kN. This is normally achieved by use of a personal energy absorber as part of the assembly, but not necessarily so if—

(a) the lanyard material alone is capable of meeting the requirement; or

(b) the device to which the lanyard is attached, e.g. a Type 1 fall-arrest device, is capable of limiting the fall-arrest force to 6 kN; or

(c) the fall distance is so restricted that a fall-arrest force of 6 kN cannot be achieved, for example, where a short lanyard not exceeding 300 mm in length is used for connection of a ladder belt or harness to a ladder fall-arrest system or Type 1 fall-arrest device.

SUPPLEMENT B WHY TRAM IS A TOTAL RESTRAINT DEVICE

1. General

This paper provides the reasoning for the standard TRAM safety system being categorized as a total restraint device.

2. Requirements under Australian and New Zealand Standards

The *definitions* of fall situations and the *hierarchy of control of fall protection* are given in AS/NZS 1891 2000 Industrial fall-arrest systems and devices Part 4: Selection, use and maintenance.

Fall Situation Definitions

AS/NZS 1891.4 2000 (1.4.5 to 1.4.8) defines fall situations as follows:

Free fall, free fall-arrest

A fall or the arrest of a fall where the fall distance before the fall-arrest system begins to take any loading, is in excess of 600 mm either vertically or on a slope on which it is not possible to walk without the assistance of a handrail or hand line.

Limited free fall, limited free fall-arrest

A fall or the arrest of a fall occurring under the conditions described in Clause 1.4.5 except that under reasonably foreseeable circumstances the fall distance will not exceed 600 mm.

Restrained fall, restrained fall-arrest

A fall or the arrest of a fall where the person suffering the fall is partially restrained by a restraining device such as a pole strap, or is sliding down a slope on which it is normally possible to walk without the assistance of a handrail or hand line.

Total restraint

A control on a person's movement by means of a combination of a belt or harness, a line and a line anchorage which will physically prevent the person from reaching a position at which there is a risk of a free or limited free fall.

Hierarchy of controls

Figure 1.2 of AS/NZS 1891.4 2000 (shown at Figure 2 of Section 2 to this Handbook) gives the hierarchy of control of falls as follows (the highest control measure being at the top of the list):

- Fall restraint
- Work positioning
- Limited free fall arrest / restrained fall arrest
- Free fall arrest

3. Total Restraint

A correlation of the above information provides the requirements of total restraint as being:

A system that controls a person's movement by means of a combination of a belt or harness, a line and a line anchorage which will physically prevent the person from reaching a position at which there is a risk of:

- A free fall, this being where the fall distance before the fall-arrest system begins to take any loading is in excess of 600 mm; or
- A limited free fall, this being a fall or the arrest of a fall occurring under the conditions described for a free fall, except that under reasonably foreseeable circumstances the fall distance will not exceed 600 mm.

4. Free Fall, Falls to a Different Level, and Falls on the Same Level

The AS/NZS 1891 series is currently being rewritten. The first revision of the series is AS/NZS 1891.1, which is now in final draft. In the preface to the Draft for Public Comment, the Committee states its decision to change the *limited free fall* distance from 600mm to 1000mm, and the *free fall* distance to falls of greater than 1000mm.

The Committee has also advised Standfast Corporation (Committee member Chris Turner of WorkCover NSW to National Safety Manager Standfast, 24 Aug 06) that:

- The *free fall* and *limited free* situations currently defined in AS/NZS 1891.4 2000 are only intended to apply to *falls to a different level*,
- *Falls on the same level* are not considered to be *free fall* or *limited free fall* events.
- These ambiguities will be cleared up in the revised Standards.

5. TRAM (Total Restraint Access Module)

TRAM is designed to meet the total restraint requirements of AS/NZS 1891.4. It is constructed in such a way that the combination of the belt, anchorage and rail will not allow a user to fall to another level.

The standard lanyard length is 750mm. This allows the user both an adequate work radius, and the ability to face the direction that they are walking so that they do not need to walk backwards when using the system.

The belt is fitted with two lanyards, one at each side. These are connected to anchor points on the TRAM arm that are spaced at about hip width and at a minimum height of 882 mm, which is about waist or hip height for the user. (The anchor points are typically at about 910mm above the walkway or platform - the variance is due both to the height range of the users and the height range of the mounting equipment, which varies for different applications.).

Because the length of the lanyards (750mm) is less than the height of the anchor points (minimum of 882mm) above the walkway or platform, it is not possible to fall to another level regardless of the width of the walkway or platform. The lanyards will always cause the user to swing back onto the walkway or platform.

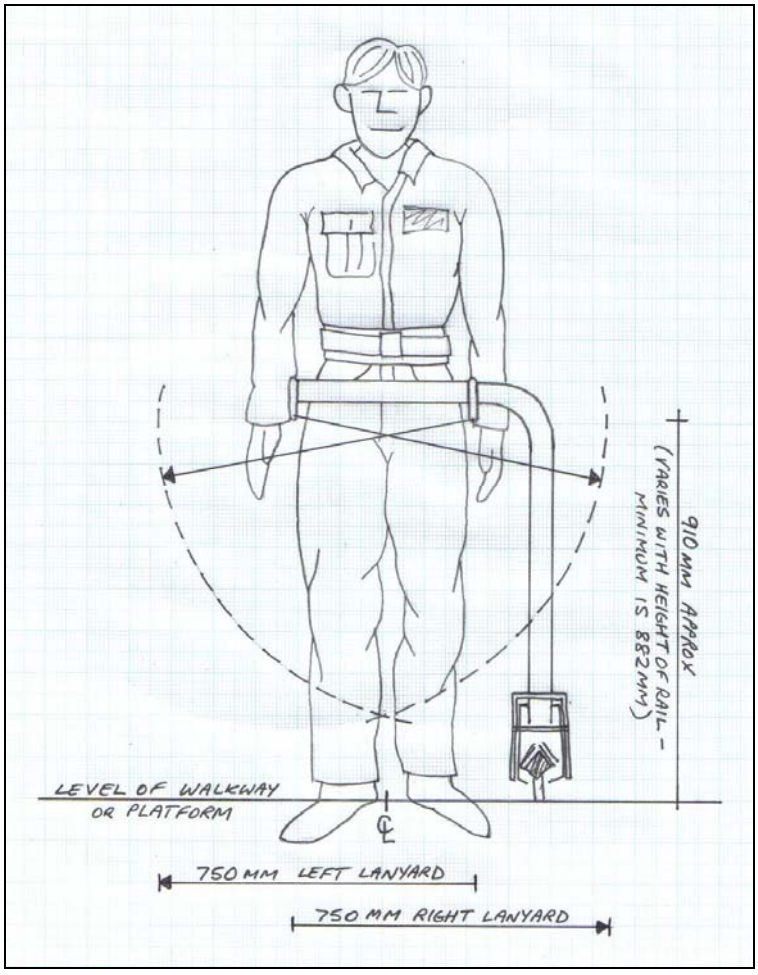


Figure 1. The TRAM System
How the combination of lanyard length and anchor point height prevent a fall to a different level

6. Further Discussion

Each lanyard and anchor point is tested to meet limited fall arrest requirements, so the user can safely connect by only one lanyard to any anchor point to increase the work radius if desired. The system will still swing the user back onto the walkway, though with less control than when two lanyards are used. Normally, the user has the two lanyards attached to the two hip-width-spaced

anchor points, and in the event of a fall on the same level this configuration serves to seat the user and swing them back onto the platform or walkway. It could be likened to an anchored pole strap.

This means, for example, that TRAM is an excellent retrofit solution for height safety in such applications as gantry and bridge cranes with narrow maintenance walkways. Even were the user to step off a 300mm wide walkway, the inner lanyard will take up full loading immediately and swing the user back onto the walkway.

7. Conclusion

TRAM's combination of lanyard length an anchor points is designed to prevent falls to a different level. The user will always be brought back into position on the walkway or platform.

TRAM *physically prevents the person from reaching a position at which there is a risk of a free or limited free fall*, as required by the definition of AS/NZS 1891.4 for total restraint devices.

TRAM is therefore a total restraint device as defined by AS/NZS 1891.4 2000 and as confirmed in August 2006 by a representative of the Standards Australia AS/NZS 1891 Committee.

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Lindsay Johnson
National Safety Manager
Standfast Corporation

September 2006

SUPPLEMENT C SAFE WORK SYSTEM - MOBILE PLANT

Mobile Equipment Used On The Surface

Mobile equipment used on the surface of mines and quarries includes haul trucks, dozers, excavators, loaders, graders, scrapers, forklifts and other mobile machinery. It is important to remember that site specific procedures are necessary for all versions of the different types of mobile equipment that are in service.

GENERAL OPERATIONAL ISSUES

To ensure vehicle safety, operations should:

- ensure the safety of vehicles;
- ensure the competence of the drivers; and
- develop safe work procedures.

Each of these is now discussed in more detail.

SAFETY OF THE VEHICLES

Safety of the fleet

Although most accidents occur on the open road, ensure care is also given to preventing accidents occurring on the roads, traffic ways and parking areas of the property. Ensure the safety of employees and visitors to the plant by regulating traffic flow within the plan and quarry confines - use appropriate signs and other measures. Where necessary, conduct additional training programs outlining precautions and control measures. Ensure that appropriate statutory requirements are enforced and that standard traffic signs are used, where appropriate. There are problems associated with maintaining a fleet of vehicles for the open road. These include:

- the drivers of the vehicles normally operate away from direct supervision;
- the complexity of the road transport system; and
- influence of other factors, such as alcoholism, drugs, long hours of driving.

Vehicle maintenance and records

Figure 5.41 Haul truck visibility restrictions

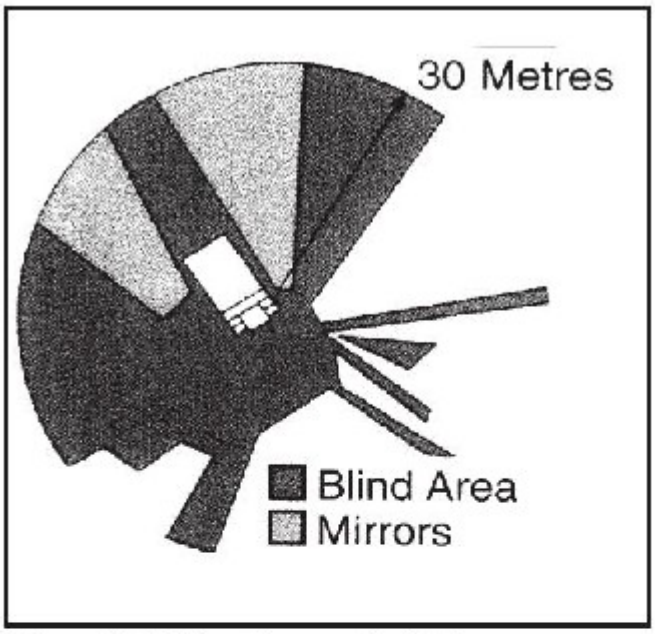
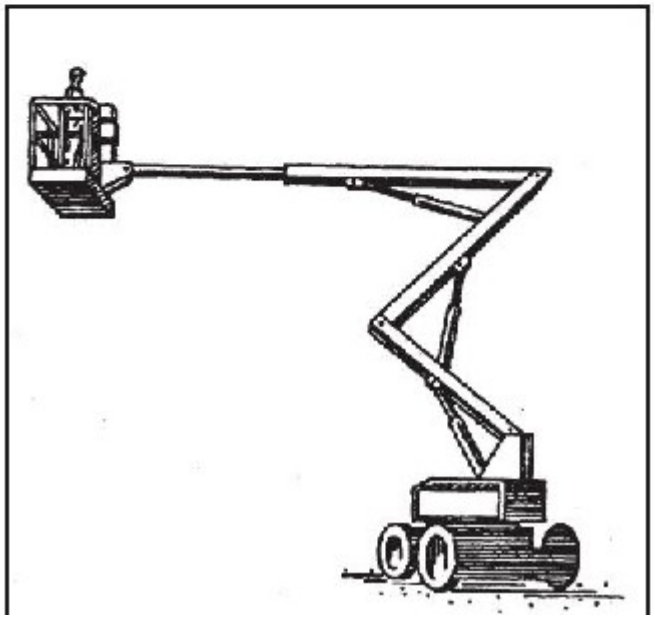


Figure 5.42 Elevating work platform – boom type



Establish a system of preventative maintenance to ensure that all vehicles are properly and regularly maintained. Each vehicle must comply with statutory requirements for roadworthiness. Ensure each vehicle has a record book that details the following:

- daily use;
- faults or damage from accidents; and
- general condition, including the condition/operation of items essential for safe use.

