RED BOOK

GUIDANCE ON SAFETY SPECIFICATIONS FOR THE PURCHASE OR LEASING OF NEW FIXED MACHINERY, MOBILE EQUIPMENT AND ROAD TRANSPORT VEHICLE

April 2023

Contents

1. INTRODUCTION

This internal guidance is intended to assist Procurement, Production and Safety personnel within CRH Europe in compiling detailed Safety specifications and standards for inclusion in the overall purchase specification and installation / commissioning process for new Fixed Machinery, Mobile Equipment and Road Transport Vehicles. Safety specifications covered in this guidance document are split into 3 categories:

Deviations from the “Minimum Requirements” to be documented and approved by OpCo Management. “Recommended Options” and “Innovations to Consider” are included to assist companies that wish to go beyond the minimum requirements to achieve a higher level of safety.

Some of the required safety technologies / devices might be added to the newly purchased equipment during the installation / commissioning phase before it is put into use – these new elements could be provided by other supplier(s). For example: if a newly purchased mixer truck is not fitted with 360° camera system or lightweight chutes, OpCo can buy these elements from other suppliers and put them in place during the commissioning phase.

Please note that visuals used in this document are examples only, aiming to support better understanding – Suppliers may offer other solutions that provide similar safety benefits. CRH Safety SharePoint access is required to view the videos referenced in this document.

This document will be reviewed regularly. If you have any suggestions, please feel free to contact the Central Safety Team.

2. GENERAL REQUIREMENTS

1.1. SUPPLIER CODE OF CONDUCT

We request that all suppliers we engage, sign up to our Supplier Code of Conduct.

Suppliers must comply with all relevant laws relating to human rights, health, safety and the environment and anti-bribery and corruption (including the UK Bribery Act, US Foreign Corrupt Practices Act, OECD Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and high-Risk Areas and section 1502 of the Dodd-Frank Act, if applicable). Suppliers must also adhere to good ethical practices as set out in the CRH Code of Business Conduct (page 11) and specifically undertake:

1. To support and respect the protection of human rights within their areas of influence.
2. To respect freedom of association and the effective recognition of the right to collective bargaining by employees.
3. To prohibit all forms of forced, compulsory and child labour.
4. To support the principles of equal opportunity in respect of the recruitment and selection of employees.
5. To comply, as a minimum, with all applicable health & safety legislation and continually improve stewardship towards best industry practice.
6. To comply, as a minimum, with all applicable environmental legislation and support a proactive approach to environmental challenges.
7. To comply with all relevant anti-bribery and anti-corruption legislation in respect of their dealings with CRH.
8. To comply with the OECD guidance as well as Section 1502 of the Dodd-Frank Act which aims to prevent the use of minerals that directly or indirectly finance or benefit armed groups in the Democratic Republic of the Congo (DRC) or in adjoining countries (“conflict minerals”).

The respective procurement teams across the CRH are increasingly embedding the Supplier Code of conduct into their technology, systems and processes.
To understand more and to request support please contact your local Procurement team.

1.2. SAFETY CONSIDERATIONS

ELECTRICAL SAFETY

- The electrical equipment of machines, including the control systems and emergency stop circuits must conform to IEC 60204-1 (fault protection for power supply to the safety related parts of the control system).
- Limit switches, used as part of safeguarding systems and emergency stop switches must be of the positive discrimination type, (those of the fast break type are acceptable if they include a positive disconnection element, in particular the failure of the return springs should cause the contacts to drop out.

Picture 1: Examples of Visual Cut-off Switch (VCS)

- All electrical sockets / switches and light fittings should be suitable for a wet and dusty environment, as a minimum level of protection the electrical apparatus should have an IP rating of IP65. All switches should be lockable.
- Electrical Distribution Panels – all circuit breakers and busbars must be fully enclosed by a Perspex or other suitable cover. An internal lighting system should be in place in the panel which activates when the panel door is open. All cables should come in through the bottom of the panel.
- The Panel design should be such that if a person is required to remove this perspex cover, they can fully isolate the panel from the Supply Transformer
- Signs (in English and relevant local language) stating the following: *Caution! Where these covers have to be removed – the panels must be fully isolated through the supply transformer.*
- All electrical energy isolation devices (isolators) must:
  - be designed such that the individual responsible for switching off and locking off the energy source is protected from contact with energized electrical components, arc flash hazards and other energy hazards of the machinery / equipment
  - include arc flash resistant switchgear
  - be capable of being securely locked out both individually and capable of accepting multiple locks when a multi-hasp is required
- All electrical isolation switches should be such that it is only possible to lock the isolator in the off position – All Isolators must be clearly labelled to identify the item of equipment that they isolate.
- Where applicable, electrical energy isolation devices (isolators) should be equipped with visible break (cut-off) switches to ensure visibility of separation of contacts – See examples on Picture 1

HYDRAULIC SAFETY

- In Safety critical lifting operations, forklift trucks, excavators, scissors lifts etc – protection against the effects of failure of pressure in the supply pipeline(s) should be provided by hydraulic locking valves attached to the operating cylinder(s) which lock the pressure in the cylinder when the control pressure falls at a greater than predetermined rate.
- Single Ram down stroking presses should have a hydraulic locking valve fitted to the lower inlet to the cylinder body to prevent inadvertent down stroking in the event of oil supply loss or failure. The control circuits should be arranged so that failure of the pilot pressure causes the machine to go to a safe condition.
- Hydraulic Safety circuits should be an inherent part of the normal machine control circuits using standard 2 or 3 spool valves with appropriate porting. Actuation of the valves can be manual, solenoid, pilot oil or air operated.
- Hydraulic Pipe installations should be of rigid steel with adequate supports. Where flexible pipes are used, they should be capable of withstanding the maximum operating pressure, not be linked or stretched and be restrained by rigid supports at each end. Couplings and joins in the pipes should be suitable for the system pressure and should be capable of withstanding any vibrations, both mechanical and hydraulic, likely to be met in service. Pipework should be labelled to indicate it's function in the circuit.
- Welded hydraulic pipes are not allowed to use

PNEUMATIC SAFETY

- Pneumatic Safety circuits should be compatible with the normal machine controls and, as far as possible, use standard two or three spool valves with appropriate porting. Actuation of safety control valves can be by guards, solenoids or pilot air.
- All components in a pneumatic system should be rated for the working pressure of the system - each should carry a label stating:
  - Manufacturer's name and address
  - Manufacturer's product identification
  - Rated operating pressure
  - For hose assemblies, the date of manufacture
  - Exhaust outlets from motors, cylinders, etc. should be fitted with suitable silencers.
  - Pneumatic valves construction can be either twin spool giving 2-way directional control of air flow, or triple spool with a central neutral position. For safety circuits, they should be of robust construction and of a size to suit the application.

1.3. TRAINING

- Full Health & Safety Training must be provided by the supplier to operators and maintenance staff during commissioning of the Plant.
- 3 months after commissioning, follow up training shall be provided by the supplier to operators and maintenance staff – this is to allow for risks which become apparent, such as access, after plant commissioning.
- Operation and Maintenance Manuals must be prepared by the supplier in accordance with ISO 12100-1;5.5.

Example of Training Required for a Mobile Crusher:

1. The transport of the unit around the site i.e. the use of the travelling gear.
2. The risks involved in changing from automatic mode to “repair” mode as this overrides the Isolation system.
3. The correct earthing procedure for the machine and the hazards of static electricity.
4. The assembly of the lateral discharge conveyor belt - correct procedure and risks involved - this should also include the folding up of the operator platform and feeding hopper.
5. Gap width(s) adjustment of the crusher e.g. of the lower impact toggle.
6. The workings of the “main switch“ – to highlight in particular the cutting off of power from the generator and the “special excluded circuits “- this should also include any over current protective devices.
7. Precautions to be taken when working on hydraulic systems in terms of the supporting of conveyor belts and hoppers.
8. Procedure for securing the rotor for specified work.
9. Electricity - Supply and Risk Involved - to include earthing procedure for electric arc welding.

1.4. INSTALLATION

- The Erection of the Plant will come under the relevant country's Construction Safety Regulations. The following CRH requirements will also apply.
- In addition to the normal contractor prequalification process in each company, a **method statement and risk assessment document**, **detailing the precautions required during the installation phase, must be prepared by the Main Contractor** – this will be required in advance of the Project Commencing, as we are required to notify the Safety authorities of the commencement of the Project.
- All personnel involved in the work must be competent.
- Safety Documentation relating to the use of Cranes must be submitted in advance to Safety Department, this will include:
  - The inspection certificate for the Crane e.g. 12 or 14 months certificate
  - The thorough examination certificate for the Crane e.g. every 4 years
  - The inspection certificates for all slings etc.
  - Evidence of driving / certification for the driver
  - Please note that all crane operations on site will require the presence of a trained banksman.
- Where the project involves work at height, a Mobile Elevating Work Platform (e.g. Cherry Picker) should be available (based on Project Risk Assessments).
- Any scaffolding to be used on site must involve the following:
  - It must be erected by a competent person (who holds a FAS CSCS or equivalent card).
  - Arrangements must be put in place to ensure the daily inspection of scaffolding.
- All work at height, outside the method statement must be notified in advance to the relevant Company Safety person. Safety Nets or Air Bags (for Fall Prevention) must be used where appropriate.
- All trench / excavation work must be notified to the Safety Officer before any work commences.
- No Lone working is permitted irrespective of the activity.
- The CRH Construction Project Safety Protocol must be referred to.

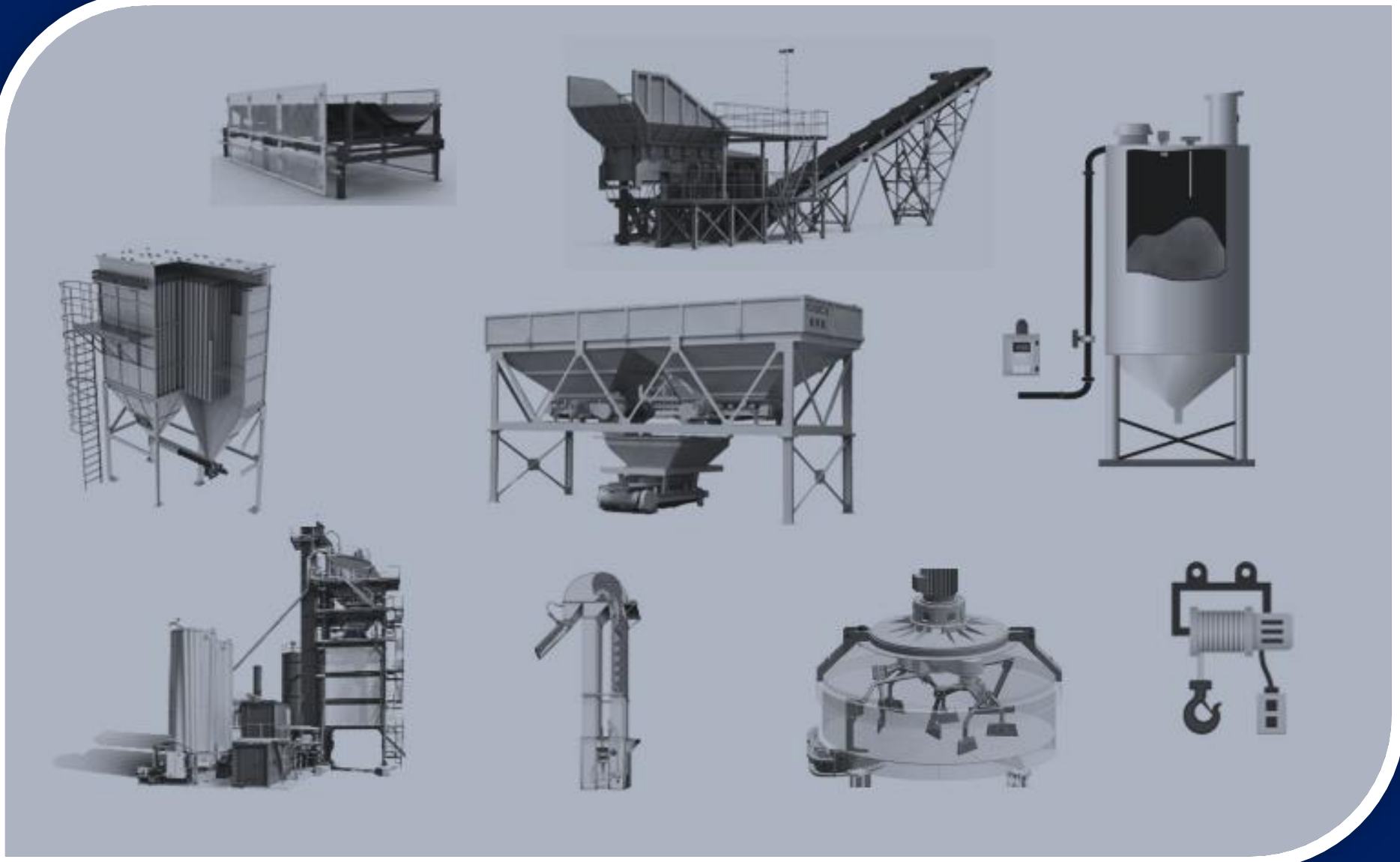
Document 1: CRH Construction Project Safety Protocol

1.5. ADDITION TO TRANSPORT CONTRACTS

A transport contractor for CRH shall on signing the contract agree to the following requirements:

- Must pass an initial safety prequalification process in accordance with Life Saving Rule No.1. This prequalification will cover areas such as driver selection and training, vehicle safety systems etc. (as outlined in LSR 1 in the LSR Booklet).
- Must comply with CRH driver and vehicle safety requirements and the key aspects covered in the "CRH Transport Safety Checks" which cover verification of the following:
  - That the driver of the contract vehicle has conducted a daily prestart check of the vehicle before the commencement of his shift.
  - That the driver has the required personal protective equipment in the vehicle.
  - That the reverse warning system is in working order.
  - That a pedestrian mirror is fitted to the front windscreen of the vehicle.
  - That a handbrake warning alarm is in place where if the driver door is opened an alarm will sound if the handbrake is not engaged
  - To have side under run protection guards with combined pedestrian / cyclist warning sign
- All vehicles purchased by the Transport Contractor after the date of this contract must comply with the safety specifications outlined in relevant heavy goods vehicle section the CRH Red Book (guidance on procurement).
- If the Transport contractor fails to pass any element of the CRH Transport Safety Check – they shall be liable for a financial penalty. The system of financial penalty will be decided by the relevant opco. Example: Failure of a CRH Transport Safety Check: €100 (and dismissal from site if non-compliance is deemed by local management to be serious).
- Additional fines, as defined by the opco may also be put in place.
- The Transport Contractor will be required to be attend and participate in ongoing Driver health initiatives.

3. FIXED MACHINERY



3.1. CONVEYOR BELTS / DRIVE SYSTEMS

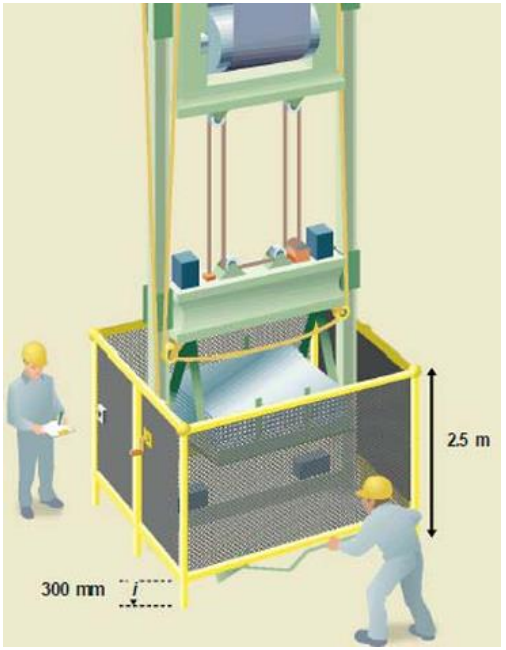
	MINIMUM REQUIREMENTS	
3.1.1.	**FIXED HIGH-VISIBILITY MACHINE GUARDING** All machine guards should have high-visibility colours such as red, yellow, orange etc. and be secured such that they require an engineering tool to remove them i.e. the use of quick release clips, such as toggle clips or tail gate catches is not permitted, neither are hang on guards.	Picture 2 Picture 10
3.1.2.	**GUARDING ON SNUB ROLLERS, HEAD AND TAIL DRUMS** Guards on snub rollers, head and tail drums must prevent access to in-running nip points – the guard must extend for a minimum distance of 1 metre from the nip point – dimensions and general construction should be in accordance with EN 620:2021 and BS EN 618:2002+A1:2010.	Picture 2
3.1.3.	**GUARDING ON RETURN ROLLERS** All accessible snub and return rollers must be guarded by mesh bolted to the underside of the conveyor (Ref: BS EN ISO 13857:2019 Safety of machinery. Safety distances to prevent hazard zones being reached by upper and lower limbs). Plate type guards can also be fitted along the full length of the roller in front of the in – running nip point.	Picture 10
3.1.4.	**SKIRTING GUARDS OR LOAD POINT GUARDS** In situations where fixed skirts are fitted above conveyor idlers, a trap point exists between the idler and the belt. Panels of guards should be fitted to prevent access to the trap points associated with the skirts of the conveyor.	Picture 6
3.1.5.	**GUARDING ON GRAVITY TAKE UP UNITS** Conveyor gravity take up units should be enclosed with mesh panels to a height of 2.5 metres which prevent access to moving parts within the tower including the risk of the gravity take up weight.	Picture 3
3.1.6.	**GUARDING ON V BELTS** The V belt should be enclosed with a cover fitted over the exposed end of the shaft or bearings – a sheet metal guard is required to cover flexible coupling and input to the gear box.	Picture 7
3.1.7.	**GUARDING ON BELT FEEDERS** The drive should be fully enclosed using either mesh or sheet metal as the guard material – a mesh guard should be fitted along the full length of the belt feeder.	Picture 5

