CEMENT CONCRETE
& AGGREGATES AUSTRALIA

Agitator Design - Good Practice Guide

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Cement Concrete & Aggregates Australia (CCAA) is the national peak body for the heavy construction materials industry which generates around $15 billion in annual revenues and employs approximately 30,000 Australians directly and a further 80,000 indirectly.

Collectively, the industry encompasses cement manufacturers, concrete suppliers and extractive operators, which extract materials such as stone, gravel, sand and limestone required to make both concrete and cement.

Concrete is the **world's most popular construction material**. Its strength, durability, flexibility, suitability, affordability and sustainability make it the logical choice for the $200 billion building and construction industry. Concrete is vital to build our schools, homes, workplaces, hospitals, roads, bridges and ports and underpins our entire economy.

This Good Practice Guide has been developed by CCAA as a means to stimulate discussions with truck manufacturers and concrete bowl designers in the hope of identifying solutions, which may influence agitator design and ultimately improve safety outcomes for drivers.

In Australia, approximately 6500 concrete agitators are required to transport concrete from the batch plant to construction site.

Despite technological advancements, the concrete supply chain remains labour intensive and agitator drivers are prone to an elevated risk of injury. This is demonstrated by a 2013-14 survey of CCAA members which highlighted over 500 preventable injuries were suffered by agitator drivers undergoing their daily tasks (Table 1). Overwhelmingly, there are 3 main areas of risk:

- Access / egress from the cabin of the agitator;
- The risk of a slip, trip or fall from the rear of the agitator; and
- Scraping, cleaning, manoeuvring or lifting of the agitator chute.

INJURY DATA

Injury data for agitator drivers was collected over a 12 month period in 2013-14. The purpose of collecting this data was to understand the primary hazardous tasks that occur when interacting with an agitator. An aggregation of this data is provided in table 1.

The results demonstrate the key hazards and tasks that can lead to injury and this has allowed CCAA to focus this Guide towards responding to these risks.

For example, slips, trips and falls were the cause of 47% of all reported injuries with access and egress from the cabin and access to the rear being identified as primary hazardous tasks.

While some other causal factors are able to be identified, these are not directly related to the agitator. For example, uneven ground and unsafe site setup make up the largest contribution to slips, trips and falls. These hazards are therefore not able to be addressed in this Guide but are in fact addressed through CCAA's Concrete Pump Delivery Industry Guideline, which focus on 'safe site delivery'.

Whilst it is acknowledged that every job contains some level of risk, each injury costs employers:

- **Time** – Accommodating Personal Leave whilst the employee recovers;
- **Productivity** – Caused by the time to retrain or cover the absence of the employee and accommodating any re-assignment or light duties;
- **Money** – The costs of the injury, the cost of re-assignment or retraining and increased workers compensation premiums.

In Australia, approximately 6500 concrete agitators are required to transport concrete from the batch plant to construction site.

Table 1: AGITATOR INJURIES
Nov 13 to Nov 14

NO.	INJURY CAUSE	TOTAL	
1.0	**Slips Trips & Falls**	**238**	**47%**
1.1	Unsafe/untidy site setup	61	26%
1.2	Uneven ground	59	25%
1.3	Fall from rear step/ladder	52	22%
1.4	Egress from front cabin	31	13%
1.5	Access from front cabin	17	7%
1.6	Slump stand	17	7%
1.7	Fuel tank step	1	0.4%
2.0	**Chutes**	**102**	**20%**
2.1	Lifting/manoeuvring chute	42	41%
2.2	Chute clearing/cleaning	34	33%
2.3	Jammed/cut hands/fingers	20	20%
2.4	Chute failure/set up	6	6%

NO.	INJURY CAUSE	TOTAL	
3.0	**Concrete Delivery**	**44**	**9%**
3.1	Contact with concrete/dust	22	50%
3.2	Blow back	11	25%
3.3	Diesel fumes	3	7%
3.4	Admixture	2	5%
3.5	Concreter argument/fight	2	5%
3.6	Clearing hopper	2	5%
3.7	Delivery hose/sock	2	5%
4.0	**Cleaning**	**44**	**9%**
4.1	Wash out bay	17	39%
4.2	Water hose	15	34%
4.3	De-dagging	6	14%
4.4	Contact cleaning chemical	6	14%

