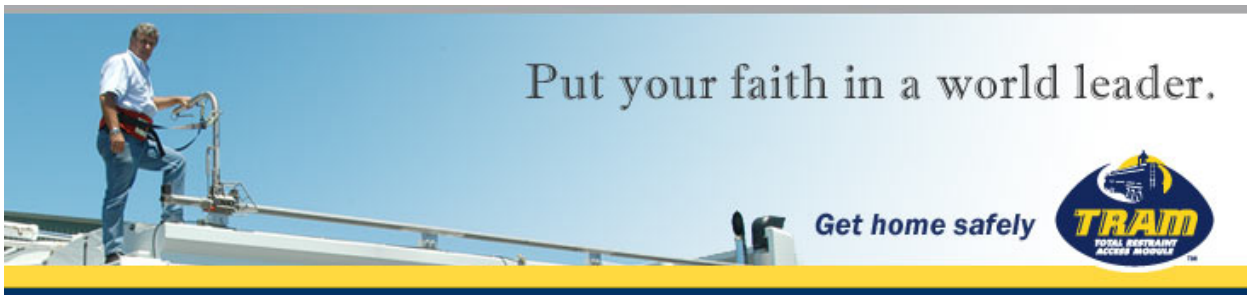

Road tanker height safety systems

"At present only one tank-based system [the TRAM] has been identified which could effectively prevent or protect a worker from the consequences of a fall on the ladder or from the top of the tank"

Source: UK Health and Safety Laboratory

Standfast Corporation considers that the following requirements need to be met by height safety systems for them to be effective in mitigating the risk of a fall from height.

- They must have sufficient load rating to withstand the force applied in the event of a fall (certification against standards does not guarantee this, as discussed below).
- They must provide a practicable solution for as many aspects as possible of the operation being undertaken. In regard to road tankers, they must cover the ladder climb, the transition between the ladder and the tanker top, and working on the tanker top.
- They must gain user-acceptance. If the user does not like using the product or does not see its benefit, the system will not be used unless workers are closely supervised.
- They must be reliable because if they malfunction, either the tanker becomes grounded or the user is exposed to the risk of a fall by accessing the tanker top without protection. To achieve reliability the system must stand up to the rigours of the work environment, and maintenance requirements should be minimal.

Load rating

- **Guardrails required to withstand a minimum of 55 kg**. AS 1657-1992 requires that guardrails withstand a load of 550 N (about 55 kg) of force applied outwards at the centre of each span.

  When considering guardrails as an option, tanker operators need to be aware that almost all workers will have greater mass than 55 kg, so regardless of certification to AS 1657-1992, attention should be paid to the ability of the guardrail system to withstand the force of a worker falling against them.

- **Horizontal lifelines required to withstand loads of in excess of 1200 kg.** AS/NZS 1891.2:2001 requires of horizontal lifeline systems that a static force of 12 kN (about 1200 kg) shall not cause release of the load or fracture of any component of the system, designed extension of energy absorbers or designed yield of any component excepted.

  A certified horizontal lifeline system will easily withstand the force applied on it by a worker falling from a tanker.

- **TRAM is certified to withstand over 600kg, and is proven to withstand over 1500kg**. TRAM is built to meet the requirements of AS 1891.4-2001 for fall restraint and it withstands

loads of in excess of 6kN (about 600 kg, as tested by laboratories accredited by Australian Standards and to 0 kN by NEL Laboratories under the CE Standard for fall arrest.

The call for TRAM as a height safety solution in applications other than on road tankers has led to Standfast improving the system to perform as a Type 1 fall arrest device. In-house tests have proven it to withstand well in excess of a 22 kN load without permanent distortion.

Like horizontal lifelines, TRAM will easily withstand the load applied to it by a falling worker. What sets TRAM apart is the manner in which TRAM achieves fall prevention and the unique protection it provides on the ladder-tanker top transition. This is covered below.

Protection on the ladder

There is no requirement for protection on a ladder of less than 6m in length, though it may be seen as desirable in some applications. The TRAM system can be used for ladder protection by fitting anchor points to the ladder to which the user secures the hooks of the TRAM belt to them as they climb - this is the case where TRAM is installed on livestock trailers. Hooks could be fitted to the standard harnesses or belts used on horizontal lifeline systems, though they might cause interference when connecting to the lifeline system. Guardrails do not provide for this option.

Protection during the ladder-tanker top transition

"The transfer between the ladder and the walkway, particularly in the descent, is considered to be the most hazardous element of the whole access operation." This statement comes from the report *Safety of workers when accessing the top of tank containers*, released by the UK Health and Safety Laboratory in 2005 and can reasonably be applied to road tankers for, though road tanker ladders are generally of a better ergonomic design than tank container ladders, the range and precariousness of the movements required of the operator are highly similar.

- **Guardrails and horizontal lifelines provide no protection in the transition between the ladder and the trailer top**. These systems provide no fall protection until the driver is on top of the trailer.
- **TRAM. Total protection in the transition between the ladder and the trailer top**. Users connect to, and disconnect from, the TRAM system whilst on the ladder and maintaining three points of contact. The TRAM system assists them in the climb onto the tanker top, and in the awkward move from the tanker top back to the ladder.