	MINIMUM REQUIREMENTS	
3.1.8.	**SCREW CONVEYORS** • Where screw conveyors are provided with inspection covers, all covers should be secured with fastenings that require a tool for their removal. • Exposed rotating shafts on the ends of screw conveyors should be fitted with adequate secure covers. • Bolted on covers over the full length of the screw must be used at all times and access points must also have bolted on covers. • Any discharge points must either be long enough to prevent reaching the screw or have bars or similar, welded across them.	Picture 4
3.1.9.	**EMERGENCY STOP PULL CORD** All accessible sections of conveyors must have an emergency pull cord covering the full length of the belt (for longer belts a number of cords may be used over the length of the belt) up to a height of 2.8 metres above the ground. An emergency stop for each belt must be positioned at the end (access point from the plant floor) of the catwalk. All emergency pull cords must comply with BS EN 620:2021. A trip cord should activate a stop with a force less than 125 N and a movement (of the cord) of less than 300 mm. The Emergency Stop must have a manual push button reset i.e. resetting through Computer Software is not acceptable, all emergency stops and pull cords should be part of the "Safety Circuit" and should on operation ensure that the power is switched out rather than be wired through the electronic control system on the machine.	Picture 9
3.1.10.	**SAFE ACCESS FOR CLEANING** There must be sufficient distance between the tail drum and floor to allow the safe insertion and removal of a spillage tray or possibility to insert a vacuum cleaner hose.	Picture 2
3.1.11.	**INTEGRATED STARTUP WARNING ALARM** A 3-second-long unambiguous auditory warning shall be given 10 seconds before the start and a visual warning signal, such as flashing lamp, shall be provided.	Video 2
3.1.12.	**LOCAL ISOLATOR** Each motor must be have an accessible Isolator fitted, which where appropriate must be linked to compressor or hydraulic motors (Ref : BS EN ISO 14118:2018 – Safety of machinery. Prevention of unexpected start-up). The Isolator should be within a reasonable distance e.g. 5 metres of the applicable motor.	Picture 8
3.1.13.	**REMOTE GREASING / LUBRICATION SYSTEMS** Remote Greasing/lubrication systems must be installed for rotors and all drums. Greasing point needs to have extension outside the guard to allow operators easy access without removing guards.	Picture 12

	MINIMUM REQUIREMENTS	
3.1.14.	**BELT ADJUSTERS OUTSIDE MACHINE GUARD** Adjusters to be placed in a way that eliminates the need for removing the machine guard when adjusting belts.	Picture 11
3.1.15.	**LIFELONG BEARINGS** Lifelong bearings should be used to reduce maintenance and access relates safety issues on equipment.	
3.1.16.	**SAFE HEAD DRUM WORKING PLATFORM** Around the head drum, there should be an appropriate working platform with at least 3 sides including guard, mid rails and toe boards.	Picture 13
3.1.17.	**SAFE CATWALKS** The minimum width of a catwalk should be 850 mm. Some conveyors may require catwalks on both sides.	Picture 13
3.1.18.	**FALLING OBJECT PROTECTION** Conveyors passing over traffic and pedestrian routes must be fully enclosed to protect from falling objects.	Picture 14
3.1.19.	**FIRE RESISTANT RUBBER BELT FOR HEATED MATERIALS**	
3.1.20.	**CONVEYOR ROTATIONAL / MISALIGNMENT SWITCH FOR HEATED MATERIALS** To prevent the risk of fire where a misaligned conveyor belt creates friction with a conveyor drum – leading to a risk of fire – rotational switches must be fitted to belts conveying heated material. The purpose of the rotational switch is to indicate a mis-aligned / mistensioned belt, which could contribute to a fire.	Video 1

	RECOMMENDED OPTIONS	
3.1.21.	**LIGHTWEIGHT MODULAR MACHINERY GUARDING** Durable plastic mesh panel guard that is corrosion-free, lightweight, requires no painting, is speedily installed and removed. Use of lightweight modular guarding is recommended for conveyor and other associated systems where regular maintenance is necessary to reduce the risks associate with manual handling.	Video 4
3.1.22.	**BACKSTOP CAM CLUTCH** Device that prevents reverse movement of incline conveyors, bucket elevators or pump systems.	Video 3
3.1.23.	**SPILLAGE CONTROL DEVICE AT TRANSFER POINTS** Device that helps to prevents spillage at transfer points – minimizing the need for cleaning around the transport systems.	Video 5

Picture 2: Example of machinery guarding on belt conveyors



Picture 3: Example if gravity take up unit guarding

Picture 6: Example of skirting guard

Picture 5: Example of Belt feeder guarding

Picture 4: Example of screw conveyor guarding

Picture 7: Examples of V belt guarding

Picture 8: Examples of isolators located close to the machine

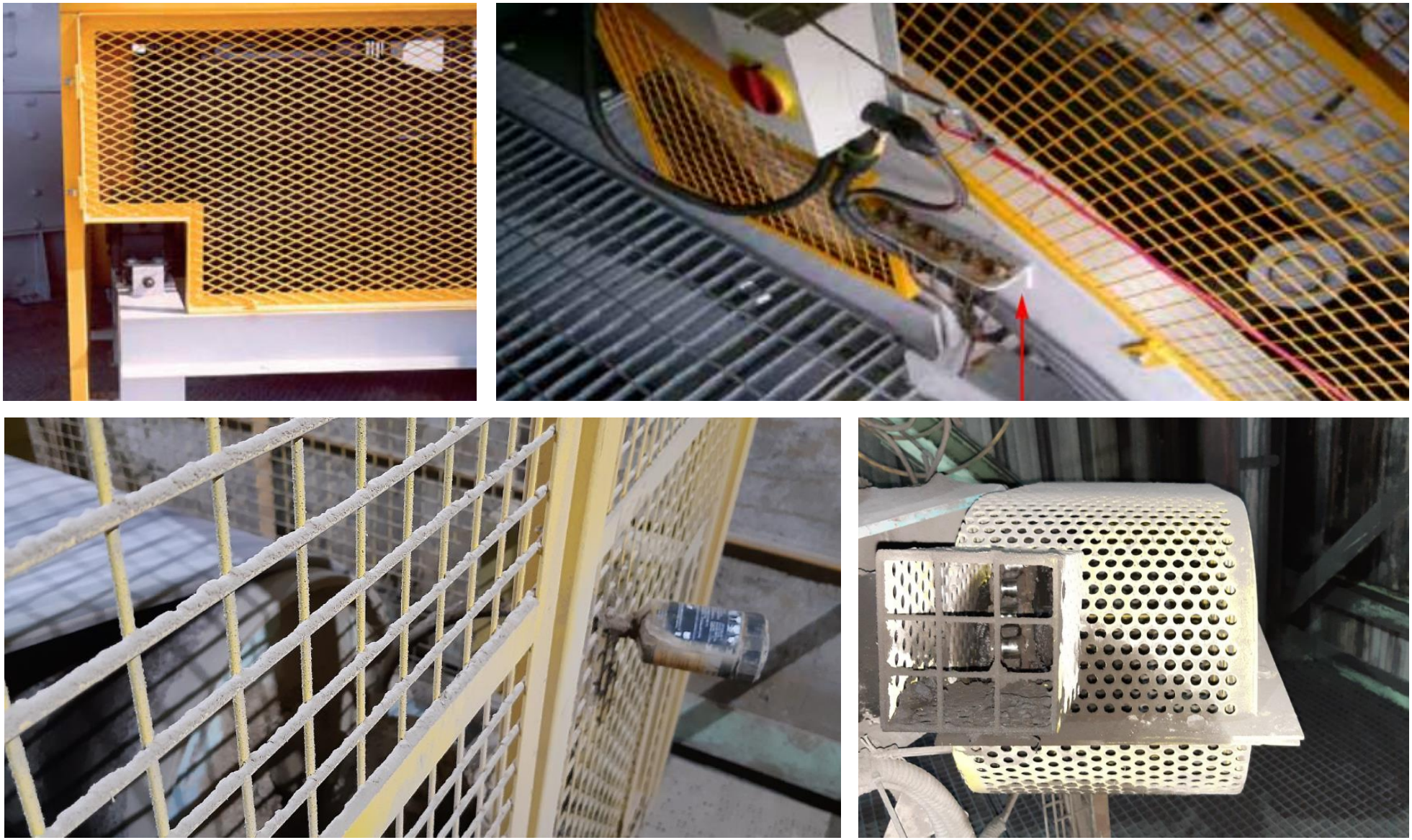
Video 1: [Example of conveyor misalignment switch (Schmersal)]

Picture 9: Examples of emergency pull cord

Picture 10: Examples of return roller guarding

Video 2: Example of startup warning alarm

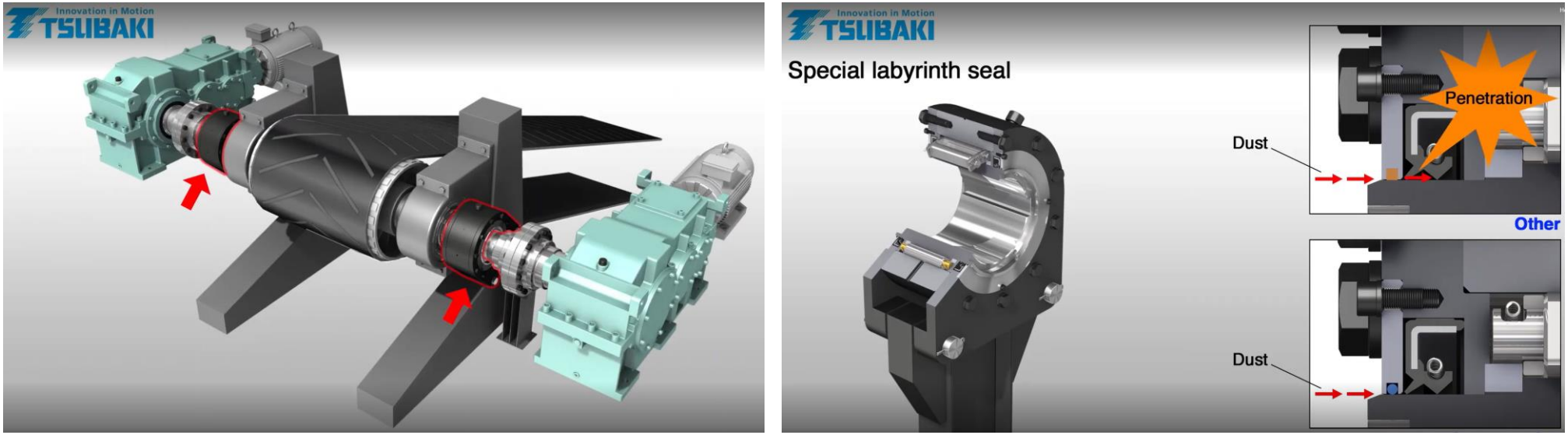
Picture 11: Examples of belt adjusters outside machine guard



Picture 12: Example of remote greasing

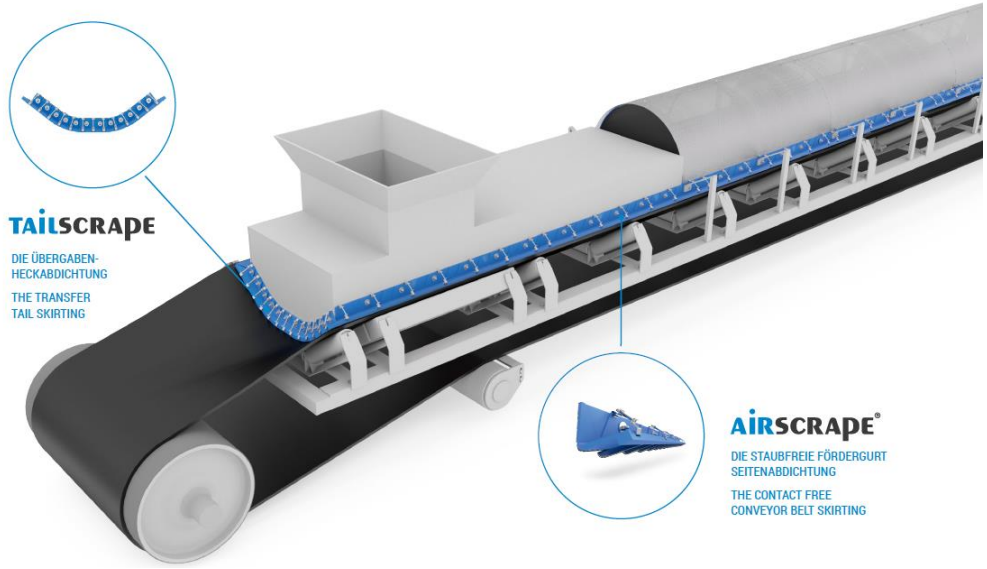
Picture 13: Examples of catwalks along the belt and safe working platforms for head drum maintenance

Picture 14: Example of falling object protection over pedestrian way



Video 3: [Example of Backstop Clam Clutch (Tsubaki)]

Video 4: [Example of Lightweight Machinery Guarding (Diacon)]



Video 5: [Example of spillage control device at transfer points - Airscrape / Tailscrape (Scraptec)]

MACHINE GUARDING STANDARDS	
BS EN ISO 12100:2010	Safety of machinery. General principles for design. Risk assessment and risk reduction
BS EN ISO 13857:2019	Safety of machinery. Safety distances to prevent hazard zones being reached by upper and lower limbs
BS EN ISO 13854:2019	Safety of machinery. Minimum gaps to avoid crushing of parts of the human body
BS EN ISO 13850:2016	Safety of machinery. Emergency stop function. Principles for design (ISO 13850:2015)
BS EN ISO 7250-1:2017	Basic human body measurements for technological design. Part 1: Body measurement definitions and landmarks (ISO 7250-1:2017).
UNE EN 547-2:1997+A1:2009	Safety of machinery - Human body measurements - Part 2: Principles for determining the dimensions required for access openings
BS EN ISO 13851:2019	Safety of machinery. Two-hand control devices. Principles for design and selection
BS EN 619:2022	Continuous handling equipment and systems. Safety requirements for equipment for mechanical handling of unit loads
BS EN 620:2021	Continuous handling equipment and systems. Safety requirements for fixed belt conveyors for bulk materials
BS EN 618:2002+A1:2010	Continuous handling equipment and systems. Safety and EMC requirements for equipment for mechanical handling of bulk materials except fixed belt conveyors
UNE EN ISO 13857:2020	Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs (ISO 13857:2019)
UNE EN 842:1997+A1:2008	Safety of machinery - Visual danger signals - General requirements, design and testing
UNE EN ISO 14120:2016	Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards (ISO 14120:2015)
UNE EN ISO 13849-1:2016	Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design (ISO 13849-1:2015)
UNE EN 981:1997+A1:2008	Safety of machinery - System of auditory and visual danger and information signals

UNE EN ISO 4413:2011	Hydraulic fluid power - General rules and safety requirements for systems and their components (ISO 4413:2010)
UNE EN ISO 4414:2011	Pneumatic fluid power - General rules and safety requirements for systems and their components (ISO 4414:2010)
UNE EN 1032:2004+A1:2009	Mechanical vibration - Testing of mobile machinery in order to determine the vibration emission value
BS EN ISO 14118:2018	Safety of machinery. Prevention of unexpected start-up
UNE EN ISO 12100:2012	Safety of machinery - General principles for design - Risk assessment and risk reduction (ISO 12100:2010)
UNE EN ISO 14119:2014	Safety of machinery - Interlocking devices associated with guards - Principles for design and selection (ISO 14119:2013)
UNE EN 1299:1997+A1:2009	Mechanical vibration and shock - Vibration isolation of machines - Information for the application of source isolation
UNE EN ISO 14122-1:2017	Safety of machinery - Permanent means of access to machinery - Part 1: Choice of fixed means and general requirements of access (ISO 14122-1:2016)
UNE EN ISO 14122-2:2017	Safety of machinery - Permanent means of access to machinery - Part 2: Working platforms and walkways (ISO 14122-2:2016)
UNE EN ISO 14122-3:2017	Safety of machinery - Permanent means of access to machinery - Part 3: Stairs, stepladders and guard-rails (ISO 14122-3:2016)
UNE EN ISO 14122-4:2017	Safety of machinery - Permanent means of access to machinery - Part 4: Fixed ladders (ISO 14122-4:2016)
UNE EN ISO 3450:2012	Earth-moving machinery - Wheeled or high-speed rubber-tracked machines - Performance requirements and test procedures for brake systems (ISO 3450:2011)
UNE EN ISO 6683:2008	Earth-moving machinery - Seat belts and seat belt anchorages - Performance requirements and tests (ISO 6683:2005)
UNE EN 60204-1:2019	Safety of machinery - Electrical equipment of machines - Part 1: General requirements