Each vehicle should have a record that shows:

- when service/maintenance is required;
- record of any work carried out on the vehicle; and
- costs associated with the above.

The operation should also have records that show the vehicles accident history, including any reference to the drivers, damage/replacement costs and any personal injuries. Ensure any accident is thoroughly investigated by line managers to establish the causes of the accident and actions to prevent similar accidents in the future.

Scheduling vehicles

Ensure vehicles are in good operating condition before being scheduled to carry a load. Ensure each vehicle is capable of handling loads within their legal load limits and within any legal limitations for the journey selected. Ensure schedules allow for:

- proper maintenance between journeys;
- security checks;
- stability of the loads carried; and
- the load limit on bridges/roads.

COMPETENCE OF THE DRIVERS

To encourage a commitment to safety, consideration should be given to driver motivational programs, including recognition of excellent safety performance and ensuring that:

- vehicle maintenance and housekeeping is rigidly enforced;
- undesirable driver performance is recognised and controlled;
- desirable driver performance is reinforced; and
- drivers understand their legal obligations under the appropriate Motor Traffic Act and other legislation.

Driver selection

When selecting a driver, take note of:

- employee selection procedures;
- past driving experience (particularly related to the job requirements);
- obtain signed clearance for request for information from RTA records on driving points system record and overloading breaches;
- class of driving licence;
- knowledge of the vehicle and its proper operation;
- physical condition and emotional stability, including the need for a medical examination, especially for long distance drivers;
- ability to perform a road test over a similar route to the one normally driven in the type of vehicle employed, to drive and deliver the operation's product;

- previous accident and overloading history.

Training For people operating large vehicles or mechanical plant, the operation must train staff and may issue certificates of competency. Include the following as part of induction training for company drivers:

- policy and procedures relating to safe driving and vehicle operation, the issue of appropriate licences and legal liability;
- road safety concepts, including knowledge of road laws and emergency procedures;
- vehicle operation, including regular checks of its condition;
- correct and safe methods for securing loads;
- the need to check the load during transport;
- emergency procedures for vehicle accidents and/or spillage of hazardous loads;
- correct loading of all vehicles within legal load limits; and
- environmental procedures for vehicle accidents and/or spillage of chemicals and/or hazardous chemicals.

Ensure that drivers receive the following ongoing training:

- specific skill training for dirt roads, off-road conditions, trailer equipment, fog, ice or snow, as appropriate;
- safety procedures for acid washing of units;
- elements of defensive driving; and
- effects of alcohol, drugs and medication on driving ability.

Influences on driver ability

Driving skills and abilities are impaired by a range of physical and psychological factors including:

- inappropriate scheduling resulting in very long hours at the wheel;
- medical conditions, such as defective hearing or poor eyesight;
- emotional problems;
- incorrect selection of vehicle for the intended task;
- effects of driving in high temperatures or high humidity; and
- serious effects caused by carbon monoxide, from a vehicle operated with a sub-standard or faulty exhaust system.

SAFE WORK PROCEDURES

General safety rules for personnel driving around quarries

An example of general safety rules is given below. All employees should be aware and understand the rules. They should be given to all new employees and contractors with any vehicles operating within the quarry.

- Always drive your vehicle at a safe and controlled speed. Where applicable, speed limits and restrictions are indicated by signs and must be observed.
- Under wet conditions, where roads are curved, especially ramps, operators must reduce speed according to the prevailing conditions.
- Seat belts must be worn in all quarry vehicles.
- Overtaking of heavy equipment by light vehicles must be done with extreme caution.
- Drivers are to observe all signs erected along haulage roads. Road signs overrule any other rules.

- Empty dump trucks give way to loaded trucks.
- All off road vehicles and mobile plant (excluding excavators) must be fitted with Roll Over protection (ROPS) and Falling Object Protection (FOPS).
- Light vehicles of any kind must always give way to heavy vehicles.

Heavy haulage vehicles

- Heavy haulage vehicles must give way to road maintenance vehicles, such as water carts, graders and wheel dozers.
- A minimum distance of 60 metres must be kept between dump trucks travelling on haul roads, especially on ramps. Dump trucks must not overtake any vehicle. However, they may overtake road maintenance vehicles if it is safe to do so, only where the driver has a clear view of the road ahead and behind.
- Keep a safe distance between dump trucks when waiting to load or tip.
- Dump trucks are not to reverse to the loader until signalled by the loader operator. The loader should be stationary with a raised bucket prior to reversing to the load point. Any collision between a loader and truck is the truck driver's responsibility.
- Dump trucks must have at least a 3-metre clearance when parked side by side.
- Dump trucks must not push other vehicles.
- If a dump truck or quarry vehicle must be parked on a down grade, steering wheels must be turned into the safety bank, wheels blocked and parking brakes applied.

Quarry products - road transport vehicles

- All safety signs in the quarry must be obeyed. These include speed signs, no entry to certain areas and warning signs of different hazards around the quarry workings.
- On entering the quarry, if drivers are unsure where to go, they must report to the weighbridge, where instructions will be given and a map supplied.
- CB radios can be used to communicate with the loader driver. Drivers should obey instructions from the loader driver as to the positioning of the truck for loading. While the truck is being loaded, the driver must remain in the cab. Under no circumstances should anyone approach the loader, without first gaining the operator's attention and then waiting until the loader's bucket is lowered to the ground.
- Trucks must give way to all quarry mobile equipment.
- If directed to load from under bins, use the platform provided for pulling the lanyard or lever. A hard hat and boots should be worn if drivers are moving about in these areas.
- Tipping should be kept as close to the main pile as possible. Never tip-off on a corner. If a safe place can not be found to tip, call the loader driver or weighbridge attendant for further instructions. Only tip on even ground.
- Never drive under the raised bucket of a loader. Approach the loader a metre or so out from the bucket and allow the loader to move out to you.

Any hazards, faults or unsafe working conditions must be reported immediately to the supervisor. Modern mobile equipment is fitted with features that provide optimum protection for operators in the event of an abnormal situation, such as a rollover. Such features include ROPS or FOPS for driver stations and seat belts. To obtain the maximum benefit of these features, procedures need to incorporate the manufacturer's requirements. Some general comments follow below, which may assist in the development of procedures.

EXCAVATORS

GENERAL

Excavator operation is skilled and important work. The safe operation of an appliance is in both the owner's and the operator's hands, and to prevent accidents it is essential that the operatives

receive good training and thorough preparation to fit them for their work. As there are so many makes, types and models of excavators, and each type and model has been designed for a specific range of work under certain conditions, definite information cannot be set down in a concise form to cover all excavators. Excavators and loaders are entirely dependent on gravity against overturning. The effects on loads of uneven, soft or sloping surfaces are critical, all having an important influence on the stability of the machine. Independent braking systems on the rear wheel also create instability. Both pedals should be welded together or equalising gear fitted to the dual braking pedals. With this in mind, stabilisers have been designed and fitted to all hydraulic small type back hoes. They should be used in the correct manner. The stabiliser which is on the lower side of uneven surfaces should be grounded first. Suitable packing should be placed under them in soft ground. An excavator may also have practical limitations, such as tyre capacities and axle strengths. Excavators have been designed for a specific range of work and it is essential that the work performed is kept within the range. The safe working load should be displayed on the machine if it is to be used for slinging loads, or work other than earth moving. Loads should only be attached to the machine on approved lugs or lifting devices not slung around the blade of the bucket. Tyre pressures also play an important part in stability. Correct air pressures should be maintained and extreme care taken when pressurising tyres containing water for ballast. A driver should not only demonstrate that he can safely drive an excavator. He is also required to have a satisfactory knowledge of the mechanical parts of the machine and be responsible for the making of regular inspections and the prompt reporting of unsafe conditions.

PRE-START

Drivers, duties prior to operating an excavator are to:

- know the safe working load and under what conditions the excavator can be used;
- check the condition of the tyres and their pressures or track gear if used. They need to know what precautions are necessary to pressurise tyres containing water as ballast;
- check the condition of the ropes and anchorages if used. Wire rope should be used if stretched, kinked, knotted, or corroded, or where ten per cent of the total number of wires in the rope are broken within a length of eight times the diameter of the rope. For example, in a 12 millimetres (mm) diameter 6/24 rope (144 wires), no more than 14 wires are broken in any 96 millimetres of length;
- ensure the ropes are correctly wound onto their drum and that too much rope does not exist for the height of the drum flanges. A rule for the safe load of a wire rope in kilograms is - diameter in millimetres squared, multiplied by 8. Example - 12 mm diameter rope is 12 x 12 x 8 = 1150 kilograms (kg) = 1.15 tonne (t);
- only approved types of rope anchorages should be used. These are, the thimble eye splice with rope spliced with the correct number of tucks against the lay. The swaged ferrule splice with its thimble or hard eye and the wedge socket with the rope fitted so that the pull is in a direct line with the attaching point of the fitting. Bulldog clips and the like are not acceptable;
- check for any loose bolts, pins, broken or badly worn gearing, sheaves and for any loose or missing keeper plates or pins;
- check the mechanical condition of the brakes, linings, bands for cracks and mechanical linkages. Ensure they are guarded against the entry of oil or water;
- ensure all guards and safety devices are replaced after adjustments, repairs or other work requiring the removal of protective equipment;
- ensure the excavator has been greased. Moving parts must be stopped before any greasing, adjusting or cleaning takes place;
- check the mechanical condition of the operating controls;
- check the mechanical condition of the travelling brakes. Where a tractor-type back hoe is used and is fitted with an independent separate brake for each rear wheel, a locking device must be used to ensure that both wheels brake evenly at all times;

- check the mechanical condition of the limiting devices;
- check for any gear which has been haphazardly placed on the machine;
- check the internal combustion engine services; and
- check the electric and hydraulic services.

OPERATION

On starting an excavator, the driver must:

- ensure all controls are in the neutral position before starting the motor;
- be in the correct driving position and seated correctly, so as to take control if the machine moves. Do not stand on tracks or near wheels;
- check that all persons are clear of the operating range of the bucket;
- ensure any gear placed in the driver's cabin is not fouling any controls;
- ensure that the bucket has been placed in a safe position;
- check all controls for operation, direction and marking;
- check the road travelling brakes for efficiency;
- check for the satisfactory operation of the limiting devices;
- ensure that all tyres are in good condition and evenly and correctly inflated to maker's specifications and if water or solid ballast is required to check if its level is correct. This is most important in the case of large wheeled rubber tyred loaders, as fast road travel is hazardous with incorrectly inflated or worn tyres;
- prior to digging, take into account the ground conditions. Never work close to loose banks or open trenches unless properly battered or timbered. Stabilisers must be in position and packed if necessary. They prevent unnecessary movement and hold the weight of the machine of the tyres;
- when digging in virgin ground, break up the hard surface first before attempting large bites;
- at all times make proper provision for placement of dug-out earth and never place it too close to the edge of the trench;
- never undermine large rocks, trees or buildings and never dig too close under you own machine;
- watch out for underground services such as gas, water, telephone or electrical conduits. If in doubt as to their location, make enquires;
- keep any part of the excavator at least 4 metres clear of overhead powerlines of up to 132,000 volts and at least 7 metres clear of overhead powerlines which are above 132,000 volts. A warning notice is to be displayed in the crane cabin;
- Not make jerky, sudden movements with any controls. This results in damage to the machine and inefficient work;
- never allow any person to ride on the machine while travelling or operating unless a Department of Industrial Relations passenger's seat has been installed and approval granted by the Chief Inspector for persons to ride on the crane. It is the operator's responsibility to ensure this; and
- always leave the bucket on the ground when not in use.

FRONT-END LOADERS

OPERATION

- Before loading, check the cubic capacity of the bucket and the type of material to be handled to ensure overloading does not occur.