NO.	INJURY CAUSE	TOTAL	
5.0	**Driving**	**41**	**8%**
5.1	Vehicle Accident	16	39%
5.2	Driving ergonomics	11	27%
5.3	Vibration	10	24%
5.4	Rollover	4	10%
6.0	**Contact with Vehicle**	**38**	**7%**
6.1	Jammed/cut hand/fingers	10	26%
6.2	A-frame	10	26%
6.3	Pump	8	21%
6.4	Bumper	4	11%
6.5	Bonnet	4	11%
6.6	Wheel strut	2	5%
TOTAL		507	

A HIERARCHY OF HAZARD CONTROLS

In publishing this Guide, CCAA has been cognisant of the Hierarchy of Hazard Controls, which is used by **Safe Work Australia** for dealing with workplace hazards. The Hierarchy of Hazard Controls comprises of three levels of control:

1. **Level 1 Control Measures** – Eliminate the hazard
2. **Level 2 Control Measures** – Substitute or isolate the hazard or use an engineering control
3. **Level 3 Control Measures** – Reduce exposure through administrative controls or personal protective equipment

Using this approach the first priority should be to eliminate the hazard, if elimination is not reasonably practicable, the risk should be minimised by doing one or more of the following:

I. substituting (wholly or partly) the hazard with something that creates a lesser risk;

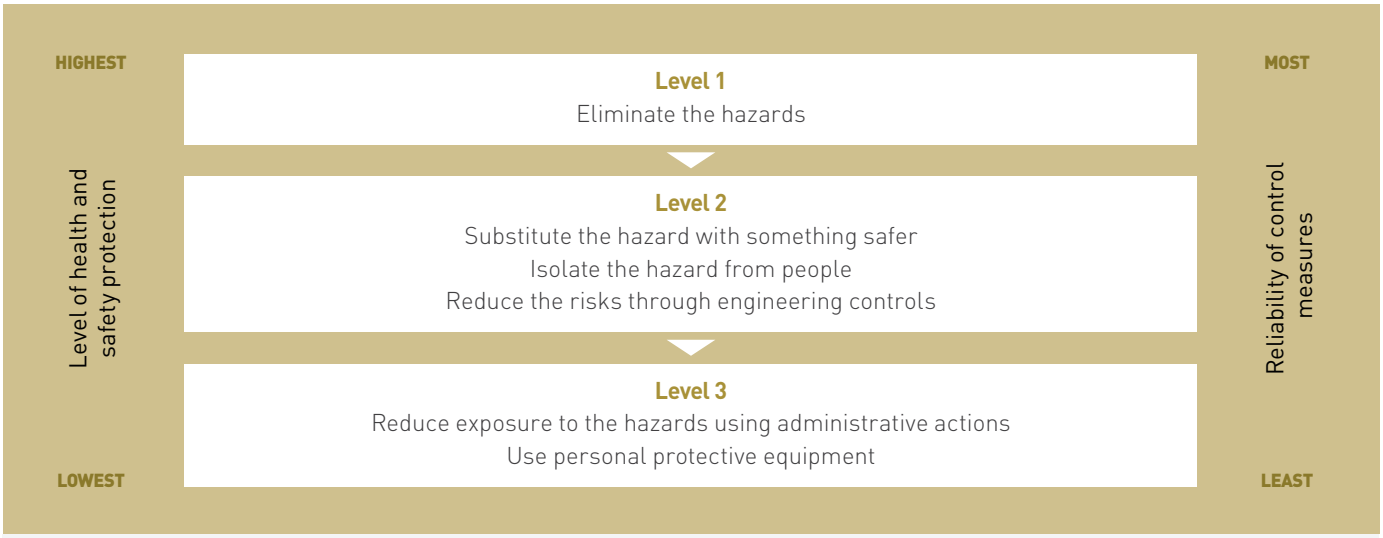
II. isolating the hazard from any person exposed to it; and/or

III. implementing engineering controls.

If the hazard cannot be minimised through these methods then an administrative control or use of personal protective equipment (PPE) may be warranted.

Administrative controls are work methods or procedures that are designed to minimise exposure to a hazard (e.g. the use of signs to warn people of a hazard).