Table 1: Machine guarding standards

3.2. CRUSHING AND SCREENING PLANTS

	MINIMUM REQUIREMENTS	
3.2.1.	**GUARDING ON DRIVES** Guards must fully enclose the transmission and drive wheels.	
3.2.2.	**GUARDING ON SPRINGS** All drawback springs etc. should be shrouded if there is any possibility of trapping a finger or an article of clothing.	
3.2.3.	**GUARDING ON FEEDERS AND DISCHARGES** If the machine is fed direct from a chute, the side edges of the chute should be protected by stanchions and hand rails or chains. The crusher discharge should be protected by a discharge chute and arranged to take a dust discharge point if necessary.	
3.2.4.	**GUARDING ON MOBILE CRUSHERS** On mobile crushing plants, all drives to the various parts of the plant should be guarded by fixed guards.	
3.2.5.	**GUARDING ON GYRATORY CRUSHERS** V Belt drive system should be guarded as per section 1	
3.2.6.	**GUARDING ON IMPACT CRUSHER DRIVES** Drive system to be guarded as per section 1. The breaker bars should be held in place by steel straps. These steel straps or clamping straps should cover at least 3 breaker bars.	
3.2.7.	**GUARDING ON SCREENS** Balance weights should be completely enclosed by a guard of sheet metal construction (when run down vibration creates a problem a sheet rubber insert may be required to protect the sheet metal guard).	
3.2.8.	**JAW CRUSHER HYDRAULIC ADJUSTMENT** In addition to the standard guarding requirements on all drives and nip points, the Jaw crusher adjustment to be hydraulically operated.	
3.2.9.	**INTERLOCKED DOORS** All new design access/inspections doors should be designed with electrical interlock access	

	MINIMUM REQUIREMENTS	
3.2.10.	**SAFE LUBRICATION** Provision should be made for lubrication of bearings from outside the guards, where bearings are obscured by the guard, lubricators should be placed in a prominent position and connected to the bearing by a pipeline.	
3.2.11.	**LIFTING ATTACHMENTS** The provision of lifting attachments should be considered where mechanical means of lifting may be required.	
3.2.12.	**SAFE ACCESS** • No rungs, step treads must be flat, anti-slip with a minimum depth of 75 mm. • If more than 2 steps, access by an incline system preferably via a stairway but as a minimum with an angle of inclination from the horizontal no greater than 75˚ • First step on access system to be rigid	
3.2.13.	**SAFE PLATFORMS FOR ROUTINE MAINTENANCE** Platforms for routine maintenance (including tasks such as cleaning windows or mirrors preferably carried out from ground level) at a height of between 1 and 2 metres above the ground or a safe working platform, shall have an anchorage point (or handhold or handrails capable of being used as an anchorage point) provided on the inside, so that a fall restraint device may be attached, with safe access to be provided for maintenance.	
3.2.14.	**PROTECTION FOR ELECTRIC OR HYDRAULIC CABLES AND FUEL LINES** Cables and fuel lines to be run and attached so as to avoid chaffing and other damage that may lead to a fire. Where these are attached to a cable tray this shall be attached in a vertical orientation rather than horizontal to avoid a build up of abrasive dust and overheating.	
3.2.15.	**INTEGRATED STARTUP WARNING ALARM** A start warning system, giving audio and visual (flashing beacon) warning.	

	RECOMMENDED OPTIONS	
3.2.16.	**ROCK BREAKER** Remote-controlled machine that provides safe means of clearing blockages – no need to enter the crusher.	Video 6



Video 6: [Examples of remote-controlled rock breakers for fixed and mobile crushers]

3.3. COMPRESSORS / AIR RECEIVERS / VACUUM PUMPS / DRYERS

	MINIMUM REQUIREMENTS	
3.3.1.	**COMPRESSORS** Compressors should comply with EN 1012-1 and be provided with: • Adequate guards over belt and shaft drives. • Suitable safety (pressure relief) valves at intercoolers, coolers and reservoirs • Pressure gauges at compressor outlet, on each cooler, intercooler, reservoir and on pressurized lubrication systems. • Temperature gauge at compressor outlet. • On water cooled compressors, a water temperature trip at water outlet. • Lubricating oil level indicator. • Air inlet filter with indication of pressure drop across it. • A well-ventilated site having a clean cool air supply free from flammable or corrosive contamination. • A clearly marked isolation switch.	

3.3.2.	**AIR RECEIVERS**
	Air Receivers should:
	• Be clearly marked with their safe operating pressures.
	• Be of a size to match the compressor output and accommodate fluctuations in air demand.
	• Carry a label giving:
	  ○ the manufacturers name
	  ○ a serial number
	  ○ date of manufacture
	  ○ the standard to which the vessel was designed and built
	  ○ the maximum design pressure (or vacuum) and the design temperature
	• Be provided with:
	  ○ an inlet and outlet port
	  ○ a pressure gauge and a pressure relief valve
	  ○ clearly marked isolation device
	  ○ a drain
	• Have a manhole to permit internal inspections.
	• Have a written schedule for inspections and examinations if the product of pressure and volume is greater than 250 bar litres.	

	MINIMUM REQUIREMENTS	
3.3.3.	**VACUUM PUMPS** Vacuum Pumps should comply with EN 1012-2. The belts and shafts driving the pumps should be guarded and a vacuum gauge fitted at the inlet to the pumps. They should be provided with an oil level indicator and a clearly marked isolation device. For larger installations and those serving a number of machines, the pumps should be located in their own separate sound proofed room.	
3.3.4.	**DRYERS** • The guarding of the drive system for the cylinder should have Interlocked guards in place to prevent access under the dryer area - The maximum distance between the ground and guard should not exceed 225 mm and the minimum height of such guards above ground level should be 2 metres. • Each motor must be have an accessible Isolator fitted, which where appropriate must be linked to compressor or hydraulic motors (Ref : EN ISO 14118:2018 - Prevention of unexpected start up of Machinery). • Local individual isolators must be provided for the burner, diesel fuel pumps, gas pumps, compressors and all exhaust fans.	

3.4. HOPPERS

	MINIMUM REQUIREMENTS	
3.4.1.	**MAN GRID** Where material is tipped directly into hoppers a metal grid (Man Grid) strong enough to withstand the impact and flow of materials should be constructed. The spacing of the bars should be such that a person will not fall into the hopper. Should it be necessary to enter a hopper a removable section must be provided.	Picture 15
3.4.2.	**SAFE ACCESS FOR CLEANING / MAINTENANCE** Provision by way of a walkway with handrails is required to allow access in the event of a blockage or maintenance.	

Picture 15: Examples of hoppers fitted with man grid

3.5. BAG FILTER UNITS

	MINIMUM REQUIREMENTS	
3.5.1.	**SAFE ACCESS FOR CLEANING / MAINTENANCE / MONITORING / BAG REPLACEMENT** • Access stairs are preferred (where reasonably practical) • Access ladders rising more than 3.5 metres should be fitted with hoops commencing at 2.5 m from ground level. The hoops should be spaced at 1.2 m intervals and the internal clearance of the hoops should be in the region of 0.8 m. For high rise ladder access of 10 m or greater there must be a rest platform every 6 metres on the access ladder. • Safe access to the stack for environmental monitoring must be provided. • Safe access for the changing of filter bags must also be provided	Picture 16
3.5.2.	**FIRE DETECTION SYSTEM** A fire detection system must be installed on the units where there is a risk of fire – this should include a visual warning system to all Control rooms.	
3.5.3.	**ISOLATOR** Each motor must have an accessible Isolator fitted, which where appropriate must be linked to compressor or hydraulic motors (Ref : BS EN ISO 14118:2018 – Prevention of unexpected startup of Machinery).	

Picture 16: Examples of bag filter units with safe access and working platforms

3.6. BUCKET ELEVATORS

	MINIMUM REQUIREMENTS	
3.6.1.	**INTERLOCKED GATE** The area where the bucket returns for loading (& unloading), if accessible, must be guarded with an interlocked (to the elevator motor) gate.	
3.6.2.	**ACCESS RESTRICTION** The operating area of the elevator must be guarded off where a person could come into contact with the moving bucket.	
3.6.3.	**ISOLATOR** Each motor must have an accessible Isolator fitted, which where appropriate must be linked to compressor or hydraulic motors (Ref: BS EN ISO 14118:2018 – Prevention of unexpected startup of Machinery).	
3.6.4.	**GUARDING AT SKIP LOADING AREA** Where the skip returns to the loading position, a mesh panel guard fence should surround the mechanism and be securely fixed to the structure. An access gate will be required which should be secured by means of a suitable electrically interlocked system.	
3.6.5.	**GUARDING ON HOT STORAGE SKIP WINCH (AT GROUND LEVEL)** Mesh panel guard fence should surround the mechanism and be securely fixed to the structure. An access gate will be required which should be secured by means of a suitable electrically interlocked system.	
3.6.6.	**DUAL ROPE SYSTEM** New elevators should be fitted with a dual rope system.	
3.6.7.	**MECHANICAL / GRAVITATIONAL ISOLATION** To prevent turning under it's own weight or if the brake (anti run back) fails there is the possibility that the drive can creep backwards or the bucket elevator can turn, even if electrically isolated.	Video 7
3.6.8.	**CLEANING PORT AT THE ELEVATOR BOOT** A port should be made available at the boot of the elevator to allow for cleaning (jetvac) of the boot before opening the main door (guard) so as to prevent a flow of material escaping out which could cause injury.	Picture 17

Picture 17: Example of cleaning port at the boot of the bucket elevator

Video 7: Example of mechanical isolation for bucket elevator

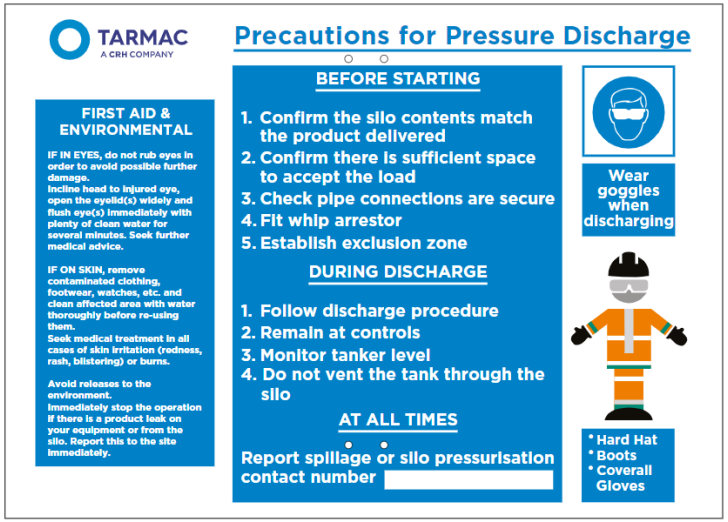
3.7. SILOS

	MINIMUM REQUIREMENTS	
3.7.1.	**SAFE ACCES TO SILO AND GUARDED WORKING PLATFORM FOR INSPECTIONS / MAINTENANCE** • Design and construction of the silo must be sufficient to enable safe access to workers to carry out inspections and maintenance on the silo roof: cat ladder; rest platforms; guardrails and mid rails on top of silo; toe boards. • It should be possible to lock the access point to each cat ladder. • Silo top must be guarded to prevent fall from height. Height of guardrail: 120 cm; Mid rails: at 50 cm; Toe boards: 15 cm	Picture 18 Picture 20
3.7.2.	**WARNING SIGN FOR DRIVERS** A notice indicating the following information to be clearly visible on each silo: • The nominal capacity of each compartment • The maximum delivery pressure • The PPE required (including full sealed safety goggles) • Safety devices required for securing the hose (whipcheck safety cable, safety clamp) • Warning for drivers that it is forbidden to blow residual air in the tanker at the end of a delivery through the silo	Picture 19
3.7.3.	**SILO FILTER** Air vent Filter to exhaust air blown in during a delivery while keeping the material inside the silo. This must: • Be correctly sized, recommended: 1700-2000 m^3/h • self-clean during operation, recommended Reverse Jet Filter • Bolted to the silo and either encased or chained	Picture 21 Video 8
3.7.4.	**PRESSURE RELIEF VALVE (PRV)** Pressure Relief Valve to open in an emergency when the pressure within the silo reaches critical over-pressure limits. This must: • Be correctly sized, recommended venting capacity up to 13,000 m^3/h • Be correctly calibrated, recommended: 50 millibars (0.73 psi)	Picture 22 Video 9
3.7.5.	**PRESSURE SENSOR** Pressure sensor to detect pressure increases within the silo and trigger an alarm before the Pressure Relief Valve is activated. This must: • Be correctly calibrated, recommended: 40 millibars (0.58 psi)	Picture 23

	MINIMUM REQUIREMENTS	
3.7.6.	**LEVEL PROBE** High level probe to detect when the material reaches a maximum safe level to prevent over filling. This must: • Be typically set to 1 to 1.5 m from the top of the silo • Immediately activate an audible and visual alarm to the driver showing the need to shut down • Be linked to an automatic shut off valve which is activated after 30 secs • Be positioned at approx. 2/3rds of the silo's radius	Picture 24
3.7.7.	**FAILSAFE AUTOMATIC SHUT OFF VALVE** Automatic shut off valve (pinch or butterfly) to control the delivery process and remove the risk of human error by closing when an alarm condition activates. This must: • fail in a closed position to protect the silo in the event of any system failure • the bypassing of pinch valves can occur, so they need to be enclosed if they are accessible.	Picture 26 Picture 25
3.7.8.	**HIGH LEVEL WARNING ALARM** High Level Warning Alarm to be clearly visible and audible for trucks drivers.	Picture 27
3.7.9.	**LOCKABLE FILL POINT**	
3.7.10.	**MAINTENANCE PLAN** The manufacturer must provide a maintenance plan for all silo safety equipment.	

	RECOMMENDED OPTIONS	
3.7.11.	**GROUND LEVEL TESTING (GLT)** Ground level testing panel to check all of the safety equipment is functioning (including pressure sensor, level sensor, pressure relief valve, air supply to the filter's self-cleaning mechanism, and the position of the inlet valve). The functional test is done prior to making a delivery from ground level.	Video 10

Picture 18: Examples of access ladder: rising more than 3.5 m should be fitted with hoops commencing at 2.5 m from ground level. The hoops should be spaced at 1.2 m intervals and the internal clearance of the hoops should be in the region of 0.8 m. For high rise ladder access, there must be a rest platform every 6 m on the access ladder.



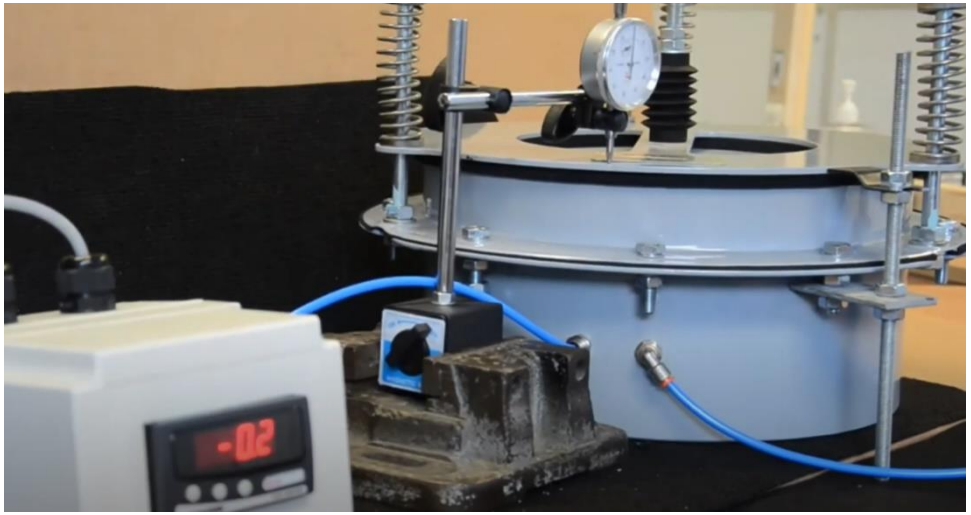
Picture 19: Examples of notifications at cement silos

Picture 20: Example of ladder restriction - padlock key is required to access the ladder

Picture 21: Examples of reverse-jet filters

Video 8: Operation of silo venting filter including reverse-jet cleaning

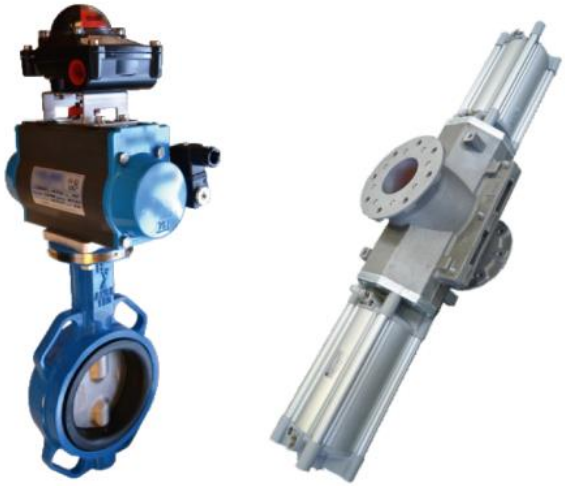
Picture 22: Examples of Pressure Relief Valves (PRV)