- At all times carry a loaded bucket as close to the ground as possible, to just clear ground obstructions. Do not raise the bucket to unloading height until reaching the dumping point. The dangers of a high bucket are instability, obstructed vision and the possibility of striking overhead obstructions.
- When travelling on sloping surfaces with a loaded bucket, always keep the bucket facing uphill and never travel sideways on a steep incline. If necessary, prepare the sloping surface by cut and fill before taking loads up or down.
- Never travel in reverse before looking behind to check for persons or obstructions in your intended path.
- Major factors in accidents during truck loading operations include truck position, driver location and traffic flow. Loader operators should move cautiously, especially in congested areas.
- The loader operator and the truck driver should agree where the driver will stay when the truck is being loaded; either in the cab, or away from both loader and truck - never on the truck body.
- Persons are not to ride in the bucket.
- To avoid cave-in, never work close to loose edges. Remember the loaded machine is extremely heavy when back filling deep trenches, work at 90 degrees to its edge.
- Buckets should always be grounded when the operator leaves the cab. A bucket left elevated for any reason should be securely blocked.
- Equipment left unattended should be locked or made inoperable so that any unauthorised person, particularly a child, cannot start the engine.

FORKLIFTS

An employer must ensure that every person who operates a forklift is competent to do so. He must ensure that the operator has been trained and assessed in the safe operation and health and safety procedures. Types of forklift accidents which can cause injuries include:

- being struck by a moving forklift;
- the forklift tipping over and overturning;
- collision with other vehicles or stationary objects;
- part of the operator's body protruding out of the cabin and hitting an object; and
- losing the load.

FORKLIFT HAZARDS

These situations can cause fork lifts to overturn:

- driving fast;
- turning sharply (a cornering forklift can overturn at 6 km per/hr or less);
- turning on sloping ground;
- travelling with a load raised;
- working on uneven or sloping ground;
- carrying a load forwards down a slope ;
- carrying an unevenly balanced load; and
- travelling across an incline.

If a forklift overturns, the safest place for the operator is in the cabin, restrained by a seat-belt and if possible, by body restraints built into the seat. The most common cause of death with these vehicles is when an operator attempts to jump clear of an overturning forklift and is crushed by

either the overhead protective guard structure or the mast. Always stay inside the cab when a forklift overturns. Do not attempt to jump clear.

SAFE WORK PROCEDURES

Examples of safe procedures for operating fork lifts are as follows:

- passengers on fork lifts are strictly forbidden, unless there is a separate seat provided with a restraint;
- other people are to be kept clear when a forklift is operating;
- the operator should take care when moving between artificial and natural light;
- the load is to be made secure and lowered to a safe centre of gravity before carrying;
- sudden stops and starts are to be avoided;
- no part of the operator's body is to protrude beyond the overhead protection;
- ramps are not to be used unless the forklift operator is trained in their use;
- the operator is to remain seated and secured at all times;
- the forklift is to operate within a designated area, separate from pedestrians; and
- the operator is to remain in the cabin when a forklift overturns.

People should never be raised on the forks or a pallet. If there is no other way to lift a worker, a proper work platform should be used in accordance with Australian Standards. A safe system of work should include a daily safety check and a requirement to carry out regular maintenance checks.

HAUL TRUCKS

GENERAL

Operators of haulage trucks should develop a zero tolerance safety attitude. This means that they will not operate equipment that is not properly maintained. Many haulage incidents have occurred from:

- drivers attempting to jump from a truck that is out of control;
- trucks going over the edge at dump point due to over travel or the collapse of the edge of the slope; and
- drivers being run over after parking their truck when the truck rolled.

The operator should know what to do in the case of:

- runaway/roll-over;
- engine failure;
- steering problems;
- brake failure;
- tyre failure; and
- fire.

OPERATION

All operators should:

- do a complete walk around inspection of the truck before boarding;
- conduct a safety check of the truck and test systems before driving. Use a buddy system to test lights;
- buckle up and stay buckled;

- put your mind in gear before moving, or putting the truck in gear. Warn people around the truck that it is preparing to move. This is especially true if the truck has been in idle;
- pay attention to the machine and the surroundings. Watch out for animals, people, other vehicles, changing road surfaces, odd sounds, slumping or sloughing slopes, highwall and haul road conditions, downed or low wires, lighting or visibility problems and unusual response of vehicle controls. Tell a supervisor so the problem can be fixed;
- avoid miscommunications and unexpected movements by talking with co-workers before, during and after field repairs or maintenance;
- be aware of changes in conditions: weather, traffic, visibility, haul route, or other work in progress; and
- watch your speed at all times. Set the parking brakes, place all controls in off or shutdown, and turn the wheels into the hill or use chocks when leaving the truck cab for any reason. When using wheel chocks, always place them on the driver's entry side. This will remind you to pick up the chocks before returning to the cab.

VISIBILITY

All operators should be totally aware of the restricted visibility which occurs from haul trucks. Below is a typical haulage truck visibility diagram. Figure 5.41 Haul truck visibility restrictions

DUMPING

All operators should:

- follow the dumping procedures used at mine;
- check the dump area: cracks along its top edge, overly steep slopes, sunken areas and soft areas. The weight of the truck near an unstable edge can be enough for it to break loose and cause the truck to go over the edge;
- watch the weather. Rain, melting snow and freezing and thawing can weaken the dump area and lead to unstable slopes;
- make sure the dumping area is level or slopes slightly upward toward the edge. This will help control the truck when backing up;
- be sure the dump area is adequately lighted;
- cross windrows at an angle, one wheel first to prevent jarring the load, the truck and yourself;
- approach the dump site from left to right (when possible);
- keep at least one truck width away from the berm;
- make sure the dumping berm is in place. Contact the appropriate supervisor if it is not.

When backing up, stop at least one truck-length away from the dumping berm to avoid overloading the dump edge;

- keep at least two truck widths apart if more than one truck is dumping at a time to help prevent collisions or weakening the dump area;
- back up perpendicular or at a slight angle to the dumping berm so the truck's left rear tyre approaches the berm first. This can help keep the truck from penetrating or going through the berm;
- do not expect the berms or bumper blocks to stop the truck;
- back up slowly and come to a gradual stop at the dump point. This prevents overloading the truck's rear axle or causing the edge of the dump area to break away;
- stop just before the truck reaches the berm or bumper blocks;
- shift the truck into neutral when dumping;

- set appropriate brakes when dumping;
- do not use the retarder brake when dumping;
- make sure the truck is clear of overhead powerlines, people and other equipment before raising the truck bed and dumping the load - contact kills!;
- watch for material stuck in the truck bed. It can make the machine unstable;
- be sure the truck is clear of overhead powerlines, people and other equipment before lowering the truck bed; and
- completely lower the truck bed before leaving the dump area. For better vision turn left (whenever possible) when leaving the dump area.

Stockpiles

Stockpiles are especially hazardous when there are activities at the top edge and the toe. Loading out material at the toe causes sloughing which can cover the loader. It can also oversteepen the slope, making the top edge of the pile unstable for trucks which may be dumping at the top.

- Pay attention to the stockpile and its surroundings;
- Always dump in an area where there are no activities immediately;
- Never dump over an oversteepened slope; and
- Dump at least one truck-length away from the edge.

Waste dumps

Waste dumps can be soft, weak, loose and have steep slopes which may cause instability. Of special concern are dumps that are constructed by trucks dumping over the dump edge to form angle of repose slopes.

- Check the dump edge for sloughs and cracks along the edge before approaching the dump.
- Look for mid-axle dumping berms.
- Too much moisture can weaken the pile, so be careful!

Bins and hoppers

Watch for overhead obstructions chutes, gratings, stopping blocks and guide rails. Look over the area before pulling in to dump to check for any damage to any of these features. Dumping at these areas is very repetitive and special efforts are needed to maintain driver awareness.

HAULAGE ROADS

Haulage road conditions can play a big part in the safety of a mining operation. Poor road conditions can make it much more difficult to operate equipment safely. Hazardous conditions include: grades that are too steep; roadways that are too narrow; inadequate traffic control signs; unstable slopes; poor drainage; problems due to weather conditions; inadequate sight distance at the crest of hills and around curves; and lack of adequate berms or guardrails. These conditions can lead to loss of control of the truck, collisions with other vehicles, runaway trucks and trucks going off the roadway and overturning. Important considerations for keeping haul roads safe include:

- roadways wide enough to allow the safe passage of the largest equipment that uses the haul road surface;
- the width of the roadway should be:
- one truck operating - at least twice the width of the truck; or
- two trucks operating - at least three times the width of one truck;
- the curvature of the road should be related to the turning characteristics of the truck;
- the roadway should be kept damp to settle the dust but should not be so wet as to cause the truck to lose traction when turning or braking;

- the manager should determine at what maximum speed trucks can operate safely on any particular haulage way underground. The dimensions of main haulage ways should be sufficient to provide a safe passageway for the largest truck or loader that is to operate in the haulage way. A minimum clearance of 1.8 metres horizontal and 600 mm vertical should be considered;
- the roadway should be regularly watered and graded to ensure that it is maintained in a good and safe condition;
- adequate berms or guardrails on elevated roadways where there is a danger of a vehicle running off the road. Berms higher than axle-height should be used in more critical areas such as steep grades and sharp curves;
- haul road grades compatible with the capabilities of the equipment using them. Steep grades have been a factor in haulage accidents;
- unless designed for specific tasks, and taking into account the nature of the travel way and braking system, ordinary trackless wheeled vehicles should be limited to gradients:
- on down hauls on the surface, a gradient of 1 in 10;
- on up hauls on the surface, a gradient of 1 in 5; or
- on underground roadways, a gradient of 1 in 6;
- traffic signs to control traffic flow and to provide vehicle operators with information (such as speed limits, grades and traffic patterns) to help ensure safe operation;
- roadways that are inspected, maintained and repaired regularly. Special checks should be made after changes in weather conditions;
- drivers trained on any change in traffic patterns. It is especially important that new operators be instructed on the capabilities of the equipment they are operating, and any special driving precautions that should be taken on the mine's haul roads;
- vehicle operators should be alert to, and anticipate, changes in road conditions, especially with changes in the weather;
- operators should promptly inform company officials of any unusual or potentially dangerous road conditions. Examples would be:
- poorly drained areas;
- soft shoulders;
- washed out areas, ruts and gullies;
- boulders or debris on the roadway;
- ice and snow drifts;
- cracks or unstable slopes above or below the roadway; or
- excessive dust.

ROPS AND FOPS

Falling-Object Protective Structure (FOPS) means a system of structural members arranged to reduce the possibility of crushing of the operator if a rock or other object falls on the cabin, or in the case of passengers, protection for those people. Roll-Over Protective Structure (ROPS) means a system of structural members arranged to reduce the possibility of the crushing of the operator if the machine overturns.

- a FOPS should be fitted to items of equipment and machinery such as Load-Haul-Dump (LHD) units, dump trucks, rollers, dozers, and rubber-tyred drilling rigs and personnel carriers, used principally in the underground workings of a mine.

- a ROPS should be fitted to items of equipment and machinery such as wheeled prime-movers, wheeled off highway dump trucks, rubber-tyred and crawler mounted dozers, scrapers, graders, loaders and tractors (with or without attachment) used mainly on the surface workings at any mine or quarry.
- a ROPS should be fitted to items of equipment and machinery such as small agricultural wheeled tractors.
- a FOPS or ROPS should conform with the requirements of AS 2294, except for small agricultural wheeled tractors, which should conform with AS 1636 or any equivalent.

If it is considered impracticable to meet standards requirements, the manager will need to determine alternative effective safety precautions. If a FOPS or ROPS suffers discernible deformation as a result of an accident, the equipment or machine should not be used until the structure has been replaced or restored to a condition which, in the written certified opinion of the manufacturer, the manufacturer's agent or a qualified mechanical or structural engineer, is at least equal in strength to the structure as originally fitted. Note: Seat belts where fitted should be worn to provide optimum safety for haulpack truck operators in the event of a truck fitted with ROPS rolling over.

ELEVATING WORK PLATFORM VEHICLES (CHERRY PICKERS)

GENERAL

Elevating work platforms are used to raise persons, tools and materials above ground level to perform work.

SAFETY HARNESSES

Safety harness should be worn and properly secured at all times by people when aloft. There should be an attachment anchorage point in the basket appropriate for the harness.

CONTROLLED DESCENT DEVICES

An elevating work platform should be fitted with a controlled descent device suitable for use for escape from the platform in the case of a power loss. Personnel working from an elevating work platform should be instructed in the correct use of the controlled descent device.

SAFE WORKING LOAD

The safe working load as marked on the basket should be observed at all times.

CLEANING

Equipment should be maintained in a clean condition and the walkways on the vehicle tray are to be kept tidy and free of obstructions at all times.