  The same UK HSE report as quoted above found that *"…At present only one tank-based system* [the TRAM] *has been identified which could effectively prevent or protect a worker from the consequences of a fall on the ladder or from the top of the tank"*

Protection on the trailer top

- **Guardrails provide limited fall protection. "**A guardrail should be a minimum of 116.2cm above the walking surface to form an effective barrier. The guardrail is then above the height of the centre of mass of all workers and is at waist height or more for all workers" [(1)]: pop-up handrails are about 900mm high (the AS requirement is 900-1100mm). This means that drivers can pivot over the rail if they lose their balance or are struck by a foreign object.

  The average male shoulder width is about 483mm, so to stop drivers passing under handrails, intermediate rails (or infill) are required to ensure that a width of no greater than 450mm is achieved between the rails. Pop-up rails have no intermediate rail, only a single strand of wire that can flex to allow openings of greater than 450mm.

  Most guardrail systems have a gap adjacent to the top of the ladder, providing no protection from a fall in that area. Some have a pullout sections with no intermediate rail at one end of the tanker, increasing the risk of falling under the rail.

[(1)] From *Ergonomic Considerations Related to Guardrail Design*, 2005, Grant Tracy, MScTechOHS, BThp, BHMS.

- **Horizontal lifelines prevent falls from the tanker top, but with complications**. These systems will retain the user on the tanker if they slip or trip, but the lifelines and the method of operation of the system can be problematic. Cable trolleys must pass over intermediate supports without catching, but hang-ups on intermediate supports are a common operating problem with lifeline systems. Lifelines may also snag on fittings on the tanker top. This may pull the user off balance with the complication that the snagged lifeline will be under tension and act as a pivot point for an accelerated fall onto the tanker top. In such situations, the tension in the lifeline and the accelerated fall restrict the user's ability to avoid hitting obstacles as they fall.
- **TRAM provides total protection on the trailer top.** Like the lifeline system, when connected to TRAM, a driver cannot fall from the tanker top. The and the design of the system, however, ensures that there will be no snagging and that if the user loses their footing, they are brought back through a short and clear path into a position of safety.

User acceptance

Without doubt, guardrails are the easiest height safety system to use. The worker does not have to wear a belt or harness and they have total freedom of movement on the tanker top. As shown above, though, they are not the most effective system of fall prevention.

Both TRAM and horizontal lifelines require the user to wear a belt or harness. These can meet with rejection by workers who perceive them to restrict their freedom of movement, but cannot balance this against a need. As with any change of work practice, it is recommended that the affected people have direct involvement in assessing both the hazards that have initiated the need for a change and the available options for controlling them.

Being involved in the selection of a safety solution gives people a feeling of ownership and makes them far more likely to make that solution work.

Reliability

There are many different manufacturers of guardrail and horizontal lifeline systems, so Standfast recommends that the manufacturers be contacted for details of how they stand up under the required operating conditions and what the maintenance requirements are.

As a general comparison:

- The TRAM unit runs on a rail constructed of steel tube that is welded to mounting blocks that are riveted or welded onto the tanker. This installation is simple and robust and requires almost no maintenance. Standfast has a TRAM unit running on a test bed using a less-than-favourable rail to simulate a punishing operating environment. The unit has so far undergone the equivalent of 13 years of operating (based on five uses a day up-and-back) without failure. The test is on going.

  A lifeline system runs on a steel cable (two cables in some cases) that has a more complicated method of fitting. The cable will be prone to wear at each point of connection to the supports and is not likely to have as long a life as the TRAM rail. Because of this wear, maintenance and inspection requirements will also be more demanding than for TRAM.

- Guardrails on tankers are usually of the pop-up type. These involve many more moving parts than the TRAM or lifeline systems and each part is subject to forces from many directions. It is reasonable to assume that the potential for wear and tear to affect performance is greater than for either TRAM or a lifeline system, so maintenance and inspection requirements would therefore be greater.

Author:
Lindsay Johnson
Safety Manager
Standfast Corporation
May 2006

Some Australian statistics…

From Work Cover South Australia

"A recent report found that transport workers have a rate of injury caused by falling from vehicles and equipment that is four times the average for all workers and the severity of their injuries is nearly double that of all other injury claims."

(Work Cover SA, *Road Transport Falls Prevention Manual*)

From Workplace Health and Safety Queensland

"Falls from heights are one of the biggest health and safety issues in the transport industry," Mr Stockill [WHS Qld, 2005] said…Last year alone, 22 drivers of heavy trucks received serious injuries as a result of falls from heights in Queensland…In total, 2,460 work days were lost in the heavy truck driving sector due to falls from height".

(www.dir.qld.gov.au/workplace/publications/safe/sep05/target/index.htm)

From Work Cover NSW

"Falls from heights costs the industry a considerable amount in workers compensation. For instance, in the 2000/2001 financial year, workers compensation claims for falls from heights for NSW truck drivers were in excess of $4,000,000…"

(Media release *WorkCover blitz on falls from road tankers*, 8 Mar 2005)

From Work Safe Victoria

"Mr Pilkington [WorkSafe Victoria Transport and Storage Industry Program Director] said falls from height remains a major workplace safety issue in the transport industry. On average, one person is killed in a fall from a truck every year - and about 150 drivers suffer a serious injury resulting from a fall".