With regard to agitators, innovations in engineering and design can provide effective solutions to eliminate, isolate or substitute hazards, resulting in a safer working environment for drivers.



Level 1 control measures

The most effective control measure involves eliminating the hazard and associated risk. The best way to do this is by not introducing the hazard in the first place. If the hazard cannot be eliminated, control the hazard by introducing Level 2 controls.

Level 2 control measures

If it is not reasonably practicable to eliminate the hazards and associated risks, you should minimise the risks by using one or more of the following approaches:

- Substitute the hazard with something safer
- Isolate the hazard from people
- Use engineering controls

An engineering control is a control measure that is physical in nature, including a mechanical device or process.

Level 3 control measures

If you cannot implement a Level 2 control measure, then you must implement Level 3 control measures. These control measures do not control the hazard at the source, instead they rely on human behaviour, training and supervision. Two approaches to reduce risk in this way are:

- Use administrative controls
- Use personal protective equipment (PPE)

Design and engineering solutions can minimise hazards.

SAFER AGITATORS – AREAS FOR IMPROVED DESIGN

Taking into account the aggregated injury data and the Hierarchy of Hazard Controls above, CCAA has developed this Guide for the purpose of identifying many of the hazards faced by agitator drivers and the risks associated with these hazards.

This Guide seeks to stimulate innovation in vehicle and concrete bowl design so that engineering solutions may be found to reduce the likelihood and occurrence of such injuries.

The following highlights areas where improved design and engineering could lead to safety improvements for agitator drivers.

Cabin Access and Egress

The injury data (Table 1) identifies access and egress from the cabin as being a hazardous task that accounts for approximately 20% of all slips, trips and falls sustained by agitator drivers.

In order to address this hazard, consideration should be given to the following:

- **The design of the cabin steps** – The number, height, width, depth and slip resistance of the material used to construct them.
- **Cabin grab handles** – The placement, length and colour of grab handles to enable 3 points of contact and high visibility.
- **Lighting** – The location, type and brightness of lighting in relation to the steps and ground below.
- **The wheel nuts** – The shape of wheel nuts to minimise the potential for cuts and abrasions.
- **Safe storage options**
  - The design and functionality of door pockets to accommodate the placement of delivery dockets, remote control units and/or other items so that drivers can access and egress the cab of the truck without holding items in their hands.
  - A safe and accessible place to store and enclose personal items, such as tools and phones, as these can become projectiles and injure drivers in the event of an accident.
- **The cabin door** – The method used to prevent the door from inadvertently closing.

Access to the Rear and Chute Design

Approximately 30% of injuries (reported on Table 1) are sustained through slips, trips and falls at or near the rear of the agitator and through interactions with the chute.

Access to the rear of the vehicle is required during the discharge of concrete. During the discharge of concrete, the driver is positioned at a height on the vehicle to undertake a number of manual tasks including slump check and controlled water addition as well as scraping, cleaning and changing the chute.

The ultimate aim is to reduce the number of injuries suffered by agitator drivers as they go out about their daily tasks.

Bearing in mind the Hierarchy of Hazard Controls, consideration should be given to how these tasks can be eliminated in their entirety, making the discharge of concrete an automated task that reduces the need for the driver to access the rear of the agitator. If this is not reasonably practicable, consideration should be given to the following:

- **Stable footing** – The method, size, location and slip resistance of construction material used to allow the driver to access the rear of the agitator to perform required tasks. Whatever the chosen method (i.e. ladder, steps and/or platform) it is important that the design allows the driver to manoeuvre safely and comfortably by providing stability and minimising over-reaching.
- Rear grab handles – The placement, length and colour of grab handles to enable 3 points of contact and high visibility.
- **The primary chute** – The construction material, finish height, angle and addition of a vibrator to the chute to eliminate or reduce the need to repetitively scrape the chute, which can present a risk for musculoskeletal injury.
- **The secondary chute** – The location, positioning and weight of the secondary chute to reduce the risks associated with manual handling, lifting and bending.
- **Nip, crush and shear points** – Options for guarding nip, crush and shear points such as the trunnion rollers and back fins on the agitator.

All CCAA Members understand the need to be as safe as possible in the workplace. It is the paramount consideration.