DAILY INSPECTION

Operators of an elevated work platform should make a daily inspection of the whole unit and give particular attention to following:

- all main components for distortion, dents, damage, burns or cracks. In particular, when a fibreglass insert is incorporated in the upper boom it should be closely examined for cracks or damage;
- the inflation pressure and condition of all tyres;
- the fuel and oil levels of all applicable components;
- all hydraulic hoses;
- evidence of excessive oil leaks from the equipment;
- the basket for damage and cleanliness;
- the operation of all controls through their maximum working range;

- the basket levelling, steel wire cables and levelling linkages for wear;
- the operating speed of the basket in all directions of travel;
- the condition of the safety harness and the anchorage point to which it will be attached;
- the operation of the parking brake, especially where it is automatically operated by an interlock with the boom;
- the operation of the hydraulic accumulator unit and/or the emergency, battery-operated hydraulic pump;
- the condition of all accessories, that is, slewing crank handle, emergency pump switch and key, wheel chocks, road marker cones, warning notices, flashing lights and spot lights; and
- all defects should be repaired to the manufacturer's specifications by a competent person or verified as being within acceptable limits before the elevated work platform is operated at a work site.

TRAVEL PROCEDURE

Elevated work platform drivers must:

- ensure that the boom is in the travelling position and firmly resting in the travelling support frame with basket and boom retainers affixed before the vehicle is moved;
- ensure that, where the vehicle is fitted with outriggers or spring lockouts, the outriggers are retracted and pinned or that the spring lockouts are disengaged before the vehicle is moved;
- be constantly aware that equipment on the vehicle is higher than the cabin. The height of the elevated work platform is displayed on a notice in the cabin;
- be aware that, for particular elevated work platform units, the equipment on the vehicle overhangs the front and/or rear of the vehicle. Care should be taken to allow for these overhangs, when manoeuvring close to buildings, vehicles or other obstructions; and
- not travel with the basket in the elevated position;

Vehicles are permitted to travel short distances with a person in the basket, provided that:

- the basket is in the travelling position in the travelling support frame;
- the person is wearing an approved safety harness correctly attached to an anchorage point in the basket;
- the road speed of the vehicle is limited to 5 km/h (walking pace) and the driver takes special care, and
- the travelling is made on ground level.

Reverse only to position the vehicle at the work site, not to move between work sites. Whenever possible reverse the vehicle under the guidance of an observer, so positioned to permit an unobstructed view of both the intended path of the vehicle and the driver. Consider the location of hazards associated with the surrounding conditions at the work site. Ditches, manholes, culverts and the like should always be regarded as possible hazards.

SETTING UP AT THE WORK SITE

Persons required to operate elevated work platforms in the course of their duties should, before going aloft, ensure that:

- the position of the vehicle is satisfactory for the task to be undertaken;
- wheels, and outriggers where fitted, are on a sound footing. Avoid soft ground, side slope or other conditions that may affect the stability of the unit. Elevated work platform units should not be used where the vehicle slope in any direction exceeds 5 degrees, or the slope indicator, if fitted, is outside the safe region;
- the parking brake has been firmly applied;

- for an elevated work platform unit without outriggers, one pair of wheels has been chocked. For elevated work platform units with outriggers, the front wheels have been chocked. Heavy timber baulks may be required beneath outrigger pads where they may damage a surface or if the surface is soft or uneven;
- spring lockouts, where provided, have been fully engaged;
- the area is clear of personnel before lowering the outriggers; and
- all persons are clear of the path of the basket and the booms while the basket is being lowered to the entry position.

RESCUE PROCEDURE

All elevated work platform operators should be adequately trained in rescue procedures for the type of elevated work platform prior to operation.

SUPPLEMENT D SAFE WORK SYSTEM - GAS CUTTING

Gas Cutting, Welding and Heating

The control of risks in the use of oxygen and fuel gases (acetylene, or liquefied petroleum gas [LPG]) involves considerations of the operator's competence, equipment, work procedure and the surrounding environment.

OPERATOR EDUCATION

Those who use oxygen and fuel gases (acetylene or LPG) in mines to cut, weld or heat must have attained a satisfactory level of competence in use of the procedure.

OPERATOR PROTECTION

Goggles with the correct shade of filter should be used. Suitable protective clothing should be worn - that is, gloves, aprons and shoes (boots). Oxygen or another gas should not be used to dust clothes or work. An appropriate respirator should be worn when working on lead, lead-bearing materials, steel coated with lead paints, cadmium-coated materials, zinc-coated materials or any objects containing metals giving off toxic fumes.

EQUIPMENT

Inspection of equipment should be made before it is used. Faulty items should be replaced immediately. Items to inspect include cylinder regulators, flashback arrestors, hoses, couplings, torches and tips. The manufacturer's advice should be heeded. Hoses should be protected from sparks, hot slag, hot objects, sharp edges or open flames. If hoses are burnt in a flashback they should be replaced. When oxygen and fuel gases (acetylene or LPG) are used in a mine shaft, an automatic hose reel should be used.

WORKING IN A SHAFT, RISE, PASS, LIFT, PIT OR CLOSED VESSEL

Cylinders should be located above the cutting point so that sparks, slag and molten material cannot fall on hoses or on fusible plugs. A suitable fire extinguisher and water hose should be located nearby. The area should be deluged with water if flammable material is present (for example, timber shaft frame, which cannot easily be protected, and where significant impact from a fire would result). Molten metal, slag and sparks must be prevented from falling down shafts, onto flammable material, into chemical storage areas, onto Linatex, conveyor belts, polyurethane screens, etc. Further advice on precautions, including obtaining permits to work is available in AS 1674 Safety in Welding and Allied Processes. When work is to be performed in confined spaces, the requirements of AS 2865 Safe Working in a Confined Space may apply.

FIRE PROTECTION

While oxygen will not burn, it vigorously supports and accelerates combustion, causing flammable materials to burn with great intensity. Oil or grease in the presence of oxygen may ignite spontaneously and burn violently. A suitable fire extinguisher should be located nearby. The operator should be aware where other fire fighting equipment is located. Work areas should be clear of all rubbish and flammable material. Where flammable material cannot be removed it should be suitably protected. The operator should ensure that his/her clothing is not oily. All mines should have a written procedure for inspecting a location after welding, cutting or heating has been performed, to ensure fires do not occur.

STORAGE AND HANDLING OF GAS CYLINDERS

- Cylinders should be stored at least 15 metres from fuel bays, fuel outlets and mobile equipment under repair.
- Cylinders should be housed behind a fireproof partition.

-
- Storage areas should be fitted with suitable heat deluge water spray systems and a notice indicating that this is an approved storage area for oxidants and acetylene bottles.
- Storage areas should be fitted with locking doors, level floors and should be raised at least 150 mm above the surrounding floor.
- Dry powder extinguishers should be positioned not less than 8 metres, nor more than 10 metres, from the storage areas.
- Never sling or lift a cylinder by the valve cap or guard.
- Cylinders should only be lifted in approved cradles.
- Where possible, use an approved cylinder trolley for transporting cylinders, even for a short distance.
- Leave the valve protection caps/guards in place when cylinders are not in use.
- Keep cylinder valve outlets clean and free from contaminants, particularly oil and water.
- Do not use cylinders as rollers or supports, or for any purpose other than that for which they are designed.
- Never permit oil, grease or other readily combustible substances to come into contact with the valves of cylinders containing oxygen, nitrous oxide or other oxidants.
- Do not subject cylinders to abnormal mechanical shocks which may cause damage to their valves or safety devices.
- Never attempt to repair or modify cylinder valves or safety relief devices.
- Damaged valves or threads should be tagged and reported immediately to the shift foreman/shift boss.
- Cylinders in bulk (more than two) should only be transported underground in approved containers with the cylinders secured.
- Up to two cylinders may be transported in a shaft conveyance if they are secured.
- All cylinders should be kept upright, empty or full, away from any sources of heat, electrical circuits and oil or grease.
- Cylinder valves should be tightly closed when not in use.
- Cylinder keys should be left in position when gas cylinder valves are open. Only standard keys should be used to open cylinder valves.
- Oxygen cylinders should not be stored with cylinders of acetylene or near highly combustible material.
- Acetylene cylinders should be kept upright whether in use or in store, full or empty.
- Oxygen and acetylene cylinders should be fitted with a flashback arrestor when in use. Flashback arrestors should also be fitted to the handpiece.
- All oxygen and acetylene cylinders should be placed on a stable footing and be secured by chain when ready for use or stored.
- When cylinders are used in a cage or on a stage they should be chained upright to a rigid support.
- Cylinders should be made secure when they are being transported.
- Cylinders should be returned to safe storage area when a cutting job is completed.

BACKFIRES AND FLASHBACKS

A (backfire) is a momentary extinguishment or burning-back of the flame into the blowpipe tip. It is caused by touching the tip against the work, by particles entering the tip and obstructing the gas

flow, or by overheating the tip. The trouble will sometimes clear itself immediately. If the work is hot enough, the blowpipe will then re-light automatically.

"Back feeding" or "reverse flow" of fuel gas or oxygen causes the gases to become mixed in the blowpipe, the hose, the regulator, or in the cylinder. This is a condition in which worn or malfunctioning torch valves allow different gases to mix dangerously in gas hoses. It occurs when the torch tip becomes plugged, when pressure is bled from the equipment by turning off the cylinder valves with torch valves open, and when pressure is exhausted from the fuel gas cylinder while the torch is in use. If these gases ignite, a flashback occurs, possibly with an explosive and devastating result. A flashback is the burning-back of the flame into the blowpipe or the ignition of an explosive mixture in one of the gas lines. Flashbacks can burn right back into the tubing. However, external damage does not always make itself evident following a flashback. Frequently, the only sign is a cloud of carbon smoke issuing from the welding tip when the blowpipe valves are open. The least amount of damage caused by a flashback is the burning of the inside of the hose lining which, if repeated over a period of time will result in disintegration of the hose.

In the case of flashbacks, the following procedures apply.

- Flashback into the blowpipe (this creates a shrill hissing sound as the flame burns at the mixer). If such flashback occurs, close the blowpipe oxygen valve at once. Then close the fuel gas valve. Wait a few moments to be sure the flame inside the blowpipe has had a chance to burn out.
- Flashback into the rubber tube. If such a flashback occurs, close the cylinder valves immediately.

Note: It is recommended that flashback arrestors should be fitted to all gas torches and oxygen and acetylene bottles when in use. This will prevent the potential for flashbacks to initiate an explosion in the gas cutting/welding/ heating equipment. Flashback arrestors should conform to the requirements of AS 4603 - Flashback Arrestors.

LIGHTING A GAS TORCH

Before lighting a torch, the assembled connections should be checked for gas tightness with soapy water or the equivalent, and not a flame. Before lighting the torch for the first time each day, hoses should be purged individually. This consists of allowing each gas to flow through its respective hose separately, for long enough to purge (get rid of) any flammable gas mixture in the hose. Hoses should not be purged into confined spaces or near ignition sources.

HOT WORK PERMITS

Cutting and welding and often processes such as brazing and cutter grinding are commonly referred to as hot work activities. (AS 1674 - Safety in Welding and Allied Processes defines hot work as grinding, welding, thermal oxygen cutting or heating and other related heat producing or spark producing operations.) Potential health safety and property hazards result from the fumes gases sparks, hot metal and radiant energy produced during hot work. Hot work equipment which may produce high voltages or utilise compressed gases also require special awareness and training on the part of the worker to be used safely. Appropriate steps need to be taken to minimise fire hazards such as the removal or guarding of combustible materials and when possible restricting hot work to specially designated areas. It is essential to have control over hot work operations in areas with potential risk. A hot work system is a good method of ensuring that adequate safe guards are taken prior to, during and after all hot work. The mine operator should issue a hot work permit. For an example of a hot work permit, refer to AS 1674. Where continuous work is being carried out a blanket permit may be issued for a number of days, however the hot work site should be inspected by the person authorising the work at least twice daily to ensure that the work is being carried out safely and in accordance with the condition set out in the hot work permit. The permit should state the potential hazards of the area concerned and set out the precautions to be taken. The following are some of the hazardous areas which contain high potential for serious consequences if exposed to hot work:

- within 6 metres of any explosive magazine or any place where explosives are stacked, stored or placed;

- within 10 metres of any battery on charge (batteries on charge produce explosives hydrogen gas);
- above or within 15 metres of any exposed or unprotected combustible material;
- in or within 15 metres of any fuel store or refuelling station;
- within 15 metres or directly above a vessel which carries or may have carried diesel oil or other petroleum products;
- within 15 metres or directly above any area from which spillage of petroleum products may have accumulated;
- within 15 metres or directly above any area in which ammonium nitrate may have accumulated; and
- in or within 15 metres of any vertical opening including a shaft drums or containers which have held or suspected to have held chemicals, fuels or flammable liquids.