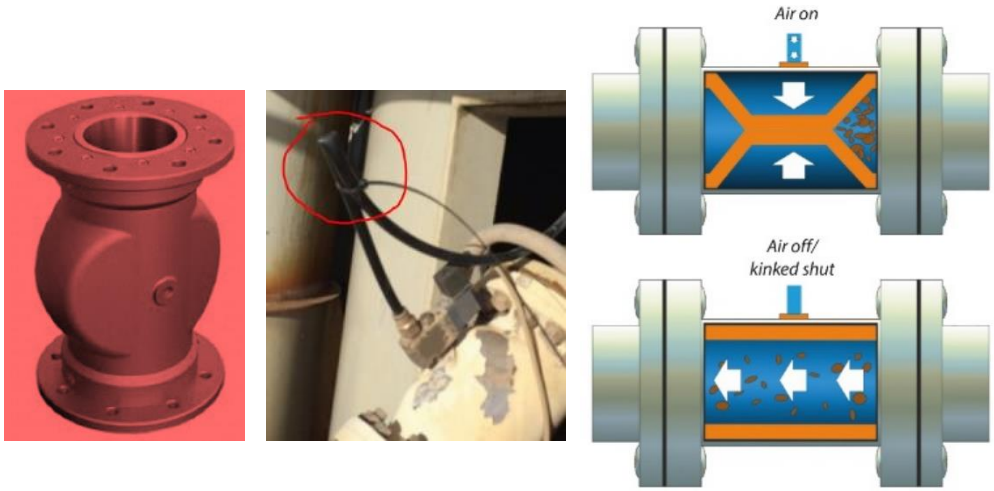
Video 9: Why Pressure Relief Valve Opening Set Points Matter

Picture 24: Examples of level sensors (Paddle switch, Capacitance Switch, Vibrating Switch)

Picture 23: Examples of Pressure Sensors (Pressure Transmitter, Pressure Switches)



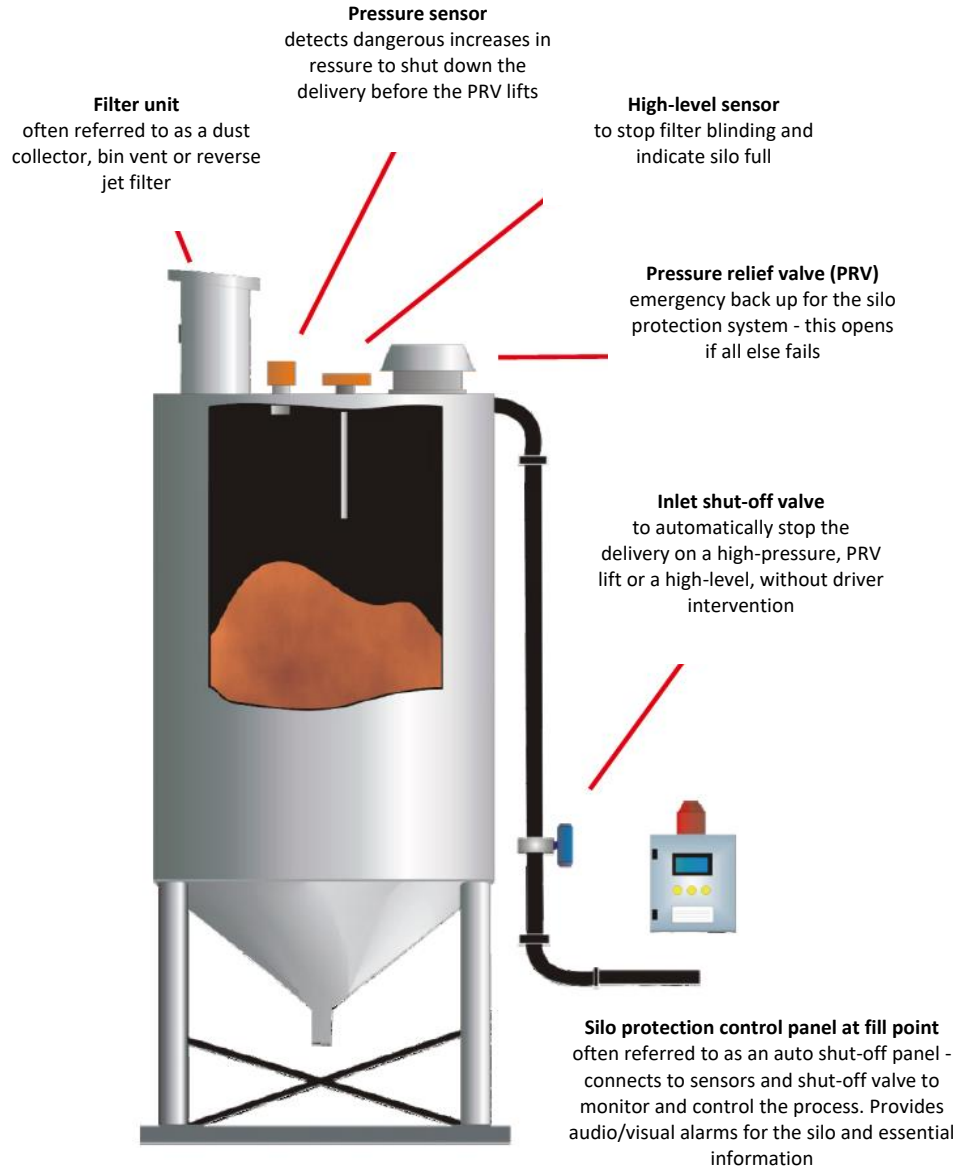
Picture 26: Example of Normally-closed failsafe butterfly- and pinch valves



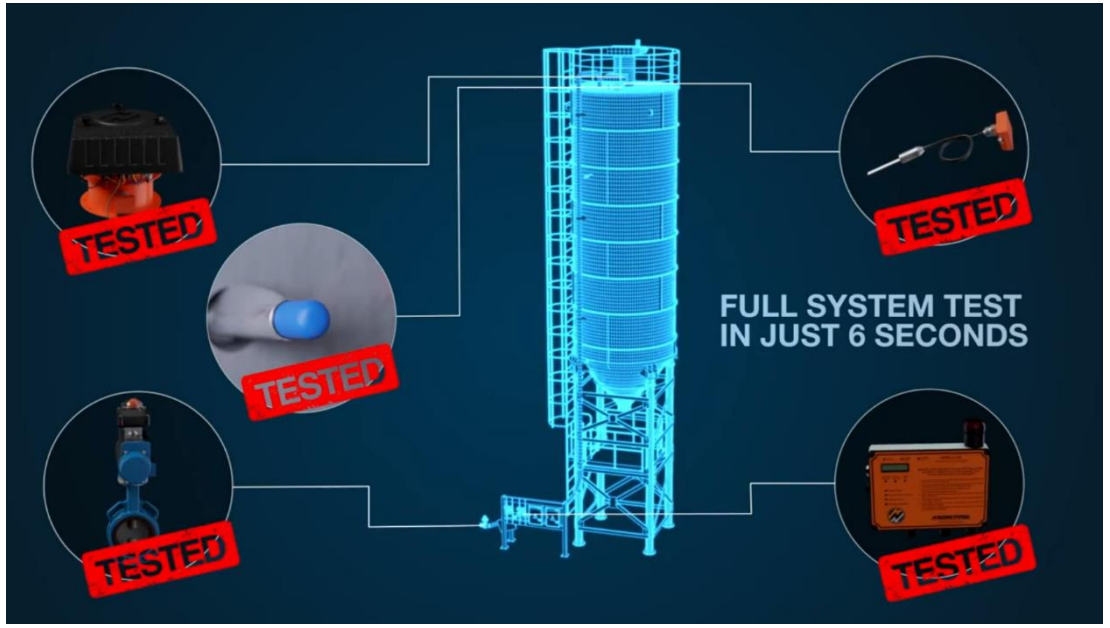
Picture 25: Normally-open pinch valves are not recommended as they are NOT failsafe and are easily bypassed or overridden

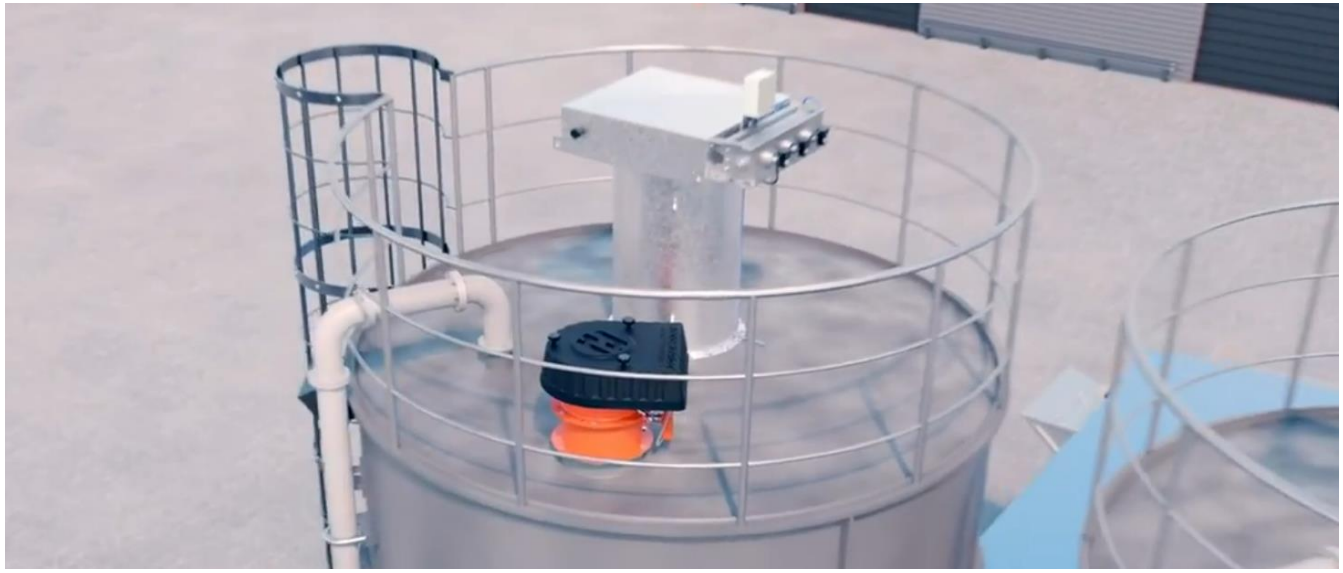
Picture 27: Examples of control panels

Document 2: MPA Guidance document on silo safety



Picture 28: Silo Safety System – Essential components





Video 10: [Example of silo protection system with Ground Level Testing – SHIELD Lite (Hycontrol)]

3.8. MIXERS

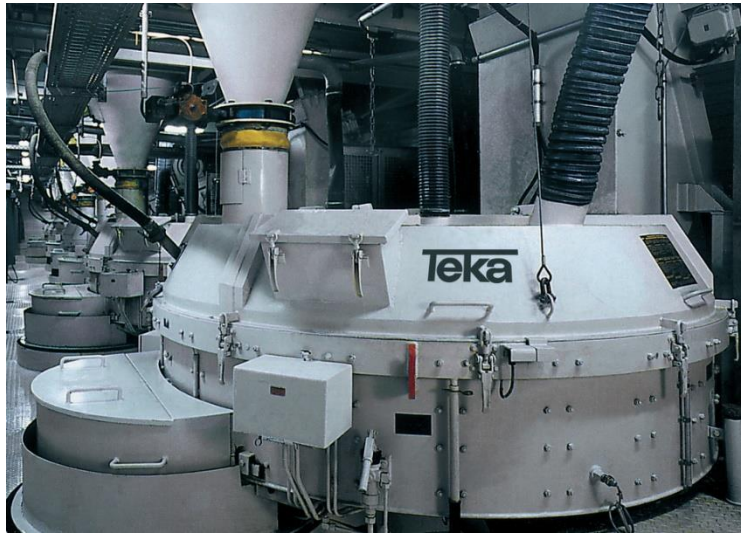
	MINIMUM REQUIREMENTS	
3.8.1.	**CE MARK**	
3.8.2.	**ELECTRICAL ISOLATION** Captive (or trapped) key system is required for the electrical isolation of the motor. The system should be such that the Key from the main control panel is not released until the electrical power is disconnected. A Captive (or trapped) key system could be considered for all energies (mechanical, hydraulic, pneumatic).	Picture 30
3.8.3.	**PNEUMATIC ISOLATION** Where the discharge door is operated pneumatically a valve should be fitted in the air supply and interlocked to ensure that the air is isolated, and the actuating cylinder exhausted / vented to atmosphere before access can be gained into the mixer.	
3.8.4.	**HYDRAULIC ISOLATION** Where hydraulically operated, the isolator to the motor of the hydraulic pump must also be included in the interlocking system. A single electric isolating switch may be provided for both mixer and pump drive motors.	
3.8.5.	**AUTOMATIC MIXER CLEANING SYSTEM** An automatic cleaning system removes the need for personnel to enter the mixer.	Video 11
3.8.6.	**GUARDING ON INSPECTION HATCHES AND DISCHARGE POINTS** Inspection hatches on the mixer cover should be provided with secondary grids to prevent contact with the moving paddles when the mixer is in operation. The discharge points should also be guarded to prevent against contact with moving parts of the mixer.	Picture 32
3.8.7.	**MIXER DOORS** • Mixer doors, with the risk of fall, should be provided with a mechanical securing system, which doesn't allow accidental closing. • Heavy mixer doors should be provided with a mechanism that supports opening and closing (e.g. manual or electric pulley, hydraulic system).	Picture 31 Picture 29
3.8.8.	**SAFE ACCESS AND PLATFORM FOR MAINTENANCE** Safe access and platform to be provided for maintenance / cleaning activities at lubrication points, mixer drums, discharge chutes, scales (calibration), discharge door bearing, mixer shaft bearing and sealing.	

	RECOMMENDED OPTIONS	
3.8.9.	**SAMPLING DEVICE** Built-in device that allows safe concrete sampling from the mixer.	Picture 35
3.8.10.	**CALIBRATION DEVICE** System that minimizes the need for manual handling while using standard weights for calibration	Picture 33
3.8.11.	**FIBRE DOSING SYSTEM** Built-in device that allows safe dosing of additives such as steel- or plastic fibres minimizing the need for manual handling and working at height.	Picture 34
3.8.12.	**LIFTING DEVICE FOR MAINTENANCE** Lifting device to minimize manual handling during maintenance activities.	

Picture 30: Examples of captive key system

Picture 29: Example of hydraulic mixer door opening / closing supporting mechanism

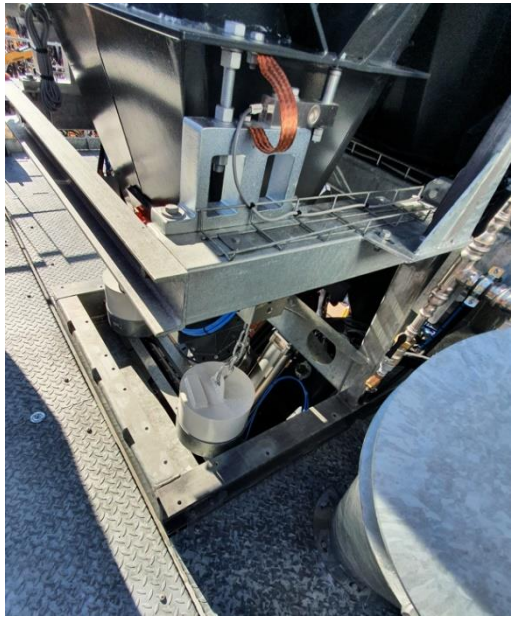
Picture 32: Example of mixer discharge point and inspection hatch guarding



Picture 31: Examples of mixer door securing

Video 11: [Examples of Automatic Mixer Cleaning Systems]

Picture 35: Example of built-in concrete sampling device (Liebherr)



Picture 33: Example of calibration device

Picture 34: Example of Fiber Dosing System (Liebherr)

3.9. SERVICE HOISTS

	MINIMUM REQUIREMENTS	
3.9.1.	**CE MARK**	
3.9.2.	**LABELLING** The Safe Working Load (SWL) or Normal Working Load (NLW) should be clearly marked on the hoist.	
3.9.3.	**RESTRICTING ACCESS TO OPERATING AREA** (as part of commissioning) • The operating area of the hoist must be guarded off where a person could come into contact with the moving Hoist • Interlocked gates should be in place at both ends (and any intermediate floors) of the hoist operation, to prevent persons entering the area where the hoist operates. These interlocks must be linked with the hoist motor and cause the hoist to stop where an access is gate is opened when the hoist is still in transit.	