A-Frame Design

The agitator A-Frame has two main purposes; firstly, to support the fixed hopper which delivers the cement, aggregates and water into the agitator bowl at the concrete plant; and secondly, to funnel discharging concrete from the agitator bowl to the chute at the point of placement.

Keeping the A-Frame clean and free from build-up of excess concrete is essential to good maintenance of the concrete bowl. Cleaning the A-Frame can be hazardous because it requires the driver to work at a height and manually dislodge hardened concrete from the A-Frame.

In order to address this hazard, consideration should be given to the following:

- **The A-Frame** – The design, finish, shape and need for exposed nuts and bolts to reduce concrete build up, particularly in 'nooks and crannies' in and around the A-Frame.

Minimising Rollover Potential

Agitator rollover remains an ongoing concern that can lead to significant injury and in some cases fatality. The industry views this as a significant risk which must be managed. The dynamic concrete load coupled with a high centre of gravity makes agitators more susceptible to rollover than other heavy vehicles.

Whilst significant resources are regularly deployed to train agitator drivers, including the development of an industry-specific eLearning education course, the industry remains focused on reducing such incidents through effective vehicle design.

In order to address this hazard, consideration should be given to the following:

- **Centre of gravity** – lowering the centre of gravity by reviewing the height, shape and dimensions of the agitator bowl.
- **The mixing speed** – the appropriate speed and methods to lock the mixing speed of the concrete bowl while in transit.
- **Electronic Stability Control** – The availability and options for electronic software to support drivers to maintain control of the vehicle.

Further Guidance on design features

Table 2 on the following page has been developed by CCAA on behalf of its members to further support identification of safety features that could be considered and sought when ordering a new Agitator.

CCAA recommends that third party contractors and owner operators check with their customers for any additional requirements that may be needed/specified to meet specific safety requirements of the company and customer construction sites.

Table 2 should serve as general guidance material only. There will be a range of factors that will impact minimum design features and specifications, including for example:

- Local road or climactic conditions (For example in rural areas with poor road surfaces)
- Specific uses outside of the norm (For example in tight access areas)
- Safety requirements specified by major contractors for large scale projects, particularly where trucks must travel extensively on sites. (For example, traveling extensively in tunnels under construction)

It is also assumed that new trucks will be compliant with the safety requirements of the current day Australian Design Rules (ADRs). Further, design requirements change over time. As such, the guidance contained within Table 2 and the remainder of this Good Practice Guide is not to be read as exhaustive in nature.