SAFE AREAS

There are areas where hot operations can reasonably take place at any time provided that the equipment is in good condition and safe operating procedures are followed (for example, workshops, open areas in plant away from combustible materials). Safe areas should be inspected on a regular basis to ensure that equipment is in good condition and that there are no fire hazards present.

PREPARATION OF WORK SITES

Preparation of work sites may vary from situation to situation and according to circumstances one or more of the following procedures may need to be observed:

- prior to issuing a hot work permit, the mine operator should inspect the hot work area to ensure the site and the equipment requiring hot work is properly prepared to prevent the danger of fire, explosion or exposure to toxic gases;
- remove any flammable or combustible liquids or flammable gases and relocate at least 15 metres away from the area. Alternatively provide physical barriers to liquids, vapours and gases between the storage and heat source;
- ventilate the area to ensure the atmosphere does not contain flammable vapours;
- sweep floors and wet them down, check walls and horizontal surfaces for collection of dusts and lints and if necessary sweep and wet down as for floors. If the area is outdoors, clear away combustible materials such as vegetation, sawdust, wooden pallets, and soak the area concerned;
- plug all drains, floor openings and pipe gutters within the vicinity of the hot work area, to prevent the possibility of sparks, slag or hot metal off cuts falling onto combustible materials;
- disconnect electrical sources;
- provide ample fire protection equipment such as fire extinguishers, fire blankets and fire hoses;
- assign a person to act as a fire watch for uncontrolled sparks, slag and hot metal off cuts; and
- when the mine operator is satisfied the area is satisfactorily prepared for the work proposed, a hot work permit can be issued, signed by himself/herself and the maintenance personnel or contractor responsible for carrying out the work.

RESTORATION OF THE WORK SITE

On completion of the hot work, the person responsible for carrying out the work should inspect the area to ensure it is safe, fill in the completion time on the hot work permit and return it to the person who originally authorised the work. The mine manager or nominated responsible person

should inspect the work area approximately 30 minutes after receiving notice that the job has been completed to check that the area is safe and free from smouldering debris. When he/she is satisfied that the area is safe, the hot work permit should be signed and filed.

TRAINING

All persons performing hot work should be trained in proper equipment operation, handling and storage of welding materials, compressed gas safety, chemical hazards, and in working procedures, including the written hot work permit. Additional training may also be necessary in the proper selection and use of personal protective equipment. Training in confined space entry is necessary before working in such areas.

CONFINED SPACES

When performing welding or cutting in a confined space the following additional considerations are necessary:

- ventilation is a prerequisite to work in confined spaces;
- gas cylinders and welding machines should be left outside;
- heavy portable equipment mounted on wheels should be securely blocked;
- whenever a welder must enter a confined space through a small opening or manhole, means should be provided to quickly remove him in the event of an emergency. Safety belts and lifelines used for this purpose should be attached to the welder's body so that his body cannot be jammed in a small exit opening;
- an attendant with knowledge of preplanned rescue procedures should be stationed outside to observe the welder at all times. He must be capable of putting rescue operations into effect;
- when arc welding is suspended for any substantial length of time, all electrodes should be removed from the holders, and the holders located so that accidental contact cannot occur. The machine should be disconnected from the power source; and
- to prevent accidental gas leakage, torch valves should be closed and the fuel-gas and oxygen supply to the torch shut off outside the confined area whenever the torch is not to be used for a substantial period of time. Where practicable, the torch and hose should be removed from the confined space.

Three factors in arc and gas welding govern the amount of contamination to which welders may be exposed. These factors are:

- dimensions of space where welding is to be done (ceiling height is especially important);
- number of welders; and
- possible evolution of hazardous fumes, gases, or dust according to metals involved.

General Requirements Mechanical ventilation is needed when:

- space is less than 10,000 cubic feet per welder;
- ceiling height in room is less than 5 metres; and
- in confined spaces, or where welding space contains partitions or other structural barriers which may obstruct cross ventilation.

Mechanical ventilation at a minimum rate of 2,000 cubic feet per minute per welder, except where local exhaust hoods, booths, or airline respirators are provided. Natural ventilation is considered sufficient for welding or cutting where the restrictions above are not present.

VENTILATION IN CONFINED SPACES

Adequate ventilation should be provided to prevent accumulation of toxic fumes or possible oxygen deficiency. This includes not only the welder, but also helpers and other personnel in the immediate vicinity. All make-up air that is drawn into the area of operation must be clean and respirable.

PERSONAL PROTECTIVE EQUIPMENT

The minimum protective equipment to be used is shown below.

Minimum Protective Equipment

PROCESS	HAZARD	PERSONAL PROTECTION
Gas cutting and welding	Radiation	Goggles with appropriate filters and clothing
	Burns	Gloves, footwear with suitable head wear for overhead cutting
Arc welding (manual)	Burns	Full face protection shields with filters
	Radiation	Adequate clothes, gloves and footwear
Electric shock grinding,and chipping	Hard particles	Goggles and hearing protection
Plasma cutting	Fumes	Goggles with appropriate filters and adequate clothing
	Radiation	Gloves, footwear and suitable head wear for overhead cutting

Recommended Respiratory Protection

Process	Shop Welding		Field Welding	
	Ventilation Good	Ventilation Poor	Ventilation Good	Ventilation Poor
Manual arc welding	Not Required	Fume mask - use if fume are excessive ie working with galvanised metal	Not required - use fume mask if fumes are excessive, ie working with galvanised metal	Not required
Tig/Mig	Not required	Fume mask	Not Required	Fume mask
Gas cutting/welding	Not Required	Fume mask - use fume mask if fumes are excessive, ie working with galvanised metal	Not required - use fume mask if Fumes are excessive, ie working with galvanised metal	Not required

REFERENCE DOCUMENTS Boral OH&S Manual, Boral. Welding Cutting and Brazing Program, University of North Carolina at Greenborough. Welding Institute of Australia. Technical Note 7. Technical Note 20 - Repair of Steel Pipes. AS 1674 Safety in Welding and Allied Processes. AS 2030 Gas Cylinders Code. AS 2865 Safe Working in a Confined Space. AS 4603 Flashback Arresters - Safety devices for use with fuel gases and oxygen or compressed air. AS 4332 Storage and Handling of Gases in Cylinders. MDG 25 Guideline for Safe Cutting and Welding Operations at Coal Mines and Coal Preparation Plants. NSW Department of Mineral Resources.

SUPPLEMENT E SAFE WORK SYSTEM - TOOLS

Tools

EXPLOSIVE-POWERED TOOLS

GENERAL

Explosive-powered fastening tools used on a mine site should be designed, used, inspected, repaired and stored as set down by AS/NZS 1873 Powder-actuated (PA) Hand-held Fastening Tools.

QUALIFIED OPERATOR

A qualified operator means a person who:

- loads, unloads, attempts to load, unload or fire an explosive-powered tool;
- is over the age of eighteen years;
- has been thoroughly trained in the correct use and adjustment of the particular type of explosive-powered tool to the extent necessary to operate the explosive-powered tool safely; and
- has been fully instructed as to the dangers associated with explosive-powered tools and the precautions to be taken in respect to them.

USE

An explosive-powered tool should not be used unless:

- it is of a type and model which has been approved; and
- it is used by a qualified operator.

ABRASIVE WHEELS

TOOLS AND GRINDING/CUTTING WHEELS

Correct grinding/cutting wheels should be selected for a specific duty. Such wheels must only be used with an arbor to suit the machine and wheel.

The safe maximum rotation speed of the wheel should match the machine to be used.

The wheel should have no visible cracks, or damage, and be fitted correctly to the machine.

The diameter of the wheel arbor should be of the correct size for the type and size of grinding/cutting wheel it will carry. The wheel washer and collar should be of the correct diameter and thickness and made with the correct recess to grip the wheel firmly. The wheel washer and collar should be of the same diameters. The nut which holds the wheel on the arbor and the washer against the wheel should be of sufficient size and strength to do the job.

OPERATION

Operators should receive adequate training in the use of grinding/cutting wheel equipment. Users should check that all tools are in a safe operating condition.

Operating speeds of all grinding and cutting tools, using abrasive discs, should be checked with a tachometer to ensure the tool is operating at the manufactures recommended speed.

With the exception of cone-shaped wheels and small mounted points, all wheels should be operated under or inside a guard, designed to protect the operator. Electrically-powered portable grinders and cut-off machines should be protected by an earth leakage unit. The power cable needs to be suitable for the rating of the tool and be in good condition.

The hose connected to an air-powered tool should be secured with a safety clip to prevent the hose from detaching. The air hose needs to be rated for the pressure to be used and be in good condition.

Air-operated grinders have air motors which reach their maximum power at approximately 50% of their free running speed. In other words, a tool at either rest or full running speed, is doing no work and develops no horsepower. To have a tool run at free speed (within proper safety limits) and at maximum power, governors are used. They should be checked regularly.

Steps commonly observed for a grinder operating at 4500 rpm include:

- first squirt some oil into the inlet bushing to ensure all internal parts are cleaned and lubricated;
- turn the tool on and check the free rpm which can be read from the spindle of the tool, which reading should be between 4200 rpm and 4400 rpm; and
- check that the governor is operating correctly by loading the tool down (applying pressure to the output spindle with a piece of wood).

As most air grinders do not have gears, they operate at relatively high speeds.

It is essential that the spindle carrying the grinding wheel runs true, and that the bearings are in good condition; otherwise, the spindle will vibrate considerably, causing rapid wear and increase the possibility of wheel breakage. Be sure spindle attachments such as chucks, collets, and arbors run true with the spindle to avoid vibration.

Note: Tools should be operated according to the manufacturer's recommendations.

MAINTENANCE

All tools used with abrasives are subject to damage from the dust. The ventilating and moving parts should be cleaned with an air hose. Occasionally, portable grinders should be disassembled and all parts cleaned.

Guards, particularly on portable machines, should be checked for cracks and loose fasteners.

The speed of air-operated grinders/cutting wheels should be checked regularly.

Grinding wheels should be dressed periodically to keep the wheel face clean and straight. A damaged wheel should be removed immediately.

The tool rest should be adjusted so that the gap between the wheel and the rest is no greater that 1.5 mm. Flange nuts should be checked to see that they have not worked loose.

Note: Tools should be maintained and repaired in accordance with the manufacturer's recommendations.

PERSONNEL PROTECTION

- Goggles should be worn at all times when grinding.
- Dust masks should be worn as appropriate.
- Suitable clothing should be worn to prevent burns or cuts.
- There should be adequate lighting and ventilation when using abrasive equipment.

SUPPLEMENT F STATUTORY REQUIREMENTS AND GUIDELINES -FALLS

Introduction

The information contained in this supplement summarises the statutory requirements and guidelines of the Australian States and Territories, and New Zealand.

At the front of the supplement is a map giving a summary of the "fall protection needed" height for each jurisdiction. Noted on the map is whether the requirement is statutory (i.e. a "must" do) or guidance. After the map, each jurisdiction is covered in detail.

Important

The contents of the supplement are correct, to the best of the author's knowledge, as at 01 Mar 07.

The information presented is not a comprehensive summary of fall protection requirements in all applications, it is restricted to height safety/fall protection that is either directly relevant to, or may be indirectly relevant to, applications where TRAM may be considered.

Direct quotations from source documents are shown in Times New Roman font.