	RECOMMENDED OPTIONS	
3.9.4.	**CRANE PENDANT LOCKOUT BAG / BOX** Wireless remote controls without operating key could be locked using crane pendant lockout bag / box to prevent unauthorized use.	Picture 36

Picture 36: Examples of crane pendant lockout bag / box

3.10. TRUCK LOADING MECHANISMS

	MINIMUM REQUIREMENTS	
3.11.1.	**SAFE ACCESS** Safe access must be provided for access to the top of the loaded tanks – stairs or pneumatic drop-down walkway(s) would be suitable.	Picture 37
3.11.2.	**START UP WARNING ALARM** A start up warning alarm to be installed where there is a risk of injury caused by the movement of the system.	
3.11.3.	**FALL PREVENTION** The truck loading mechanism is to be designed to prevent the driver falling through or underneath the safety barriers. For example there should be no gap greater than 20 cm between the base of the safety barrier and the top of the tanker. Adjustable railing or safety netting can be also considered.	Picture 38
3.11.4.	**EMERGENCY STOP** Emergency stop devices to be installed	
3.11.5.	**EMERGENCY EYE WASH** Emergency eye wash station to be located close to the truck loading area	Picture 40

	RECOMMENDED OPTIONS	
3.11.6.	**DRIVER WARNING SYSTEMS** • A warning mechanism to the driver (e.g. traffic light) that they have not fully raised the platform so not allowed to leave the loading point • Barrier system that does not allow the truck to leave the loading point until the loading head / platform is fully raised	Picture 41
3.11.7.	**CCTV TO ASSIST DRIVERS** CCTV with a fixed crosshair that is visible to drivers via a display screen to ensure they achieve correct alignment first time	Picture 39

Picture 37: Examples of truck loading mechanisms with safe access

Picture 38: Examples of railing to provide fall protection while opening / closing tanker hatches

Picture 39: CCTV with a fixed crosshair that is visible to drivers via a display screen

Picture 40: Example of emergency eye wash station

Picture 41: Example of barrier system at the loading point

3.11. BINDER / BITUMEN / FUEL STORAGE

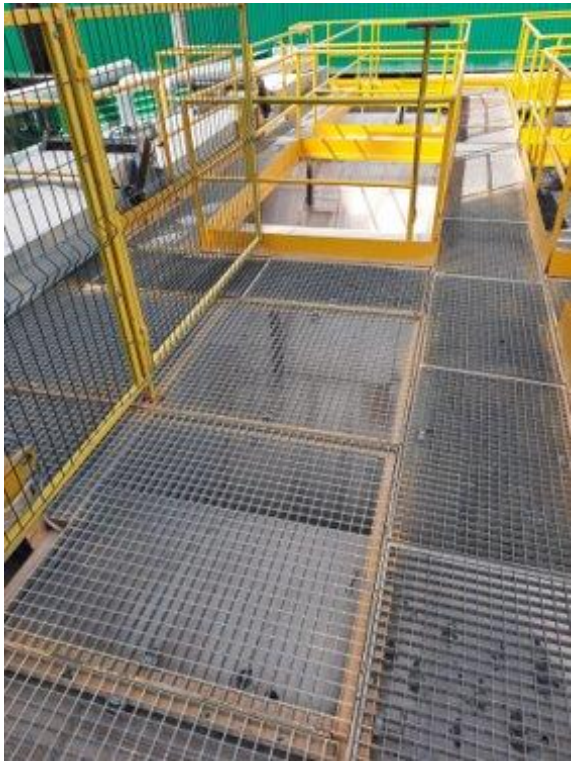
	MINIMUM REQUIREMENTS	
3.11.1.	**TANK LOCATION** Binder storage tanks should be located in the open area. (note: before renovation, tanks should be ventilated due to hydrogen sulphide and the content of hydrogen sulphide in the air should be checked with a meter)	
3.11.2.	**OVERFLOWS / HIGH LEVEL WARNING DEVICE** Overflows and/or a high-level warning device should be fitted to all tanks. The overflows should operate into an area which does not present a danger to personnel.	
3.11.3.	**FIRE PREVENTION** To prevent ignition of possible leakages, external extensions of stirrer shaft drives and external discharge points should wherever possible be located at the opposite end to the firing system (this applies to systems where the flame enters the pipeline).	
3.11.4.	**LOW LEVEL CUT OFF SWITCH** A low level cut off switch should be fitted to ensure that when binder level falls within the tank to the prescribed 150 mm above the heater tubes, all power to the heating of the tank is cut off, then automatically restored when the contents rise again.	
3.11.5.	**ELECTRIC WIRING** Electric wiring should be kept clear of vapours to prevent the fumes from rotting the insulation (e.g. use of armour cables).	
3.11.6.	**EXTERNAL FLUES** External flues should be insulated and protected so as to preclude persons from receiving contact burns.	
3.11.7.	**FIRE PROTECION** Fusible links should be attached to dead weight shut - off valves on fuel lines to each individual burners so that the fuel oil is automatically shut off in case of fire at the burner. When tanks containing bituminous materials are heated by gas burners or other fuel producing open flames, the flame should be of the jet or pressure burner type and be enclosed by a hood or baffles.	
3.11.8.	**SAFETY SHOWER** Safety Shower to be provided in close proximity allowing fast reaction in case of a potential incident.	Picture 44

	MINIMUM REQUIREMENTS	
3.11.9.	**PPE REQUIREMENTS** PPE requirements to be posted for the drivers and the employees entering the installation (helmet with a visor and neck protection; gloves resistant to high temperature, long sleeves, overalls, work shoes)	Picture 49
3.11.10.	**BINDER CIRCULATION SYSTEMS** Binder circulation systems should be designed to afford maximum security against blockage. All pipework should by design be self draining and a minimum fall of 1:12 is recommended. Minimise the number of sharp bends particularly 90° bends. Make sure pipelines are fully insulated as a minimum. Employ trace heating as required. Check the vent pipe diameter is sufficient to effectively expel / intake air at the required rate to avoid over / under pressure in the storage tank.	
3.11.11.	**FUEL STORAGE** • Manholes should be fitted with a grid beneath the main lid, to be raised only when access to the tank is required. • Exterior access to the manhole should be by fixed ladder to a non-slip walkway provided with guardrails and toeboards. This also applies to interconnecting walkways on multiple tank installations. • All tanks and filling points should be bunded.	Picture 42 Picture 43
3.11.12.	**DISCHARGING BINDER** Transfer pump on plant to pump from tanker. No requirement to pressurizes tanker – when unloading bitumen, it is recommended to use a suction pump, and not to use the pressure from the barrel (unloading with blow-out) It reduces risk in the event of a hose break.	
3.11.13.	**BLOCK & BLEED VALVES** Valves can be manual or actuated, If actuated need isolation in SOP Best Practice is for manual gate valve as the first valve from the tank. Use of sampling point seen as best way to achieve 'Try out' stage of LOTOTO process to gain physical check that isolation is effective. Ideally one per tank but can have one on ring main.	Picture 46
3.11.14.	**HIGH LEVEL ALARMS WITH STOP OF THE LOADING PROCESS** 2 alarm levels are mandatory: High Level Alarm (HLA) and High High Level Alarm (HHLA). HLA can be electronically linked with the contents gauge - the weakness is that if the gauge fails, so does the HLA. • HHLA must be independent of both the gauge and the HLA. • If either the HLA or HHLA is triggered the driver and plant operatives must be aware – via a klaxon, beacon and computer alarm.	Picture 47

	MINIMUM REQUIREMENTS	

3.11.15.	**LPG STORAGE**
	The user of the LPG (i.e., the person operating the site) does have responsibilities in relation to the tank including:
	• Siting of the tank
	  ○ There should be a minimum distance (called the separation distance) between the tank and any building, boundary line or fixed source of ignition. This should have been checked when the tank was first installed, and the supplier will know what the distance should be if you are unsure.
	  ○ There should not be any drains or gullies near to the tank unless a water trap is provided to prevent gas entering the drains. This is because LPG is heavier than air and if a leak were to develop from the tank or its controls or pipework or when it is being filled then the vapour could accumulate in an untrapped drain or gully. Ignition of these vapours could then lead to fire/explosion.
	  ○ The tank should also not be painted in any colour other than originally supplied as this may increase the amount of heat it absorbs from the sun.
	  ○ Ventilation and conditions around the tank
	  ○ In case of leaks there should be plenty of room around the tanks to ensure good air flow so that pockets of heavier-than-air LPG vapours cannot build up around them.
	• Tanker access
	  ○ There should be a dedicated flat parking area for the tanker delivering LPG. This parking area should be clear on a delivery day and people should be kept away from the tank and tanker while the transfer of LPG is taking place.
	• Security
	  ○ The tank should be protected from unauthorised access to reduce the chance of intentional or accidental interference.
	  ○ For larger tanks (e.g. 4 tonnes or higher LPG capacity) a security fence is required to keep it secure. This fence should allow natural air flow (e.g. made from wire mesh) and should be kept in good condition.
	  ○ Any gates should be kept locked unless access to the tank is required.
	  ○ For tanks below 4 tonnes LPG capacity, there may be certain circumstances where a fence may not be necessary. This can only be justified where the risk of interference is low, and there is no uncontrolled public access - for example due to tank location or other accessibility factors. Tank valve covers should be kept locked whether or not the tank is fenced.
	• Impact protection
	  ○ If possible, the tank (and its associated piping) should not be in areas where there is motor traffic. However, where this is not possible, then protection from a motor vehicle hitting the tank is required such as crash barriers or bollards.	

Picture 44: Safety shower, next to unloading area



Picture 43: Example of safe access to the manhole

Picture 42: Example of manhole fitted with grid

Picture 45: Example of level measuring device

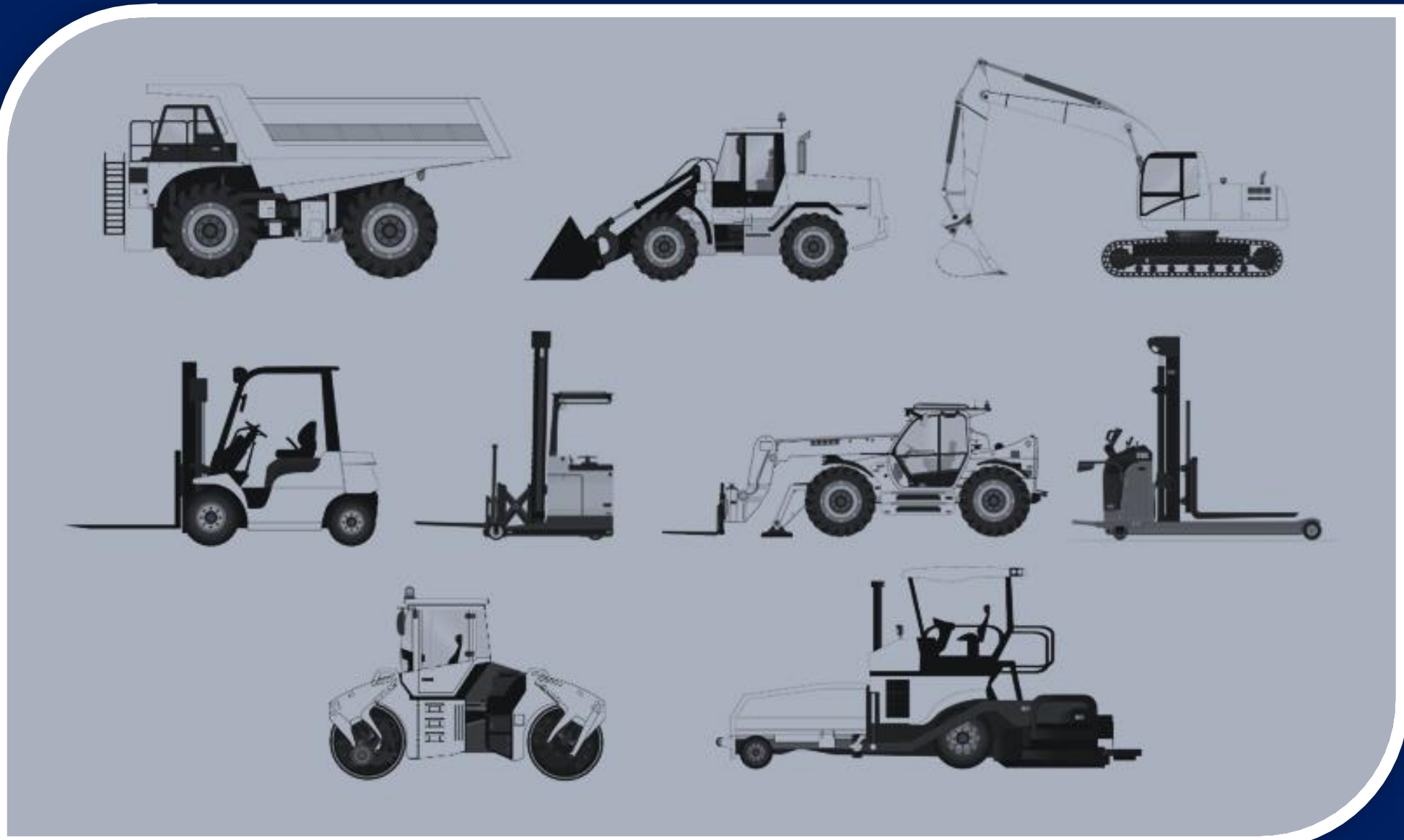
Picture 49: Example of PPE requirements posted at the installation and examples of PPE in use

Picture 48: Example of pump

Picture 46: Example of Block and Bleed Valves

Picture 47: Example of High Level Alarm (HLA) / High High Level Alarm (HHLA)

4. MOBILE EQUIPMENT



4.1. HEAVY MOBILE EQUIPMENT

	MINIMUM REQUIREMENTS		DUMP TRUCKS	LOADING SHOVELS	EXCAVATORS
4.1.1.	**CE MARK** CE mark certificate and plate.		✓	✓	✓
4.1.2.	**BLIND SPOT MIRRORS** Mirrors that minimize blind spots around the vehicle. Concave mirror with an attached or integrated convex mirror and a pedestrian mirror (over the windscreen looking down in front of the vehicle) should also be included.	Picture 50	✓	✓	✓
4.1.3.	**REVERSING CAMERA OR RADAR SYSTEM** Radar or colour CCTV System, with casing offering a IP level of 68.		✓	✓	✓
4.1.4.	**REVERSE WARNING SYSTEM** A reverse warning alarm and reverse warning light. Consider white noise in sensitive areas.		✓	✓	✓
4.1.5.	**HIGH VISIBILITY MARKINGS / CHEVRONS** • High Visibility Markings to the front and along the sides of the vehicle should be in place. High Visibility “Keep away / Keep clear of slewing radius“ (in the relevant local language) signs at the back of the machine. • Red and White Chevrons to be painted on the counterweights or other suitable surfaces on the rear of each machine. • Hi-Viz marking of handrails to aid visibility and reduce the potential for falls from height	Picture 51 Picture 52		✓	✓

	MINIMUM REQUIREMENTS		DUMP TRUCKS	LOADING SHOVELS	EXCAVATORS
4.1.6.	**TRAINING & MAINTENANCE** Training Requirements should also be specified. Familiarisation training to be supplied by the supplier on handover.		✓	✓	✓
4.1.7.	**AIR CONDITIONING WITH HEPA FILTERS** Our operations operate under an occupational exposure limit for respirable crystalline silica of 0.05 mg/m^3. All operator cabins must be constructed so as to prevent dust ingress, this should include the provision of air conditioning (using a HEPA (high-efficiency particulate air) filter) within the cab, and substantial sealing around windows and doors.		✓	✓	✓
4.1.8.	**SEATS** • Cab seats and linings to be made from non-porous materials that prevent dust retention and enable easy cleaning. • High backed seating with lumbar support & fully adjustable for height and reach		✓	✓	✓
4.1.9.	**OPERATIONS & MAINTENANCE MANUALS** The Operations & Maintenance Manuals must be supplied in English and the relevant national language. QR code (providing access to the documents) posted on the mobile equipment can be considered.		✓	✓	✓
4.1.10.	**AUTOMATIC BRAKE TESTING SYSTEM** In built automatic brake testing device**.** An exception is permitted if the relevant opco have a long-term service contract in place with a national provider to conduct independent brake testing (at least 2 times per year or as per statutory requirements whichever is greater).	Picture 60 Video 14	✓	✓	

	MINIMUM REQUIREMENTS		DUMP TRUCKS	LOADING SHOVELS	EXCAVATORS
4.1.11.	**PARK BRAKE ALARM** When the driver leaves his seat without activating the parking brake, an audible warning alarm should sound (not applicable for tracked excavators).	Picture 73	✓	✓	✓
4.1.12.	**WHEEL CHOCKS** Wheel chocks to be fitted and stored on the machine (not applicable for tracked excavators).	Picture 63	✓	✓	✓
4.1.13.	**TYRE ROCK EJECTOR** Tyre rock ejector to be fitted to twin wheeled dumpers.	Picture 65	✓		
4.1.14.	**ROPS and FOPS** Roll Over Protection System (ROPS) and Falling Object Protection System (FOPS).	Picture 62	✓	✓	✓
4.1.15.	**SEAT BELT** • High visibility seat belts • Dashboard audible warning alarm and an external light both of which indicate when the seat belt is not being worn.	Picture 58 Picture 76	✓	✓	✓
4.1.16.	**BEACON** Amber flashing or rotating beacon (LED preferred) being hard wired to ensure it is activated on start up.		✓	✓	✓
4.1.17.	**GROUND LEVEL FUELING POINT**	Picture 56	✓	✓	✓

	MINIMUM REQUIREMENTS		DUMP TRUCKS	LOADING SHOVELS	EXCAVATORS
4.1.18.	**GROUND LEVEL LOCKABLE ISOLATION SWITCH** Isolation labels to be located both beside the isolation point (and where relevant on the outside of any cover). Labels to clearly identify the system they control and to be permanent, durable (for the life expectancy of the machine).		✓	✓	✓
4.1.19.	**WARNING INDICATORS** • Fuel Level and pressure • Engine oil pressure • Hydraulic oil level • Engine air filter restriction • Hydraulic filter bypass • Service brake oil pressure • Transmission filter bypass • Engine inlet manifold temperature • Hydraulic oil temperature • Lift mode indicator that is activated for lifting tasks		✓	✓	✓
4.1.20.	**LIFT MODE INDICATOR** Lift mode indicator that is activated for lifting tasks. Machines with a maximum rated lift capacity at a minimum lift point radius as specified by the manufacturer of greater than or equal to 1,000kg or an overturning moment greater than or equal to 40,000 Nm (Newton Metres) are fitted with - (i) check valves on the cylinders used for lifting or by another means to prevent a gravity fall of the load in the event of a hydraulic failure, and (ii) an acoustic or visual warning device that indicates to the operator when the rated lift capacity or corresponding load moment is reached.				✓