(http://www.ferret.com.au/articles/25/0c02c925.asp)

From the National Occupational Health and Safety Council

Height of Fall. "Many of the [total of work-related falls in Australia] were from heights that would not usually be considered to be dangerous…Overall, 55% of falls were from four metres or less…"

Vehicles. " Thirteen workers died (all separate incidents) as a result of falls from motor vehicles (11 from trucks and two from utilities)…Most people fell short distances (three metres or less) and half suffered head injuries…The incidents comprised three general sets of circumstances: loading or unloading material whilst standing on the tray of a truck and falling, often after being hit by the material (six incidents); standing on the tray or platform and falling from the vehicle, often as it turned at slow speed (four incidents); and falling whilst attempting to get out, or down from, the vehicle (three incidents)."

(NOHSC, *Work-related fatalities involving falls in Australia, 1989 to 1992,* June 2000)

RISK ANALYSIS – FALL FROM HEIGHT ON A ROAD TANKER ACCESSED BY LADDER

COMPARISON OF TRAM, HORIZONTAL LIFELINE AND GUARDRAIL SYSTEMS AS RISK CONTROL MEASURES

Work Step	Potential Hazards & Effects	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				
		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 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

GET HOME SAFELY

TRAM TOTAL RESTRAINT ACCESS MODULE

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 → **Likelihood ↓**		1 No Injuries	2 First aid treatment	3 Medical treatment	4 Extensive injury	5 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

GET HOME SAFELY

TRAM TOTAL RESTRAINT ACCESS MODULE

Some examples of falls that TRAM would have prevented…

Fall through guardrail – driver seriously injured

A driver was seriously injured falling from a road tanker in South Australia in mid 2006.

The trailer was fitted with an air-actuated pop-up handrail system that the driver was using at the time.

Early reports indicate that the driver leaned against the wire “intermediate rail” which did not support his weight, then fell through the handrail system

Source: Initial reports SA Workcover May 2006.

Knocked from the tanker top – driver killed

In May 1998, a worker climbed atop a cement tanker and began to loosen a hatch to relieve pressure.

The hatch broke into pieces, blew off and struck the employee. He was killed when he was blown completely off the tanker. No fall protection was in use.

Reference: U.S. Department of Labor, OSHA Report ID: 0830500

Incapacitation – driver killed

In Victoria In early 2006, a driver died from a fall off the back of a grain trailer.

The suspected immediate cause is that he became incapacitated through a heart attack whilst working on the trailer top.

No fall protection was in use

Handrail collapsed – driver seriously injured

In NSW in early 2006, a driver was seriously injured when he fell whilst working on the top of a waste tanker.

The immediate cause of the accident was that the guardrail system collapsed when the driver leaned against it.

The driver’s employer is now installing TRAM on their trailers.

Some examples of accidents that TRAM has prevented…

Slip or trip on the tanker top – driver saved

In 2004, an owner operator from Victoria slipped whilst working on the rear hatch of his tanker.

He would have either fallen into the compartment or over the rear of the trailer, actions that handrails do not prevent, however he was using TRAM and it restrained him on the tanker top. The driver received only minor abrasions to his lower legs.

Fall on ladder – driver saved

(Kevin Schuurs Owner Driver KMS Fuel Transport)

“After 28 years of carrying bulk fuel and oil for S.E.Qld Fuels without an incident, I thought I was invincible. S.E.Qld Fuels had fitted the TRAM to my truck some months prior to me loading bulk oil late one evening at the Caltex Refinery. It was raining and as I was coming back off the top of the barrel. I slipped on the top step of the ladder and fell. Had my belt on and strapped to the TRAM, I didn’t even skin my leg. That’s what I like about the TRAM, “You just can’t fall, I will never fall!”

GET HOME SAFELY

TRAM TOTAL RESTRAINT ACCESS MODULE

Consideration (Details of horizontal lifeline systems not known)	**TRAM**	**Guardrails**
Safety & risk management		
Meets ANZI standards	Yes	Not if fitted with wire in place of an intermediate rail
Allows unfettered access to work areas	Yes	Yes
Passive system	No	No
Addresses the ladder-walkway transition	Yes	No
Complete fall prevention system	Yes	No
Have falls occurred with product in use?	No	Yes
Multiple person access	No	Yes
Training required	Yes	Yes
Requires a belt or harness	Yes	No
Logistics		
Weight per unit	17 kg	Air operated – 160 kg
	-	Manual double – 80 kg
	-	Manual single – 40 kg
Fitting (rail and cleats)	8 kg/m	-
Installation time (indicative)		
Petrol tankers	6 man hrs	-
Insulated tankers	18 man hrs	-
Dry bulk tankers	8-16 man hrs	-
Air operated	-	16 man hrs
Manual double	-	12 man hrs
Manual single	-	8 man hrs

Disclaimer

Standfast Corporation

May 2006