Acts, Regulations, Codes of Practice, Standards and Codes of Practice

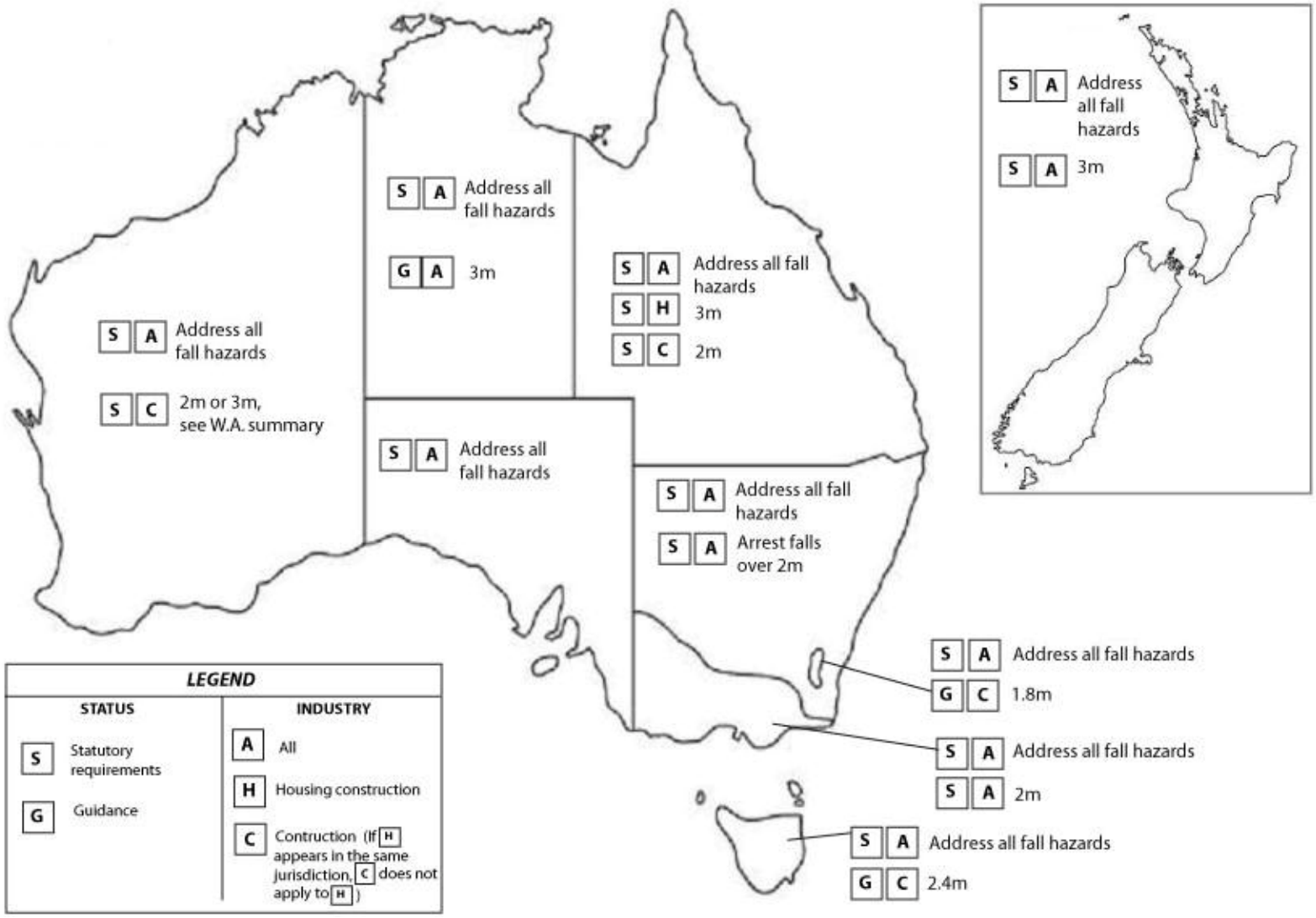
Under Acts of parliament, there are three types of instruments made to help meet workplace health and safety obligations – regulations, advisory standards and industry codes of practice.

If there is a regulation about a risk – you must do what the regulation says.

If there is an advisory standard or industry code of practice about a risk – you must either:

- do what the standard or code says; or
- adopt and follow another way that gives the same level of protection against the risk.

If there is no regulation, advisory standard or industry code of practice about a risk – you must choose any appropriate way and take reasonable precautions and exercise proper diligence to ensure you meet the obligation



SUMMARY OF FALL PROTECTION REQUIREMENTS – AUSTRALIA AND NEW ZEALAND

AUSTRALIAN CAPITAL TERRITORY

Administered by: ACT WorkCover
Telephone: (02) 6205 0200 , Facsimile: (02) 6205 0336, Email: workcover@act.gov.au

Legislation: OHS Act 1989

Part 4 Safety duties for occupational health and safety

Division 4.1 Safety duties

37 Duties of employers in relation to employees

(1) An employer shall take all reasonably practicable steps to protect the health, safety and welfare at work of the employer's employees.

(2) Without limiting subsection (1), an employer contravenes that subsection if the employer fails to take all reasonably practicable steps—

(a) to provide and maintain a working environment (including plant and systems of work)—

(i) that is safe for the employer's employees and without risk to their health; and

(ii) that provides adequate facilities for their welfare at work; or

(b) in relation to any workplace under the employer's control—

(i) to ensure that the workplace is safe for the employees and without risk to their health; and

(ii) to provide and maintain a means of access to and egress from the workplace that is safe for the employees and without risk to their health; or

(c) to ensure the safety at work of, and the absence of risks at work to the health of, the employees in connection with the use, handling, storage or transport of plant or substances; or

(d) to provide to the employees the information, instruction, training and supervision necessary to enable them to perform their work in a manner that is safe and without risk to their health; or…

Penalty for offence	Maximum Penalty
	Penalty Unit Value: Individual - $100 Corporation - $500
Failure to comply with safety duty – general offence	100 penalty units
Failure to comply with safety duty – exposing people to substantial risk of serious harm	1500 penalty units, imprisonment for 5 years, or both
Failure to comply with safety duty – causing serious harm to people	2000 penalty units or imprisonment for 7 years, or both

Regulations: Nil

ACT - Codes of Practice and/or Guidance Notes

Safety Handbook - ACT Building and Construction Industry

HEIGHT SAFETY

Generally, fall protection must be provided for anyone who could fall 1.8 metres or more. However, if the type of work makes it difficult for a worker to be fully aware of the location

of the platform edge (for example, welding, Oxy acetylene cutting and other work involving restricted vision) fall protection should be provided regardless of height.

NEW SOUTH WALES

Administered by: WorkCover NSW. Phone: 02 4321 5000 Fax: 02 4325 4145

Legislation: OHS Act 2000 **Penalty Unit Value**: $110 (correct as at Apr 06)

Sect 8 Duties of employers

An employer must ensure the health, safety and welfare at work of all the employees of the employer. That duty extends (without limitation) to…ensuring that any plant or substance provided for use by the employees at work is safe and without risks to health when properly used, and ensuring that systems of work and the working environment of the employees are safe and without risks to health.

Sect 11 Duties of designers, manufacturers and suppliers of plant and substances for use at work

A person who designs, manufactures or supplies any plant or substance for use by people at work must ensure that the plant or substance is safe and without risks to health when properly used.

Penalty for offence		Current Value
Corporation - previous offender	7500 penalty units	$825,000
Corporation – first offender	5000 penalty units	$550,000
Individual – previous offender	750 penalty units and/or imprisonment for two years	$82,500 and/or imprisonment for two years
Individual - first offender	500 penalty units	$55,000

The maximum penalties for an offence under the OHS Regulation 2001 range from $2,200 to $27,500 depending on regulatory requirement (administrative provision have lesser penalties while safety breaches have the higher penalties).

Penalty notices (on-the-spot fines) under the OHS Regulation 2001 have increased from $550 - $600 for employers and from $1100 - $1500 for non-compliance with an improvement notice. Penalty notices for the new risk management provisions have fines of $1,000 although the 12 month and two year transitional arrangements apply to these provisions.

Regulations: Occupational Health and Safety Regulation 2001

Division 6 Working at heights

56 Prevention of falls from heights—particular risk control measures

(1) An employer must ensure that risks associated with falls from a height are controlled by use of the following measures:

(a) provision and maintenance of:

(i) a stable and securely fenced work platform (such as scaffolding or other form of portable work platform), or

(ii) if compliance with subparagraph (i) is not reasonably practicable—secure perimeter screens, fencing, handrails or other forms of physical barriers that are capable of preventing the fall of a person, or

(iii) if compliance with subparagraph (ii) is not reasonably practicable—other forms of physical restraints that are capable of arresting the fall of a person from a height of more than 2 metres,

(b) provision of a safe means of movement between different levels at the place of work.

(2) If a fall arrest device is provided for use by persons at work, the employer must ensure that:

(a) all anchorage points for the device are inspected by a competent person before their first use and then on a regular basis so they are capable of supporting the design loads, and

(b) if the load-bearing capacity of an anchorage point is impaired, the anchorage is immediately made inoperable so as to prevent its use, and

(c) any harness, safety line or other component of the device that shows wear or weakness to the extent it may cause the device to fail is not used, and

(d) all persons using the device have received training in the selection, assembly and use of the system, and

(e) adequate provision is made for the rescue of a person whose fall is arrested by a fall arrest device.

NSW - Codes of Practice and/or Guidance Notes

Safe Working at Heights Guide 2004 (This guide is issued for the **construction industry**)

Prevention of falls from heights

Clause 56 specifies the measures to control the risks associated with falls from heights. Unlike other areas of the OHS Regulation, the appropriate risk control measures are not solely determined by conducting a risk assessment. Instead, clause 56 specifies a mandatory hierarchy of controls, which relate solely to the risks associated with people falling from heights. This hierarchy of controls informs the risk assessment process.

The control measures in order are:

(i) The provision and maintenance of a stable and securely fenced work platform (such as scaffolding or other form of portable work platform).

(ii) If complying with (i) is not reasonably practicable, the provision and maintenance of secure perimeter screens, fencing, handrails or other forms of physical barriers that are capable of preventing the fall of a person.

(iii) If complying with (ii) is not reasonably practicable, the provision of other forms of physical restraints that are capable of arresting the fall of a person from a height of more than two metres.

An employer must also ensure the provision of a safe means of movement between different levels at the place of work.

NORTHERN TERRITORY

Administered by: NT WorkSafe
Freecall: 1800 019 115 Telephone: (08) 8999 5010 Facsimile: (08) 8999 5141
Email: ntworksafe.deet@nt.gov.au Web: www.worksafe.nt.gov.au

Legislation: Work Health Act (2005)

Duty under the Act	Penalty for failure to comply	
	Body corporate	**Natural person**
Sect 9. Duties of employers An employer shall, so far as is practicable provide and maintain a working environment at a workplace that is safe and without risk to the health or safety of the workers working at the workplace; and ensure that the health and safety of any other person is not adversely affected as a result of the work in which the employer or any worker is engaged.	$125,000	$25,000
Sect 30B. Duties of manufacturers, &c. A person who designs, manufactures, imports or supplies any plant or substance for use at a workplace shall, so far as is practicable ensure that the design and construction of the plant, or the characteristics of the substance, are such that a person who properly uses the plant or substance is not exposed to hazards in doing so.	$125,000	$25,000

Regulations:

PART 7 – WORKPLACE

Division 1 – Work Areas

47A. prevention of falls

(1) Where a worker is required to work –

(a) in or on an elevated workplace from which he or she could fall;

(b) in the vicinity of an opening through which he or she could fall;

(c) in the vicinity of an enclosure or container into which he or she could fall;

(d) on a surface through which he or she could fall; or

(e) in any other place from which he or she could fall, and there is a reasonable likelihood that the worker could be injured if he or she were to fall, then protection against the fall shall be provided –

(f) by the provision of a safe means of access to the workplace;

(g) by the provision of secure fences, edge protection, working platforms, covers or other forms of safeguarding; or

(h) where the protection provided by paragraphs (f) or (g) is not practicable, by the provision and maintenance of safe systems of work.

(2) Safeguarding provided for the purposes of subregulation (1)(g) shall be kept in good condition and shall not be removed while the work is being performed except, so far as is necessary, to allow access or egress of a person or the shifting of plant or material.

82. Safety belts and anchorages

(1) Subject to subregulation (4), where a worker at a workplace is required to perform work on a part of a building or structure where there is a risk to the health and safety of the worker if the worker were to fall from the building or structure, and no other means of protecting the worker is practicable, an employer shall provide a safety belt, harness and lanyard complying with AS 1891, and a safe anchorage to which the safety belt can be attached.

Northern Territory - Codes of Practice and / or Guidance Notes

Prevention of Falls at Workplaces – General

This is an approved code of practice and should be followed unless there is an alternative course of action which achieves the same or a better standard of health and safety for workers.

1.2 Scope

This code of practice relates to work conducted where there is a risk of people or materials falling.

Work is conducted where a free fall of 3 metres or greater is possible, specific fall prevention mechanisms such as those described in this code must be included as part of that work.

Work conducted with a potential free fall of less than 3 metres is subject to a risk assessment as described in this code. Many situations which present a free fall potential under the three metres will still require specific fall prevention measures.