TABLE 2: Design Features for consideration when ordering a new Agitator

ITEM	HARDWARE	DESIGN FEATURES
1.	**Seatbelt**	Lap/sash fitted with suitable anchor points on the seat frame. Lap/sash seat belt required for passenger seat. Seatbelt to retract past the driver shoulder when released (as per NHVR guidance).
2.	**Ensuring park brake is activated before operator leaves the cabin**	Switch fitted on the driver's door to activate the horn if the driver opens the door and the maxi-brakes are not activated OR alternatively an automatic park brake engagement system. This is a warning system only and is audible both inside and outside of the truck. Wired so that it is active whether ignition is on or off.
3.	**Adequate Vision around the vehicle**	External mirrors (both sides including spotter mirrors). Rear vision mirrors provide the operator with a means to see some of the area behind the equipment during reverse manoeuvring. Unipod mirror provides the operator with a means to see across the front of the truck. Reverse camera fitted with clear display unit
4.	**UHF Radio**	Fitted on truck to enable communication in batching plants and on delivery sites.
5.	**Reversing Alarms and Reversing Lights to warn others**	Reversing alarms and reversing lights provide a warning to pedestrians or other mobile equipment in the immediate area that the equipment is travelling in reverse and the operator's field of vision may be limited. In accordance with ISO9533. Alarm type varies depending on site conditions. For noise sensitive sites a low frequency broadband alarm is available.
6.	**Fire Extinguisher**	Dry Chemical extinguishers fitted (1A 10B with hose) in compliance with local conditions
7.	**Breakdown Triangles**	Breakdown triangles kept in the vehicle. Consider a minimum of 3.
8.	**Flashing Amber Light**	Flashing amber light to the top of the truck cabin clearly visible for both pedestrians and other mobile equipment that share the work area in which the equipment operates. Note: Some customers may have different requirements for lights.
9.	**Spare Tyre Restraint**	Where a spare tyre is fitted, the vehicle tyres should be secured by a secondary restraint system.
10.	**Wheel Nut Indicators**	Wheel nut indicators fitted to all wheel nuts.
11.	**Access Steps & Handholds**	Access to truck allowing three points of contact at all access points, including to cabin and rear steps/ladders. Three-point safety sticker fitted at all access points.
12.	**Transmission Interlock**	The transmission interlock (force to neutral) is a fail-safe system that forces the automatic transmission into neutral position if the driver neglects to disengage the transmission when the intention is to park. The system works by forcing the automatic transmission to neutral through the application of the maxi brake.
13.	**Environmental Flap**	Environmental flap for first chute as a load restraint.
14.	**Pressurized Water Tanks**	Pressure relief valve and pressure gauge (Rated at 300kPa) fitted to Water Tank.
15.	**Bowl Entrance Guard**	Ensure a close fit between the bowl entrance guard, the gob hopper and the bowl - mandatory fitting of guards where there is a ladder and platform.
16.	**Rear Directional Lights and Manually operated reverse spotlights.**	Rear directional lights mounted to drivers mirror to illuminate the area to the side/rear and manually operated reverse spotlights at the rear to illuminate behind the equipment to provide better vision in dark areas.
17.	**Rear step/s and platforms for Chute Cleaning**	Approved flip down grid mesh work platform/s fitted to both sides at rear of mixer. Minimum load rating 150 kgs. Where ladders and platforms are fitted - an approved self-closing gate with mid rail (to be retrofitted where possible to existing vehicles) – otherwise a back support return safety rail.
18.	**Agitator Grab Handles**	Fitted in a position and height that allows easy reach from ground level for the driver to step onto the flip down grid mesh work platform/s & maintain 3 points of contact at all times whilst on the work platform (fitted to both sides)
19.	**Suspension / Air Ride Seat**	Suspension/Air Ride seat fitted to all driver's seats: minimum seat rating is 120Kgs.
20.	**Safety Sticker Kit**	Original Equipment Manufacturer (OEM) sticker or aftermarket decals to include cyclist warnings.
21.	**Side Protection**	Protection bars ensure pedestrians and cyclist cannot travel between any axles separated by more than 1m.
22.	**First Aid Kits**	First Aid kit, fit for purpose based on company assessment.
23.	**Mixer Remote Control**	Remote that prevents the bowl from revving if transmission is in drive or reverse and enables the operator to stand in a safe location that allows visibility for safe discharge of the load.
24.	**PTO Jack Shaft Guard**	If Applicable so operator does not get caught in the moving part.
25.	**Light Weight Chute scraper with storage point**	Straight handled scrapers only, no hooks. Secure storage location for chute scaper.
26.	**Trunnion Roller Guards**	Mesh or Solid guards to prevent access by fingers/hands to nip point on trunnion roller.
27.	**LED door lights**	LED light strip fitted to underside of driver's door.
28.	**Daytime Running Lights**	Mandatory for all new trucks. Also Mandatory for company owned trucks.
29.	**Emergency Stop**	Rear external mixer emergency stop button fitted and operational on both sides.
30.	**Chute vibrator**	Vibrator added to main swivel chute to help the concrete to move easier down the chute.

CONCLUSION

All CCAA Members understand the need to be as safe as possible in the workplace. It is the paramount consideration.

CCAA Members dedicate time and resources to educate, train and revise compliant policies and procedures to keep their employees and contractors safe.

This Good Practice Guide has been produced because design and engineering solutions offer significant potential in seeking to eliminate, substitute and isolate hazards associated with agitators.

CCAA and its members continue to invest in training, education, sharing information and other control measures to manage risks to agitator drivers.

CCAA hopes that this Guide is a conversation starter and promotes discussion, research and development by vehicle designers, agitator bowl manufacturers and concrete suppliers in the hope of improving agitator vehicle design.

The ultimate aim is to eliminate the number of injuries suffered by agitator drivers as they go out about their daily tasks and to ensure all staff are as safe as possible in their interactions with these vehicles.

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