	MINIMUM REQUIREMENTS		DUMP TRUCKS	LOADING SHOVELS	EXCAVATORS
4.1.21.	**LIFTING SIGNS** • Where machines are not certified for lifting a standardised decal shall be prominently displayed, in cab on the machine and any usual lifting point (e.g. where lifting eyes are fitted as standard). • Lifting points shall be clearly identified e.g. decals or contrasting paint on the outside and a decal inside the machine to indicate it is capable of lifting. • Specific Machine Lifting Charts to be clearly visible				✓
4.1.22.	**INCLINOMETER** System that continually monitors the angle of the vehicle in relation to the ground during the tipping process and assists in the prevention of potential overturns.	Video 13 Picture 59	✓	✓	
4.1.23.	**WINDOWS** • Laminated safety glass • Tinted or polarised windows (not required for machines that work mainly indoors)		✓	✓	✓
4.1.24.	**LOW NOISE CABIN DESIGN** All operator cabins must be constructed so that the noise level within the cab is less than 80 dB(A).		✓	✓	✓
4.1.25.	**AUTOLUBE SYSTEM** All machines to be fitted with an autolube system for all greasing points (except rotating prop shafts).	Picture 54	✓	✓	✓

	MINIMUM REQUIREMENTS		DUMP TRUCKS	LOADING SHOVELS	EXCAVATORS
4.1.26.	**FIRE PROTECTION** • Engine bays to be fitted with Automatic Fire suppression Systems for vehicle with a payload in excess of 40 t (OpCo to decide <40 t) • Provide a suitably sized portable fire extinguisher, with designated fixing points both inside and outside the cab • Label firefighting equipment with red and white signs clearly visible (scaled appropriately to the machine size) to unambiguously indicate the location type and use of either the automatic, manual or portable equipment.	Video 15	✓	✓	✓
4.1.27.	**SAFE ACCESS** • Access stairs with handrails (instead of ladders) to be used for large quarry equipment • Safe Access must be provided for all Maintenance Operations – this includes safe access for checking of Daily Checks on Oil and fluid Levels e.g Sight auges for fluid level checks. • Guard rails should ideally be 1200 mm (minimum 1100 mm). • If a step has to be used for standing on for maintenance, it must be at least 320 mm wide so as to accommodate both feet beside each other • Anti-slip steps and surfaces - Where it is foreseeable that foot placement may be required on a machine for access (in addition to access systems, walkways, and platforms) for whatever reason, then anti-slip material must be affixed to that surface. • Rigid Dump Trucks: Fall protection required to access front radiator	Picture 57	✓	✓	✓

	MINIMUM REQUIREMENTS		DUMP TRUCKS	LOADING SHOVELS	EXCAVATORS
4.1.28.	**BODY TIPPER ALARM** Shift limiter – as the body is being lowered you cannot go up the gears.		✓		
4.1.29.	**LOCKING BRACKET / BODY PROPS** A restraining system for the body of the dump truck, to cater for maintenance work with the body raised. This can take the form of a steel loader ram sleeve to prevent uncontrolled lowering or check valves on loader frame cylinders (to prevent uncontrolled lowering of frame and bucket in the event of a burst hydraulic hose). Mechanical props, where visible must be painted in high visibility paint and must have text posted on them identifying them as safety props.	Picture 53	✓		
4.1.30.	**LOW VIBRATION DESIGN** Whole Body Vibration should be reduced through the use of vibration proof foundations or pads and vehicle and/or cab suspension systems. Seats must be fitted with adjustable suspension units. Whole Body Vibration should be reduced through to fulfil the requirements of ISO7096.		✓	✓	✓
4.1.31.	**RADIATORS** A radiator cap with an effective depressurization interlock cap i.e to ensure the radiator pressure has been released before allowing removal of radiator cap; thus preventing scalds.		✓	✓	✓
4.1.32.	**COMMUNICATIONS IN CAB** Dedicated location within cab for fixing communication equipment (to avoid retrofitting of equipment obscuring the driver's vision).		✓	✓	✓
4.1.33.	**EXTERNAL LIGHT** When the driver's door is opened, an external light fitted adjacent to the	Picture 55	✓	✓	✓

	MINIMUM REQUIREMENTS		DUMP TRUCKS	LOADING SHOVELS	EXCAVATORS
	cab door must activate, this is to cater for situations where the driver may be working in reduced light conditions.				
4.1.34.	**REMOTE BATTERY CONNECTION SYSTEMS** Remote battery connection systems e.g Euro Battery Connectors (EBC) such as the Anderson switches to be fitted to allow jumpstarting and battery charging without having to access the battery area.		✓	✓	✓
4.1.35.	**HYDRAULIC HOSE CHECK VALVES** Hydraulic hose check valves in lifting cylinders (2 on boom and one on dipper ram). Also audible warning device for lift mode.				✓
4.1.36.	**QUICK HITCH DEVICES** Safe and easy removal / attachment of different sized buckets and rock breakers must be supplied as an integrated design to hold the buckets and other attachments in place. The system in place must provide a visual and audible system to notify the driver when the lifting device is not correctly secured by the relevant mechanism. These devices must depend on either: • Positive hydraulic pressure • Mechanical locks • Safety pins The audible warning device must sound when the quick hitch button has been activated.				✓
4.1.37.	**BOXING RING FALL PROTECTION** Internal and external rings to minimize the risk of fall from height during maintenance or inspections.				✓

	RECOMMENDED OPTIONS		DUMP TRUCKS	LOADING SHOVELS	EXCAVATORS
4.1.38.	**CAMERAS WITH BLACK BOX RECORDING SYSTEM** System for capturing data from multiple camera's on board including a forward facing camera to record any incidents or accidents. The system should record general machine information such as machine location, time, speed etc.		👍	👍	👍
4.1.39.	**PROXIMITY DETECTION / COLLISION AVOIDANCE SYSTEM** Radar and/or camera system that warns the driver and activate the brake if necessary.	Video 19 Video 18 Video 17 Video 16 Video 21	👍	👍	👍
4.1.40.	**FATIGUE MONITORING AND WARNING SYSTEM** System that provides early warning solution for truck drivers by e.g. actively tracking eyes, facial features and movement, using artificial intelligence, to detect fatigue and distracted driving behaviours.		👍	👍	👍
4.1.41.	**SELF-ADJUSTING WHITE NOISE REVERSING ALARM** Smart reversing alarms white noise which adjust to background noise level	Video 20	👍	👍	👍
4.1.42.	**AUTOMATIC TYRE PRESSURE CHECK SYSTEM** Automatic tyre pressure gauge indicator in the cab with visual and audible alarm to alert driver to under or over pressure outside safe limits (not applicable for tracked excavators).	Video 12	👍	👍	👍
4.1.43.	**MIRROR PROTECTION** Steel protection shields to be installed to prevent mirror damages.		👍	👍	👍

	RECOMMENDED OPTIONS		DUMP TRUCKS	LOADING SHOVELS	EXCAVATORS
4.1.44.	**VACUUM SYSTEM** Vacuum system fitted to machine with suction hose permanently available in the cab of a suitable length to reach all corners of the cab to enable cleaning. Hose should be retractable / safely stored.		👍	👍	👍
4.1.45.	**FILTERS FOR SRF LOADERS** Carbon filters / additional HEPA filters for SRF loaders.			👍	
4.1.46.	**HYDRAULIC ACCESS STEPS** >30 t excavators to have hydraulic access steps to minimise the risk of slip, trip and fall incidents during cab access and egress.				👍
4.1.47.	**OVERHEAD UTILITY PROTECTION / POWER LINE WARNING SYSTEM** System for detecting overhead high voltage powerlines, and giving the operator both visual and audible information on their proximity to them with any excavator arms or raised bodies etc.	Video 23 Video 22	👍		👍

	INNOVATIONS TO CONSIDER		DUMP TRUCKS	LOADING SHOVELS	EXCAVATORS
4.1.48.	**NON-TIPPING DUMPER** Truck design that eliminates the risk of vehicle overturn and contact with overhead structures while unloading	Video 24	☆		

Picture 50: Examples of blind spot mirrors

Picture 51: Examples of high-visibility markings

Picture 52: Examples of Hi-Viz marking of handrails on mobile plant to aid visibility and reduce the potential for falls from height



Picture 53: Examples of high visibility locking brackets / body props


Picture 56: Example of ground level fueling point

Picture 54: Example of automatic greasing system

Picture 55: Example of lighting at access stair

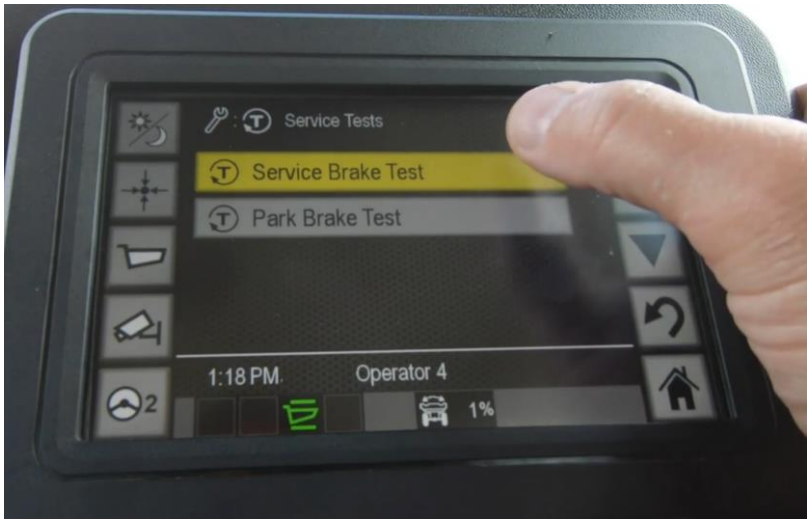
Picture 57: Examples of safe access stairs (instead of ladders) on large quarry equipment

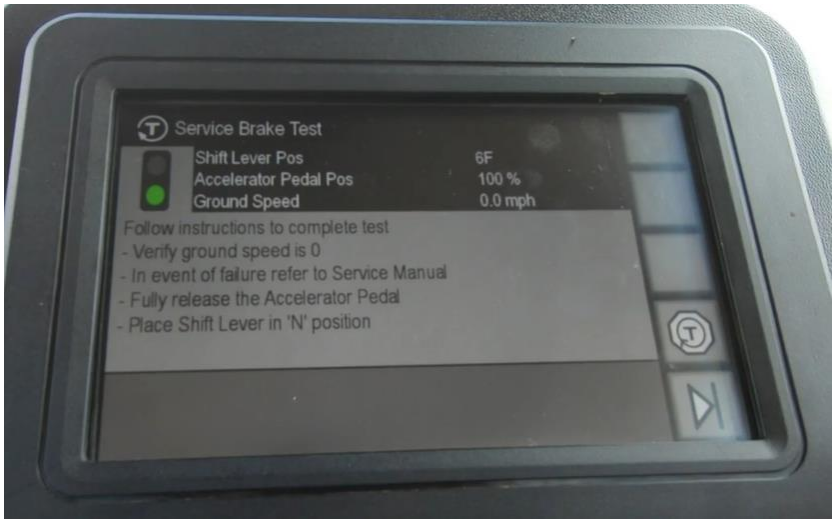
Picture 58: Example of high-visibility seat belt and seat belt use indicators – visual and audible dashboard alarm; a green light on the outside to indicate whether the safety belt is fastened

Video 13: [Examples of built-in (CAT) and retrofitted (TSafe) inclinometers]

Picture 59: Example of built-in inclinometer (Bell)

Video 12: [Example of Automatic Tyre Pressure Check System - IntelliTire (Bridgestone)]





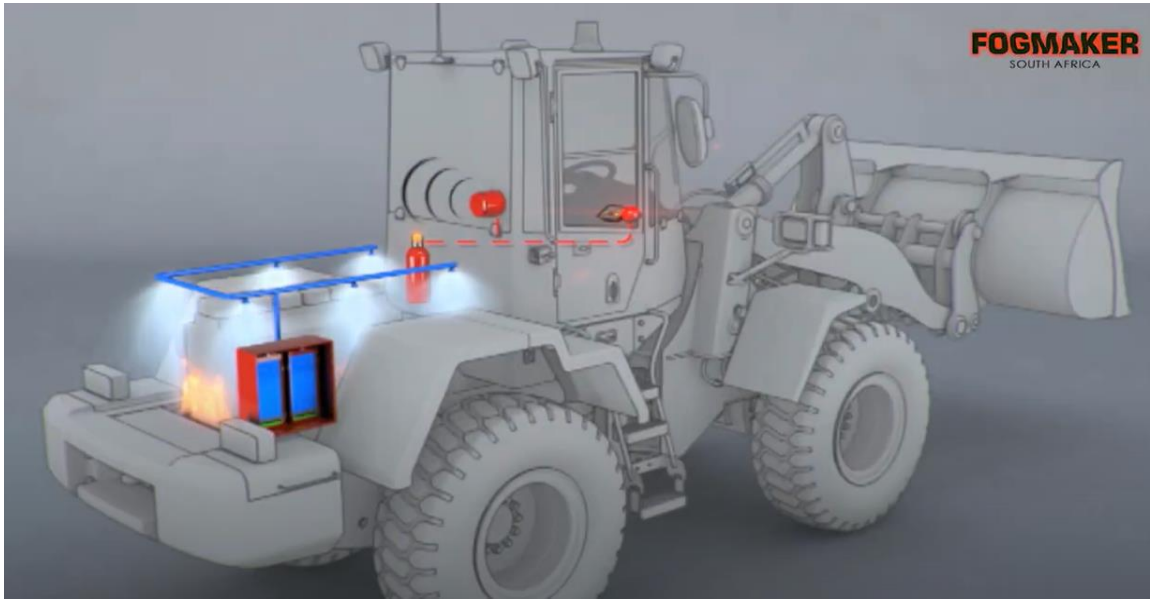
Picture 60: Example of Onboard Service Brake Test (Caterpillar)

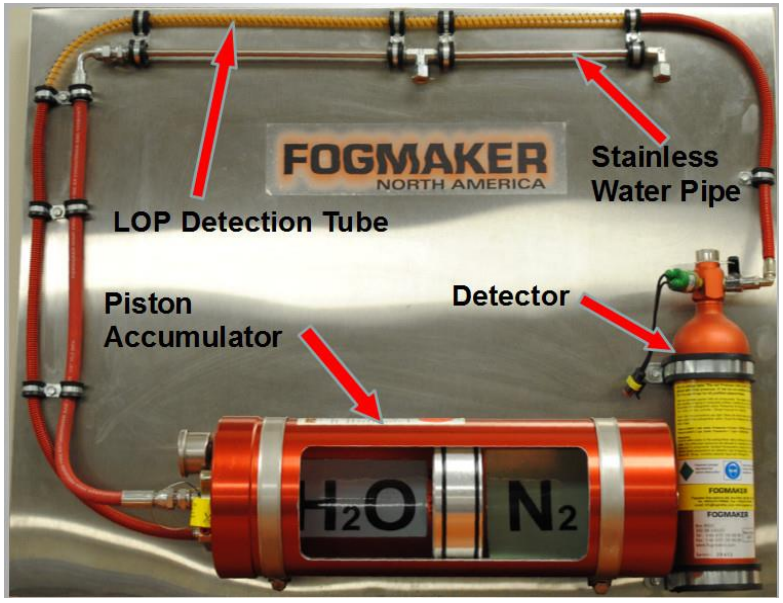
Video 14: [Example of in built Automatic Brake Testing System (Symret)]

Picture 61: Examples of safe access and guarded working platforms

Picture 62: Examples of ROPS and FOPS

Picture 63: Examples of wheel chocks

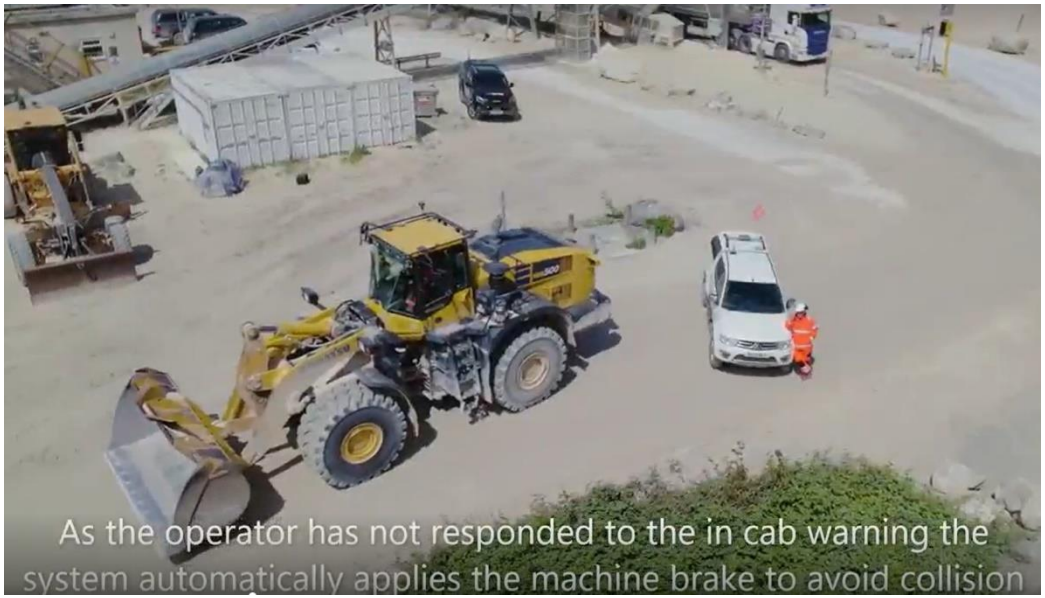




Video 15: [Example of Automatic Fire Suppression System (Fogmaker)]