2.3.4 Specific control measures for the prevention of falls

Specific control measures include:

• designing and planning new buildings, structures or plant with consideration to the prevention of falls;

• ensuring that designs or plans to modify existing buildings, structures or plant consider the prevention of falls;

• looking at the way jobs can be done safely to eliminate or reduce the likelihood of a fall;

• organising and sequencing work so that people do not interfere with or increase the risk of a fall for themselves or others;

• identification, collection and presentation of information and knowledge required by contractors to enable them to work safely; and

• identifying the training or knowledge required to work safely if there is the risk of a fall.

Control measures are not mutually exclusive. That is, there may be occasions when more than one control measure must be used to reduce the risk of a fall.

QUEENSLAND			
Administered by: Workplace Health and Safety Queensland. Phone 3225 2000			
Legislation: Workplace Health and Safety Act 1995 **Penalty Unit Value:** $75 (correct as at Apr 06)			
	Individual	**Imprisonment**	**Corporation**
Multiple deaths 2000 penalty units	$150,000	3 years	$750,000
Offences causing death or grievous bodily harm 1000 penalty units	$75,000	2 years	$375,000
Exposure to a substance likely to cause death or grievous bodily harm	$56,250	1 year	$281,250
Offences causing bodily harm 750 penalty units	$56,250	1 year	$281,250
Other offences 500 penalty units	$37,500	6 months	$187,500
Regulations: Workplace Health and Safety Regulation 1997			

The Queensland Regulations only give reference to fall protection for the construction industry.

Subdivision 10 Relevant person's obligation for risk of a person falling

214 Risk of fall of less than 3m in housing construction work or less than 2m in other construction work or construction work on roof with slope not over 26°

(1) This section applies to—

(a) construction work that is housing construction work during which a person could fall less than 3m; or
(b) construction work that is not housing construction work during which a person could fall less than 2m; or
(c) construction work on a roof, or partly completed roof, surface with a slope not over 26º.

(2) However, this section does not apply to construction work where a person could fall from—

(a) a ladder or fixed ladder; or
(b) a platform supported by trestle ladders; or
(c) scaffolding that the person is erecting or dismantling; or
(d) an area near a ladder that the person needs to use to get on or off the ladder.

215 Risk of fall of at least 3m in housing construction work or at least 2m in other construction work or construction work on roof with a slope over 26°

(1) This section applies to—

(a) construction work that is housing construction work during which a person could fall at least 3m; or
(b) construction work that is not housing construction work during which a person could fall at least 2m; or
(c) construction work on a roof, or partly completed roof, surface with a slope over 26º.

(2) However, this section does not apply to work where a person could fall from—

(a) a ladder or fixed ladder; or
(b) a platform supported by trestle ladders; or
(c) scaffolding which the person is erecting or dismantling; or
(d) an area near a ladder that the person needs to use to get on or off the ladder.

Queensland - Codes of Practice and/or Guidance Notes

There are no specific guidelines or codes of practice relating to falls protection. Some codes, e.g. the Rural Plant Industry Code of Practice 2004, give an overview of how to manage the risks of working at heights.

SOUTH AUSTRALIA

Administered by: SafeWork SA Phone 1300 365 255 Email help@safework.sa.gov.au

Reference: Occupational Health, Safety and Welfare Act 1986

Duties under Part 3—General provisions relating to occupational health, safety and welfare	**Penalty for failure to comply**	
	First Offence	**Subsequent Offence**
Duties of employers: An employer must, in respect of each employee employed or engaged by	Division 2 fine (Up to $100,000)	Division 1 fine (Up to $200,000)

the employer, ensure so far as is reasonably practicable that the employee is, while at work, safe from injury and risks to health…		
Duties of manufacturers etc: A person who designs, manufactures, imports or supplies any plant to which this subsection applies must ensure so far as is reasonably practicable that the plant is designed and constructed so as to be safe	Division 2 fine (Up to $100,000)	Division 1 fine (Up to $200,000)

Note regarding aggravated offences

Where a person contravenes a provision of Part 3—

(a) knowing that the contravention was likely to endanger seriously the health or safety of another; and

(b) being recklessly indifferent as to whether the health or safety of another was so endangered,

the person is guilty of an aggravated offence and liable upon conviction to a monetary penalty not exceeding double the monetary penalty that would otherwise apply under Part 3 for that offence, or imprisonment for a term not exceeding 5 years, or both.

Regulations Occupational Health, Safety and Welfare Regulations 1995

Division 2.13—Prevention of falls

2.13.1—Prevention of falls

If a person must work in an elevated workplace from which he or she could fall…and it is reasonably foreseeable that the person would be injured in such a fall…due to the distance of the fall…reasonable protection against a fall must be provided.

No fall distances are given.

South Australia - Codes of Practice and/or Guidance Notes

Working at Heights Booklet

This guidance document contains the following information:

PERSONAL FALL PROTECTION

Systems of work and equipment that secure a person to a building or structure are known as personal fall protection.

Personal fall protection systems should be used to minimise the risk of:

• a person falling from a height (travel restraint devices)

• injury to a person after they have fallen from height (fall-arrest systems).

Types of fall-arrest systems:

• Where there is a risk of a free fall **up to 2 m**, a fall-arrest harness connected to a lanyard assembly and attached to a fall-arrest static line or an anchorage point

• Where there is a risk of a free fall of **not more than 600 mm**, a ladder belt connected to a lanyard of not more than 300 mm in length attached to a ladder fall-arrest device.

TASMANIA		
Administered by: WorkCover Tasmania Phone: 03 6233 7657 or 1300 366 322 Fax: 03 6233 8338 Email: wstinfo@justice.tas.gov.au		
Legislation: Workplace Health and Safety Act 1995 **Penalty Unit Values:** XXX.		
PART 3 - Duties and Obligations Relating to Workplace Health and Safety	**Penalty for failure to comply**	
	Natural person	**Body corporate**
9. Duties of employers (1) An employer must, in respect of each employee employed by the employer, ensure so far as is reasonably practicable that the employee is, while at work, safe from injury and risks to health and, in particular, must – (a) provide and maintain so far as is reasonably practicable – (i) a safe working environment; and (ii) safe systems of work; and (iii) plant and substances in a safe condition; and (b) provide facilities of a prescribed kind for the welfare of employees at any workplace that is under the control or management of the employer; and (c) provide any information, instruction, training and supervision reasonably necessary to ensure that each employee is safe from injury and risks to health.	500 units	1500 units
16. Duties of employees While at work, an employee must – (a) take reasonable care for the employee's own health and safety and for the health and safety of other persons, including persons working under the direction or supervision of the employee, who may be affected by the employee's acts or omissions at the workplace; and (b) comply with any direction given to the employee by an employer or responsible officer with respect to any matter relating to health and safety under this Act..	100 units	NA
15. Persons in control of workplaces, &c. (1) A person who has control of any premises, plant, substance or temporary public stand to which subsection (2) applies must ensure so far as is reasonably practicable that the premises and the means of access to or egress from the premises, or the plant, substance or temporary public stand are safe and without risk to health and safety.	500 units	1500 units
14. Duties of designers, manufacturers, importers, suppliers and installers (1) A person who designs, manufactures, imports or supplies any plant or structure for use at a workplace must so far as is reasonably practicable –	500 units	1500 units

(a) ensure that the design and construction of the plant or structure is such that persons who use the plant or structure properly are not, in doing so, exposed to risks to their health and safety; and (b) when the plant or structure is supplied, ensure that adequate information is supplied in respect of – (i) any dangers associated with the plant or structure; and (ii) the conditions necessary to ensure that persons using the plant or structure properly are not, in doing so, exposed to risks to their health and safety.		

Tasmania - Regulation

There are no OHS regulations in Tasmania

Codes of Practice and/or Guidance Notes

Codes of Practice
The only Codes of Practice with any relevance to fall protection are

- Working at Heights in Commercial Construction
- Managing the Risk of Falling in Housing Construction

In general, these documents require fall protection for any assessed fall risk, but state in particular that it is required for falls of over 2.4m in height

VICTORIA

Administered by: WorkSafe Victoria. Phone 1800 136 089 (Toll Free) or (03) 9641 1444 Email: info@workcover.vic.gov.au.

Legislation: Victorian OHS Act 2004

Penalty Point Values: The Victorian Treasurer sets the value of a penalty unit each F/Y. For the 05/06 F/Y the value of a penalty unit is $104.81. For the 06/07 F/Y the value is $107.43. The latter value is used for the totals below.

Duties under Part 3 - General Duties Relating to Health and Safety	Penalty for failure to comply	
	Natural person	**Body corporate**
Duties of employers to employees: …so far as is reasonably practicable, provide and maintain for employees of the employer a working environment that is safe and without risks to health.	1800 units $193,374	9000 units $966,870
Duties of persons who manage or control workplaces: …must ensure so far as is reasonably practicable that the workplace and the means of entering and leaving it are safe and without risks to health.	1800 units $193,374	9000 units $966,870
Duties of designers of plant: A person who designs plant who knows, or ought reasonably to know, that the plant is to be used at a workplace must ensure, so far as is reasonably practicable, that it is designed to be safe and without risks to health if it is used for a purpose for which it was designed.	1800 units $193,374	9000 units $966,870
Duties of designers of buildings or structures: A person who designs a building or structure or part of a building or structure who knows, or ought reasonably to know, that the building or structure or the part of the building or structure is to be used as a workplace must ensure, so far as is reasonably practicable…that it is designed to be safe and without risks to the health of persons using it as a workplace for a purpose for which it was designed.	500 units $53,715	2500 units $268,575

Regulation: Occupational Health and Safety (Prevention of Falls) Regulations 2003

(The following summary and analysis is from Grant Tracy, Director of Safety, Standfast Corporation)

The objective of the *Occupational Health and Safety (Prevention of Falls) Regulations 2003* is 'to prevent falls of **more than 2 metres'**. The Regulation requires *Hazard Identification and Risk Assessment* and allows for a *generic risk assessment* to be used for similar tasks. The employer must control the risk of falls and a *Hierarchy of control of risk* is provided in the regulation.

Occupational Health and Safety (Prevention of Falls) Regulations 2003

Part 2 – Identification of Tasks and Control of Risks

Division 2 – Risk Control

204 Employers duty to undertake control of risk

If an employee is required to undertake a task that involves a fall hazard at the workplace, the employer must ensure that the risk of fall is –

(a) eliminated; or

(b) if it is not practicable to eliminate the risk, reduce so far as is practicable.

205. Hierarchy of control of risk

(1) For the purposes of complying with regulation 204, an employer must ensure that a risk of a fall *at the workplace is* controlled, so far as practicable, by arranging for tasks to be undertaken –

(a) on the ground;

(b) on a solid construction.

Fixed gantries are an example of the control described in this provision of the regulation. As described in the Risk Assessment, loading and unloading at locations with fixed gantries is a suitable and effective control to the risk of falls from road tankers.

(2) If…a risk of fall remains, the employer must control the risk, as far as is practicable, by ensuring that a passive fall prevention device is used.

NB

Part 1 – Preliminary

104. Definitions

In these Regulations –

"passive fall protection device" means material or equipment, or a combination of material and equipment, that is designed for the purpose of preventing a fall, and that, after initial installation, does not require any ongoing adjustment, alteration or operation by any person to ensure the integrity of the device to perform its function;

Example

Temporary work platform, roof safety mesh or guardrailing

Examples of passive fall prevention devices can be readily found in other industries, and are provided in the Regulation. For example, *roof safety mesh … is designed for the purpose of preventing a fall* in the construction industry. *After initial installation… roof safety mesh…does not require any ongoing adjustment, alteration or operation… to ensure the integrity of the device or to perform its function.*

This definition suggests that the pop-up handrail systems would not be an example of a passive fall protection device, as the driver is required to *operate* the system each time the top of the tanker is accessed. Furthermore, many of the handrail systems require compressed air *to ensure the integrity of the device.*

(3)If… the risk of fall remains, the employer must control the risk, as far as is practicable, by using a work positioning system.

NB

Part 1 – Preliminary

104. Definitions

In these Regulations –

"work positioning system' means –

(c) travel restraint system

The use of fall restraint and fall arrest is described in this part of the regulation.

The TRAM is a 'total restraint' control as described in Australian/New Zealand Standard 1891 Industrial fall-arrest systems and devices Part 4: Selection, use and maintenance. The standard defines that total restraint will prevent a person from reaching a position where there is a risk of fall. Total restraint provides a greater level of safety when working at heights than the use of fall arrest systems.

The terms of this part the Regulation clearly include the use of the TRAM as a control for working at heights on top of road tankers. Although the main principle of the *Occupational Health and Safety Act 1985* is that those who create risk from work activity are responsible for the protection of workers, there is also duty for employees to co-operate with their employers and take care.

Occupational Health and Safety (Prevention of Falls) Regulations 2003

Part 3 – Other Duties

303. Employee's duty to work as directed

An employee who has been provided with information, instruction and training…must –

(a) carry out a task in accordance with that information, instruction and training; and

(b) use any risk control measures put in place or provided by the employer in accordance with that information, instruction and training.

Victoria - Codes of Practice and / or Guidance Notes

Codes of Practice

- Code of Practice - Prevention of Falls in General Construction
- Code of Practice - Prevention of Falls in Housing Construction
- Code of Practice for Building and Construction Workplaces (No 13)
- Code of Practice for Plant (No 19)
- Code of Practice for Demolition (No 14)
- Code of Practice for Demolition (Amendment No. 1)(No 21)

Falls & Industry Specific Publications

- Basic steps to preventing falls from height
- Working on roofs
- Ladders
- Trucks
- Mezzanines
- Falls Prevention In the Agriculture Sector
- Prevention of falls in the transport of waste and recyclables
- Prevention of falls in the transport of steel
- How to prevent fatalities in the Agricultural industry
- How prevent fatalities in the Service Industries
- How to prevent fatalities in the Construction Industry
- How to prevent fatalities in the Manufacturing Industry
- How to prevent fatalities in the Transport and Storage Industries

Guidance Notes

- Proper use of fall arrest and travel restraint systems
- Maintenance and inspection programs for chair lifts and aerial ropeways
- Safe installation and removal of outdoor advertising material
- Falls Prevention Above ground fuel tanks
- Falls Prevention Farm Forest Pruning
- Prevention Of Falls In The Transport Of Livestock
- Falls Prevention Working on Roofs

WESTERN AUSTRALIA

Administered by: WorkSafe WA. Phone 1300 307 877 or visit www.safetyline.wa.gov.au.

Legislation Occupational Safety and Health Act, 1984

The key obligations and the penalties for failure to comply follow:

Duties under the Act	Penalty for failure to comply	
	Contravention	Contravention resulting in death or serious harm
Sect 19. Duties of employers An employer shall, so far as is practicable, provide and maintain a working environment in which his employees are not exposed to hazards	$100 000	$200 000
Sect 23. Duties of manufacturers, etc. A person who designs, manufactures, imports or supplies any plant for use at a workplace shall, so far as is practicable ensure that the design and construction of the plant is such that persons who properly install, maintain or use the plant are not in doing so, exposed to hazards	$100 000	$200 000

Regulations

Occupational Health and Safety Regulations 1996

Summary:

- Edge protection needed for specific tasks (see 3.55 below for details) where the fall distance is greater than 2m.
- Edge or fall protection needed for all other situations where the fall distance is greater than 3m.
- Despite these specific requirements, there is a general requirement, concordant with the obligations under the Act, that employers, etc, identify and control all fall risks (see 3.49 below for how the Regulations cover this).

The sections relevant to the application of TRAM in fall protection are:

3.49. Identification and assessment of hazards in relation to falling

This section requires that employers, main contractors, self-employed person, and any person having control of the workplace or a person having control of access to the workplace identify and control all risks where:

> "…a person at the workplace is likely to be exposed in relation to the person falling from one level at the workplace to another…"

3.55. Edge protection

This section requires that employers, main contractors, self-employed person, and any

person having control of the workplace or a person having control of access to the workplace provides the following fall protection:

- Edge of a scaffold, fixed stair, landing or suspended slab, formwork or falsework. Where a person could fall 2 or more metres, provide and keep in place an edge protection system (i.e. a guardrails system that complies with AS/NZS 1657) from the.
- All other situations. Whenever there is a risk that a person could fall 3 or more metres, either:
    - Provide and keep in place edge protection that complies with AS/NZS 1657, or
    - Provided and keep in operation a fall injury prevention system.

The Section also states that people must use the systems provided.

Codes of Practice and / or Guidance Notes

The Prevention of Falls at Workplaces

Area of interest:

Section 17. Freight transport and general plant

Safe systems of work

Employers must provide safe systems of work so that, as far as practicable, employees are not exposed to hazards. Employers must also provide employees with information, instruction and training so that they can carry out their work in such a manner that they are not exposed to hazards.

Where people are required to gain access to high areas of trucks, road transporters, tankers or rail cars for purposes of securing, restraining, loading or unloading freight, and there is a risk of falling, employers must provide a safe system of work for them to get to and from the work area.

NEW ZEALAND

Administered by: Department of Labour Head Office Wellington
Phone (04) 915 4444 Fax (04) 499 0891

Legislation Health and Safety in Employment Act 1992

6 Employers to ensure safety of employees

Every employer shall take all practicable steps to ensure the safety of employees while at work; and in particular shall take all practicable steps to—

(a) Provide and maintain for employees a safe working environment; and

(b) Provide and maintain for employees while they are at work facilities for their safety and health; and

(c) Ensure that plant used by any employee at work is so arranged, designed, made, and maintained that it is safe for the employee to use; and

(d) Ensure that while at work employees are not exposed to hazards arising out of the arrangement, disposal, manipulation, organisation, processing, storage, transport, working, or use of things—

(i) In their place of work; or

(ii) Near their place of work and under the employer's control; and

(e) Develop procedures for dealing with emergencies that may arise while employees are at work.

Nature of Offence	Penalty for failure to comply (NZD)
Offences likely to cause serious harm	imprisonment for a term of not more than 2 years; or a fine of not more than $500,000; or both
Other offences (excluding the one below)	a fine not exceeding $250,000
If a person who controls a place of work place has not taken practicable steps to advise people in the workplace of any significant hazard that they know of, but that would not be reasonably expected to arise in a workplace of that type. (That is – the person in control of the workplace does not need to control these hazards but it is an offence if they do not make workers mindful of the hazards)	A fine not exceeding $10,000

Regulations: Health and Safety in Employment Regulations 1995

21 Heights of more than 3 metres

(1) In this regulation, the term employer does not include any employer who employs any employee to carry out any agricultural work in a place of work under the control of that employer.

(2) Every employer shall take all practicable steps to ensure, in relation to every place of work under the control of that employer, that, where any employee may fall more than 3 metres,—

(a) Means are provided to prevent the employee from falling; and

(b) Any means so provided are suitable for the purpose for which they are to be used.

Codes of Practice and / or Guidance Notes

Guidelines for the Prevention of Falls

As well as reflecting the requirements of the Regulations, the guide offers the following:

2.4 Access and Egress

All persons shall be provided with a safe means of access and egress to their work area. Steps, stairs, ladders, platforms and walkways or suitable mechanical plant shall be provided. Suitable access should take into account

environmental conditions such as weather and lighting, what people may have to carry, and other relevant factors.

Serious injuries may result from falls from large trucks or tankers, while accessing or opening tank hatches; from road transporters, while accessing the top of freight containers; and grain transporters, while fitting “hungry boards” to increase grain storage capacity or using vacuum loaders.

Where people are required to gain access to high areas of trucks, road transporters, tankers and rail transportation for the purposes of securing, restraining, loading or unloading freight and, where there is a risk of falling, employers must provide a safe system of work for people to get to and from the work area. This could be the provision of steps, permanent access ladders, walkways and guardrails. Wherever practicable, as much work as possible should be carried out at ground level.

Access to and egress from large items of plant, such as large vehicles and earthworks equipment (bulldozers, scrapers, graders, excavators, etc.) and heavy equipment, including during manufacture and maintenance operations, may result in fall injuries.

Employers must give consideration of the equipment and facilities available at both the initial loading point and the unloading destination to ensure safe access and egress is provided to employees involved in the operation.

SUPPLEMENT G SUSPENSION TRAUMA

Summary of the lecture delivered by Dr Emma Grandidge, MBChB Dip IMC RCSEd Medical Director of ABC Response Training at the Arboricultural Association Conference held in York on 3 October 2006.

Suspension trauma has been known about for many years but is still little understood. It is a natural reaction caused by the body in response to being held in an upright position and with immobile legs. The way that basic human physiology works is that we need to exercise our leg muscles to help return blood towards the heart. If we are rendered immobile this process starts to fail. Blood will start to pool in the legs, the brain suffers low blood volume, is starved of oxygen, and starts to die after just a few minutes.

In tests, healthy volunteers were suspended immobile and were seen to lose consciousness in as little as five minutes. Further research has suggested that death can occur in as little as ten minutes. If the suspension has resulted from trauma then this timescale could be much more rapid.

Suspension is life threatening and urgent rescue is needed, but first consider what is happening. The blood that has pooled in the legs is loaded with toxins which, if released into the circulation could damage internal organs and even stop the heart beating. This is known as 'Reflow Syndrome'. Traditional first-aid measures could be fatal in this case.

It is essential that casualties are not laid flat at any time during the rescue or when landing on the ground. The correct management of the casualty is to keep them in a sitting position with legs either straight out or pulled up to the chest for a minimum of 30 minutes, even if they are unconscious.

In the UK, arboricultural work is controlled by the Work at Height Regulations 2005. These require, among other things, that work at height is properly planned, including planning for emergencies and rescue. This means that:

- workers must have on-site rescue equipment and training;
- workers must be rescued immediately from suspension (within ten minutes of an accident);
- workers must be aware of the risks of suspension trauma;
- any First Responders must know how to treat it safely.

Unfortunately the latter is not always true and many workers are currently running a risk of being given inappropriate medical treatment, which could increase the extent of any injury and may even be fatal.

Suspension trauma can happen to anyone regardless of height, age, weight, sex, fitness or harness type, and anyone who has been suspended for more than three minutes should be treated for it.

Obviously prevention is better than cure and measures that reduce the risk should be employed wherever possible. Regular breaks and using a work-seat are all ideal preventive measures.

SUPPLEMENT H GLOSSARY

Competent person

A competent person is one who has gained the knowledge and skills necessary to correctly form a specific task.

Falls terminology

Fall-arrest device

A self-locking device meeting the requirements of AS/NZS 1891.3 whose function is to arrest a fall.

From AS/NZS 1891

Fall-arrest system

An assembly of interconnected components comprising a harness (or belt in certain limited cases) connected to an anchorage point or anchorage system either directly or by means of a lanyard, lanyard assembly or pole strap, and whose purpose is to arrest a fall in accordance with the principles and requirements of this Standard.

From AS/NZS 1891

Fall to a lower level (or "fall to a different level")

Basically, free-falls, limited-free-falls and restrained-falls are *falls to a lower level*. When TRAM is used as total restraint, it prevents falls to a lower level. This is the primary advantage of TRAM.

Use this terminology when speaking with clients as it may make it easier for them to understand why the lanyard length is irrelevant – so long as the user cannot fall over an edge, the lanyard can be as long as you like.

Free fall, free fall-arrest

A fall or the arrest of a fall where the fall distance before the fall-arrest system begins to take any loading, is in excess of 600 mm either vertically or on a slope on which it is not possible to walk without the assistance of a handrail or hand line.

From AS/NZS 1891

Limited free fall, limited free fall-arrest

A fall or the arrest of a fall occurring under the conditions described in Clause 1.4.5 except that under reasonably foreseeable circumstances the fall distance will not exceed 600 mm.

From AS/NZS 1891

Restrained fall, restrained fall-arrest

A fall or the arrest of a fall where the person suffering the fall is partially restrained by a restraining device such as a pole strap, or is sliding down a slope on which it is normally possible to walk without the assistance of a handrail or hand line.

From AS/NZS 1891

Total restraint

A control on a person's movement by means of a combination of a belt or harness, a line and a line anchorage which will physically prevent the person from reaching a position at which there is a risk of a free or limited free fall

From AS/NZS 1891.

Hot work

Hot work includes such work as grinding, welding, thermal oxygen cutting or heating and other related heat producing or spark producing operations.

From AS 1674 - Safety in Welding and Allied Processes

Reasonably practicable

Practicable having regard to:

(a) The severity of the hazard or risk in question;

(b) The state of knowledge about that hazard or risk, and any ways of removing or mitigating that hazard or risk;

(c) The availability and suitability of ways to remove or mitigate that hazard or risk; and

(d) The cost of removing or mitigating that hazard or risk.

From AS/NZS 1657-1992

Total restraint

See *falls terminology*