Picture 64: Examples of visual and audible warning signs (seat belt, parking brake)

Picture 65: Examples of tyre rock ejector



Video 19: [Example of collision avoidance system - VMS Auto Brake System (Ogden)]

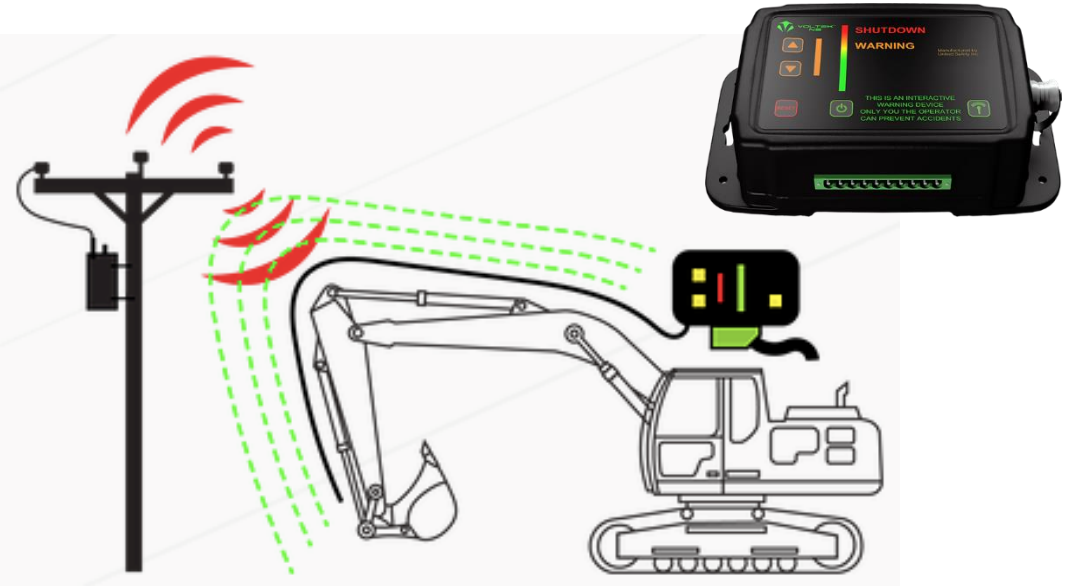
Video 18: [Example of proximity detection system - Pedestrian Detection using AI (Blaxtair)]

Video 17: [Example of proximity detection system - MineStar Detect (Caterpillar)]

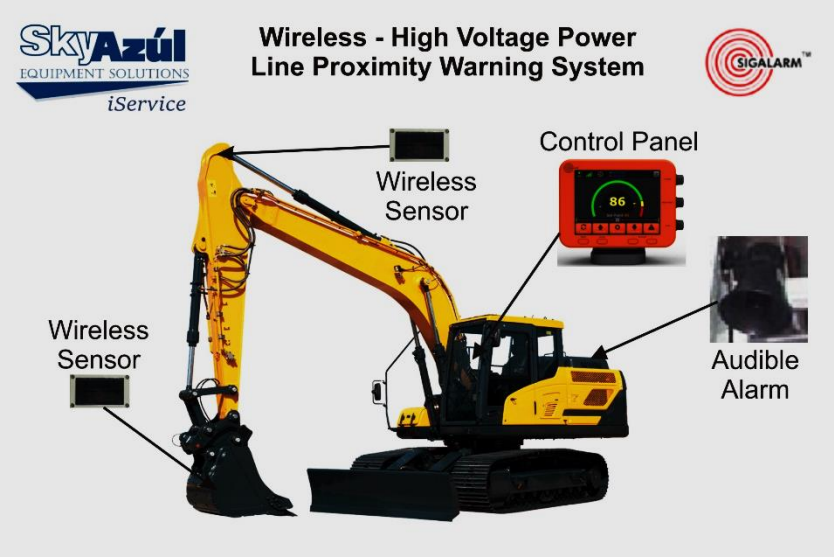
Video 16: [Example of proximity detection system - Komvision (Komatzu)]

Video 21: [Example of Collision Avoidance Technology – Mine Safe Pat System (PDG)]

Video 20: [Example of self-adjusting white noise reversing alarm (Brigade)]



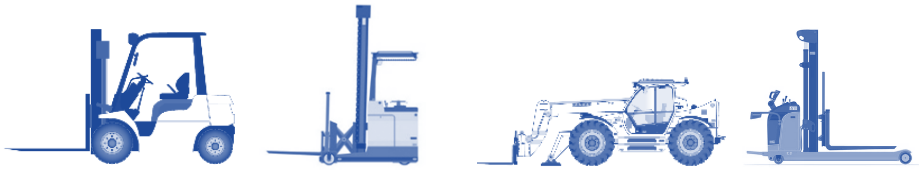
Video 23: [Example of Power Line Warning System - Voltek NS (Voltek Systems)]



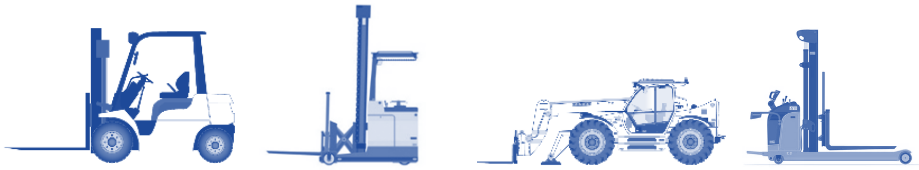
Video 22: [Example of Power Line Warning System - Sigalarm (Sky Azul)]

Video 24: [Example of non-tipping dumper - Ejector Body (K-Tec)]

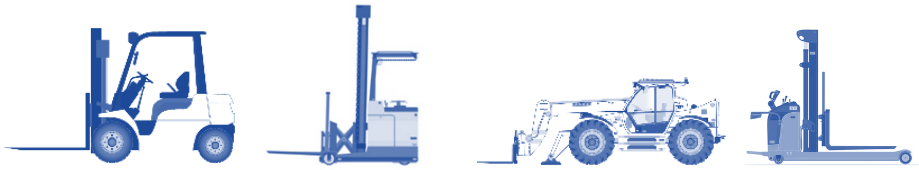
4.2. MATERIAL HANDLING EQUIPMENT



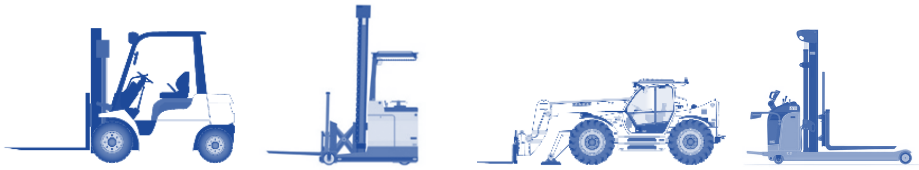
	MINIMUM REQUIREMENTS		FORKLIFT TRUCKS	REACH TRUCKS	TELESCOPIC HANDLERS	HAND OPERATED PALLET TRUCKS
4.2.1.	**CE MARK** CE mark certificate (covering the unit and lifting accessories supplied) and CE plate.		✓	✓	✓	✓
4.2.2.	**SPEED RESTRICTIONS** The operational speed of the forklift must be restricted through the vehicle management system to a maximum: • Forward speed: 16 km/h (10 mph) • Reverse speed: 5 km/h (3 mph) Speed limited to 6 km/h for pedestrian operated pallet trucks and 10 km/h for stand on pallet trucks.		✓	✓		✓
4.2.3.	**DRIVE CONTROL** Sensor which limits the speed of the reach truck to crawl speed when the mast is at close to full elevation.			✓		
4.2.4.	**WARNING LIGHT SYSTEM** For forward and backward movement, a warning light system such as the Blue or Red Light system must be installed.	Video 26 Video 27	✓	✓		
4.2.5.	**REVERSE WARNING SYSTEM** A reverse warning alarm and reverse warning light must be fitted.		✓		✓	



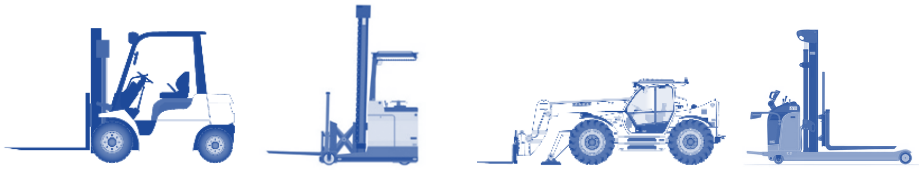
	MINIMUM REQUIREMENTS		FORKLIFT TRUCKS	REACH TRUCKS	TELESCOPIC HANDLERS	HAND OPERATED PALLET TRUCKS
4.2.6.	**AIR CONDITIONING** All operator cabins must be constructed so as to prevent dust ingress, this should include the provision of air conditioning (using a HEPA (high-efficiency particulate air) filter) within the cab, and substantial sealing around windows and doors. Occupational exposure limit for respirable crystalline silica is 0.05 mg/m^3		✓		✓	
4.2.7.	**ROLL OVER PROTECTION STRUCTURE (ROPS)**	Picture 67	✓	✓	✓	
4.2.8.	**FALLING OBJECT PROTECTION STRUCTURE (FOPS)** FOPS required where the vehicle may be used in areas having risk of falling objects, in such cases the absence of a FOPS must be clearly identified on the vehicle e.g large label within the driver's cab " This vehicle is not fitted with a FOPS structure".	Picture 67	✓	✓	✓	
4.2.9.	**SEAT BELT** • Seat belts with a dashboard audible warning when the belt is not in use • Double interlock on the seat belt – this means chair needs to feel weight before seatbelt is released. When driver buckles themselves in, the truck can be started • Hi-visibility seatbelt – it allows to easily see that belt is being worn correctly	Picture 58 Picture 76	✓	✓	✓	



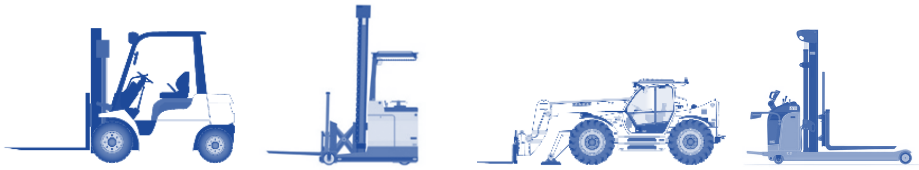
	MINIMUM REQUIREMENTS		FORKLIFT TRUCKS	REACH TRUCKS	TELESCOPIC HANDLERS	HAND OPERATED PALLET TRUCKS
4.2.10.	**TINTED WINDOWS** Only where required as a result of a site risk assessment.		✓		✓	
4.2.11.	**OPERATIONS & MAINTENANCE MANUALS** It must be supplied in English and the relevant local language. Training & Maintenance Training Requirements should also be specified.		✓	✓	✓	✓
4.2.12.	**LOW NOISE DESIGN** All (enclosed) operator cabins must be constructed so that the Noise Level within the cab is less than 80 dB(A).		✓		✓	
4.2.13.	**LOW VIBRATION DESIGN** Whole Body Vibration should be reduced through the use of vibration proof foundations or pads. The daily exposure limit value (standardised to an 8-hour reference) shall not exceed 1.15 m/s^2, and the daily exposure action value (standardised to an 8 hour reference) shall not exceed 0.5 m/s^2.		✓		✓	
4.2.14.	**LIGHTING** Long life bulbs in the lighting system.		✓	✓	✓	
4.2.15.	**GROUND LEVEL LOCKABLE ISOLATION SWITCH**		✓		✓	
4.2.16.	**KEYLESS IGNITION** A keyless ignition system to prevent operation of the forklift by an authorised person must be fitted. System must be keyless fob/tag system and not a keypad.		✓	✓		



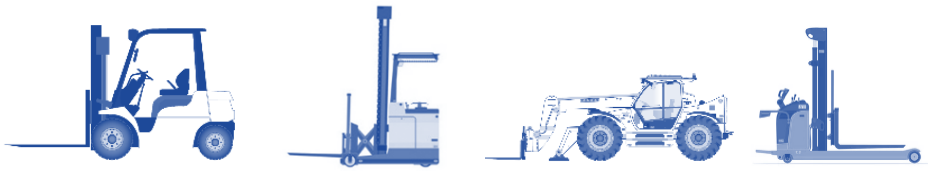
	MINIMUM REQUIREMENTS		FORKLIFT TRUCKS	REACH TRUCKS	TELESCOPIC HANDLERS	HAND OPERATED PALLET TRUCKS
4.2.17.	**WARNING INDICATORS** (where applicable) • Fuel Level and pressure • Engine oil pressure • Hydraulic oil level • Engine air filter restriction • Hydraulic filter bypass • Service brake oil pressure • Transmission filter bypass • Engine inlet manifold temperature • Hydraulic oil temperature		✓			
4.2.18.	**MIRRORS** Convex (Parabolic) / Concave driver mirrors must be fitted.	Picture 66	✓		✓	
4.2.19.	**CAB DOORS** Forklifts must be fitted with cab doors. The side guard system is permitted for non-process Distribution activities.		✓			
4.2.20.	**HYDRAULIC FORK ADJUSTMENT** Hydraulic fork adjustment, both for fork positioning and fork length should be considered in any vehicle where manual adjustment or use of fork extensions occurs		✓	✓		
4.2.21.	**BEACON** A cabtop flashing or rotating amber beacon. Rotating beacon is preferred where a flashing beacon interferes with speed glass in a welding helmet. It should not be possible to	Picture 70	✓	✓	✓	



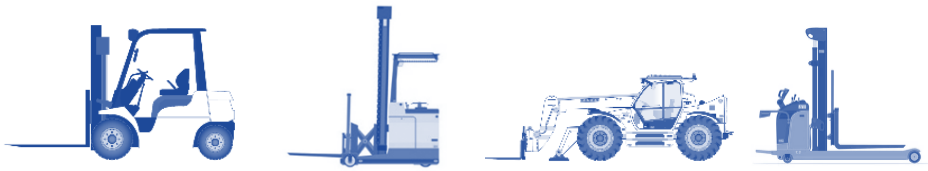
	MINIMUM REQUIREMENTS		FORKLIFT TRUCKS	REACH TRUCKS	TELESCOPIC HANDLERS	HAND OPERATED PALLET TRUCKS
	turn off the light system via any controls or switches in the cab.					
4.2.22.	**RUBBER FILLED TYRES**				✓	
4.2.23.	**HOSE CHECK VALVES** Hose check valves for all hydraulic lines.				✓	
4.2.24.	**TILT LOCK SWITCH MECHANISM** Tilt lock switch mechanism which prevents the vehicle working on an unsafe gradient.				✓	
4.2.25.	**OVERWEIGHT WARNING MECHANISM**				✓	
4.2.26.	**GROUND LEVEL FUELING POINT**				✓	
4.2.27.	**RADIATOR CAP** A radiator cap with an effective depressurization interlock cap i.e to ensure the radiator pressure has been released before allowing removal of radiator cap; thus preventing scalds.				✓	
4.2.28.	**COMMUNICATION** Communications in cab: dedicated location within cab for fixing communication equipment (to avoid retrofitting of equipment obscuring the driver's vision).		✓		✓	



	MINIMUM REQUIREMENTS		FORKLIFT TRUCKS	REACH TRUCKS	TELESCOPIC HANDLERS	HAND OPERATED PALLET TRUCKS
4.2.29.	**EMERGENCY BUTTON** Emergency button on top of the operator bar.					✓
4.2.30.	**AUTOMATIC BRAKING** Automatic braking when driver bar is released					✓
4.2.31.	**STAND ON DETECTION** Stand on detection for stand on pallet trucks that disables the movements when the operator is not standing on the platform.					✓
4.2.32.	**SIDE PROTECTION** Stand on pallet trucks needs to have side protection for the driver.	Picture 68				✓
4.2.33.	**ACTIVE FOOT PROTECTION** Active foot protection that stops driving and reverses for approximately 10 cm to prevent the feet from being trapped.	Picture 69				✓
4.2.34.	**FIRE EXTINGUISHER** Suitable fire extinguisher		✓	✓	✓	

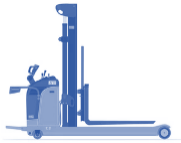


	RECOMMENDED OPTIONS		FORKLIFT TRUCKS	REACH TRUCKS	TELESCOPIC HANDLERS	HAND OPERATED PALLET TRUCKS
4.2.35.	**HALO ARRAY SYSTEM** Halo array casts a box around the vehicle and provides visual aid to pedestrians on 2-metre rule. The system should be fitted without possibility to turn off via any controls or switches in the cab.	Video 25	👍	👍		
4.2.36.	**PRE-START INSPECTION LINKED TO THE TRANSMISSION** Pre-start inspection linked to the transmission of the vehicle – it means someone has to personally endorse that the pre use check has been done before the vehicle can be started. This increases accountability of the driver to performs the checks properly. Truck will not start until pre use check has been completed.		👍	👍		
4.2.37.	**PROXIMITY DETECTION AND WARNING SYSTEM** System that warns the driver if pedestrians or objects are close to the vehicle.	Video 29 Video 30 Video 31	👍			
4.2.38.	**LIFT / MANOEUVRABILITY WARNING SYSTEM** A system which detects possible violations in lift of moving operations which may e.g.: overload the truck, risk of tipping over, risk of load shedding etc. This system can limit the vehicle and prevent the operation from being conducted, meaning the potential hazard is removed.	Video 33	👍	👍		
4.2.39.	**AUTO BRAKING SYSTEM** System that slows down the truck automatically if any object or person is in close proximity.	Video 36 Video 19	👍		👍	

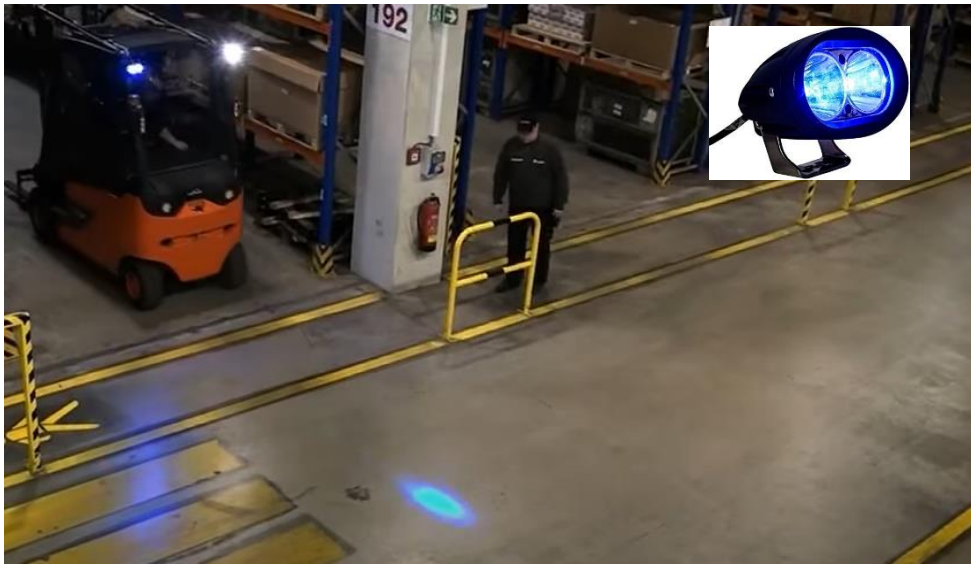


	RECOMMENDED OPTIONS		FORKLIFT TRUCKS	REACH TRUCKS	TELESCOPIC HANDLERS	HAND OPERATED PALLET TRUCKS
4.2.40.	**AUTO BRAKING SYSTEM WITH AI PEDESTRIAN DETECTION** System that detects pedestrians and slows down the truck automatically.	Video 34	✓		✓	
4.2.41.	**ADVANCED BRAKING SYSTEM** Braking system (electrical forklift) provides smooth stop when emergency brake is applied to prevent falling load from the forks. Parking brake is automatically deployed when the forklift stops on inclined surface.	Video 35	✓			
4.2.42.	**WINDOW SAFETY FILM** Safety Film applied on the windows that minimizes the risk of injuries caused by falling objects or fragments of broken glass.	Video 28	✓		✓	



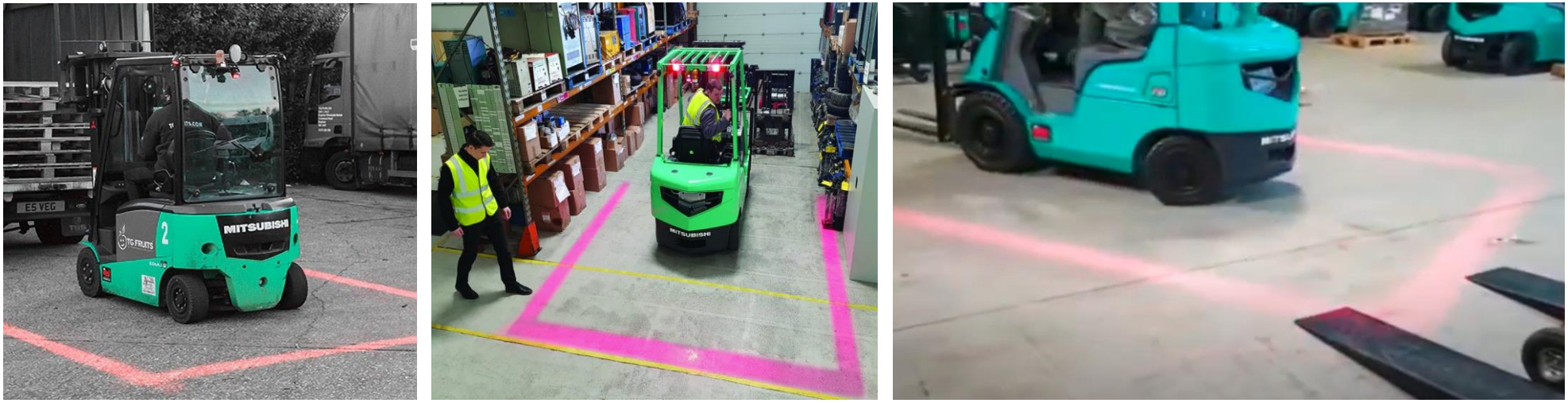



	INNOVATIONS TO CONSIDER		FORKLIFT TRUCKS	REACH TRUCKS	TELESCOPIC HANDLERS	HAND OPERATED PALLET TRUCKS
4.2.43.	**SELF ADJUSTING WHITE NOISE REVERSING ALARM** Where different noise levels may be present, a system which automatically adjusts the volume of audible alarms can be considered. This means that in quiet areas eg: close to residential, there is lower noise pollution. But in louder areas eg: plants and work environments, alarms can still be heard.	Video 32	☆		☆	
4.2.44.	**BUILT IN COMMUNICATION SYSTEM** Built in comms system to remove the need to use a mobile phone or walkie talkie whilst driving the truck		☆		☆	
4.2.45.	**RADIO-BASED ZONE CONTROL ASSIST** The system enables effective management of potential danger zones posing a high accident risk, such as low passageways, transition areas between buildings or crossings with poor visibility. The system responds to the specific situation: it alerts the driver, issues an alarm or, if necessary, intervenes to control the truck. This avoids collisions, for instance, and guarantees safe movement within the warehouse.	Video 37	☆			



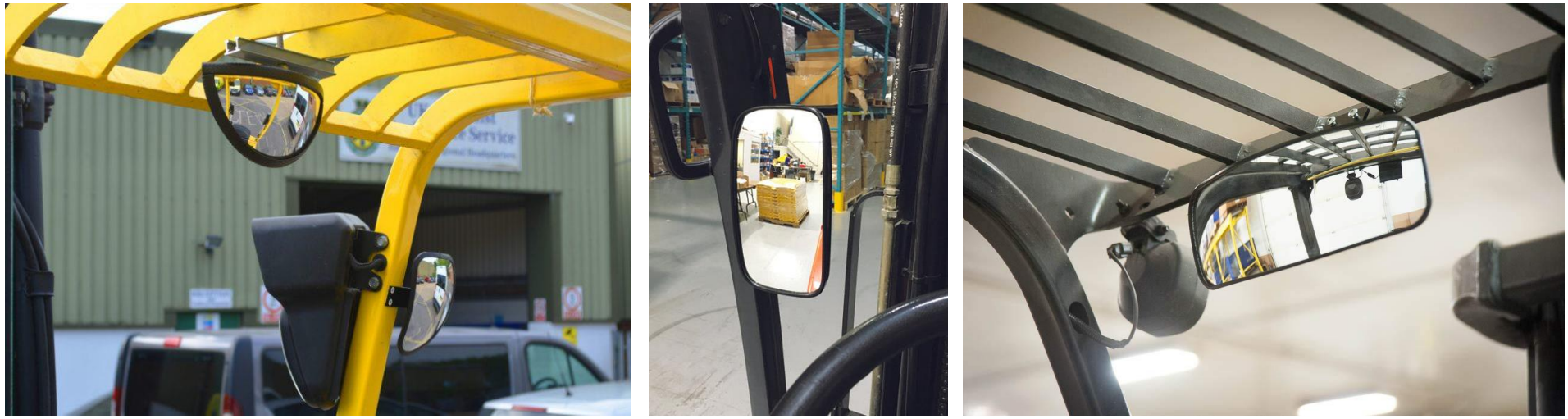
Video 26: [Example of Warning Light – Blue Light System (Linde)]

Video 27: [Example of Warning Light – Arc Red Light System (Toyota)]



Video 25: [Example of Halo Array System - Safety Zone (Mitsubishi)]

Picture 67: Examples of ROPS and FOPS cabin structures



Picture 66: Examples of forklift mirrors

Picture 70: Example of beacon

Video 28: [Example of Window Safety Film (3M)]

Picture 68: Examples of pallet trucks with side protection

Picture 69: Example of active foot protection for electrical pallet truck

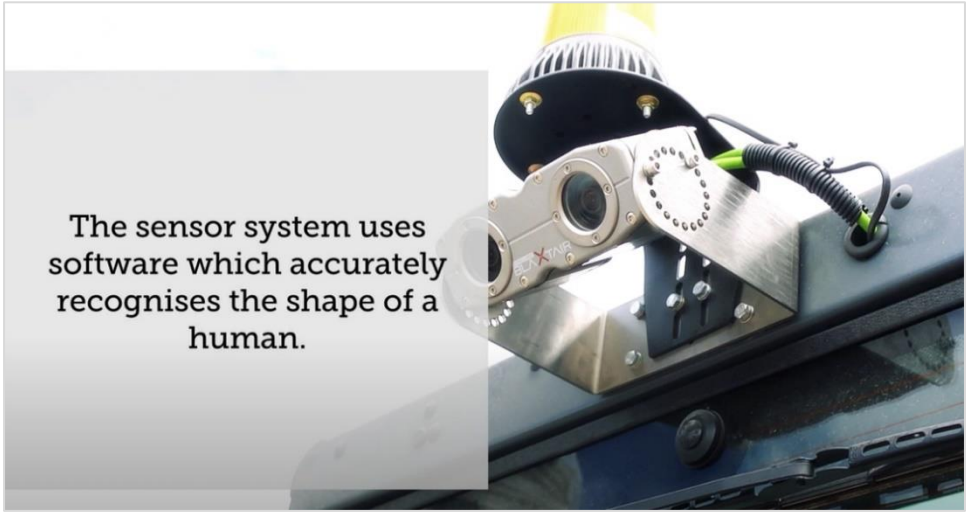
Video 30: [Example of Proximity Detection and Alert System – Smart Environment Sensor (Toyota)]

Video 29: [Example of Proximity Detection and Alert System (ZoneSafe)]

Video 31: [Example of Proximity Detection and Alert System (Rombit)]

Video 33: [Example of Lift / Maneuverability System – Safety Pilot (Linde)]

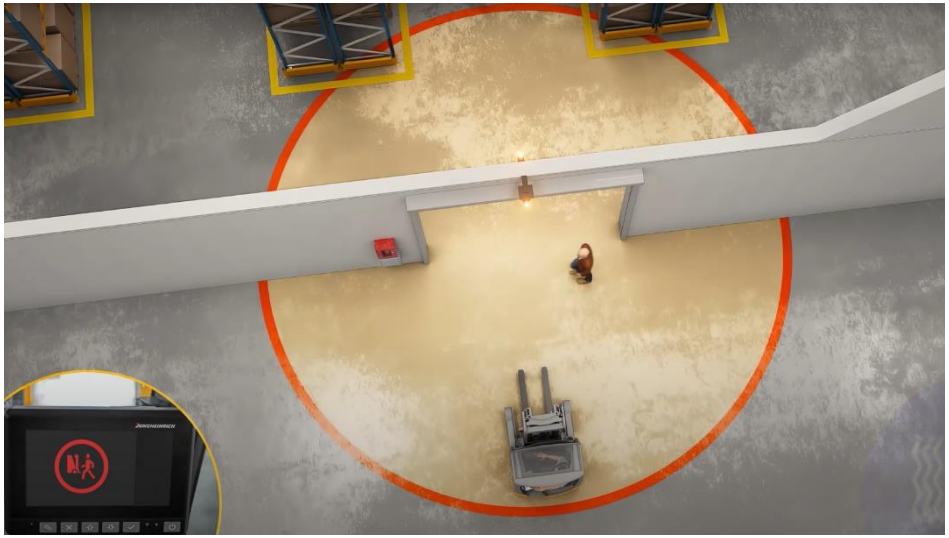
Video 32: [Example of smart self-adjusting reversing alarm (Toyota)]

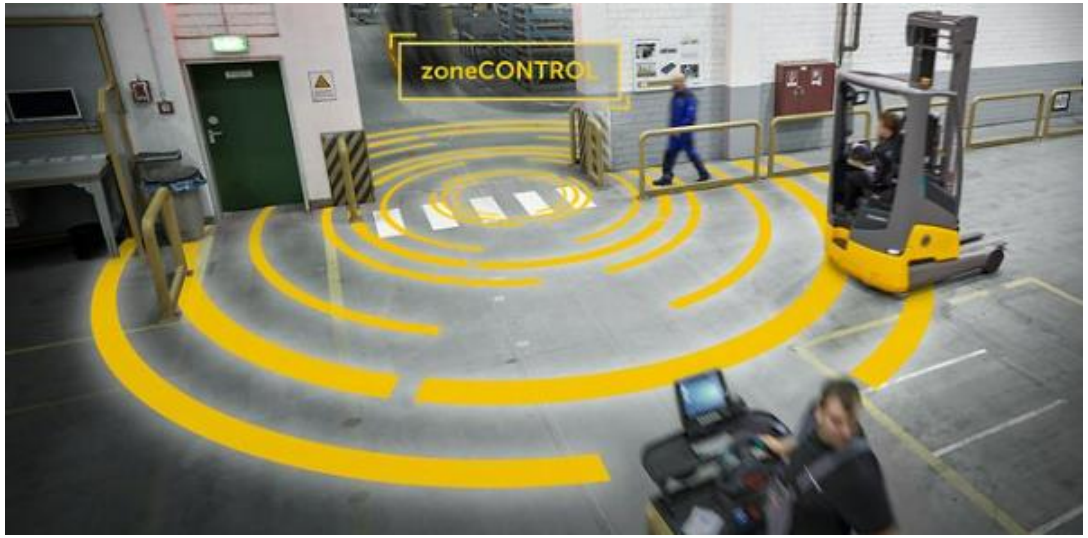


Video 34: [Example of Auto brake system using AI for pedestrian detection (Blaxtair / Jungheinrich)]

Video 36: [Example of Auto Brake System – Safe&Stop (SIS)]

Video 35: [Advanced Forklift Braking System (Linde)]





Video 37: [Example of radio-based assistance system - zoneContorl (Jungheinrich)]

4.3. ROAD CONSTRUCTION EQUIPMENT

	MINIMUM REQUIREMENTS		ROLLERS	PAVERS
4.3.1.	**CE MARK** CE mark certificate and plate.		✓	✓
4.3.2.	**MIRRORS** A Concave mirror with an attached or integrated convex mirror to ensure all round vision – minimum 1 meter rule (where applicable, depends on roller size / type)		✓	✓
4.3.3.	**REVERSE WARNING SYSTEM** A reverse warning alarm and reverse warning light must be fitted.		✓	✓
4.3.4.	**CAMERA SYSTEM** 360° Camera System with birds eye view to be installed where possible, depends on machine size / type / level of all-round vision; if installed should be recordable		✓	✓
4.3.5.	**MANUAL** The Operations & Maintenance Manuals must be supplied in English and the relevant local language.		✓	✓
4.3.6.	**ROLL OVER PROTECTION SYSTEM (ROPS)** Cabin structure (where applicable) should have ROPS		✓	
4.3.7.	**FALLING OBJECTS PROTECTION SYSTEM (FOPS)** FOPS to be considered based on risk assessment (e.g. working in tunnels, under bridges etc.)		✓	

	MINIMUM REQUIREMENTS		ROLLERS	PAVERS
4.3.8.	**LIGHTS** Road Lights must be fitted.		✓	✓
4.3.9.	**SEAT BELT WARNING SYSTEM** Warning device to Identify non-use of seat belt (alarm or light system or other system which helps control the fastening of belts)		✓	✓
4.3.10.	**NOISE PROTECTION** All operator cabins (if applicable) must be constructed so that the Noise Level within the cab is less than 80 dB(A).		✓	✓
4.3.11.	**SAFE ACCESS FOR MAINTENANCE** Safe Access must be provided for all Maintenance Operations - this includes safe access for checking of Daily Checks on Oil and fluid Levels e.g Sight gauges for fluid level checks. Platforms for routine maintenance (including tasks such as cleaning windows or mirrors preferably carried out from ground level) at a height of between 1 and 2 metres above the ground or a safe working platform, shall have an anchorage point (or handhold or handrails capable of being used as an anchorage point) provided on the inside, so that a fall restraint device may be attached.		✓	✓
4.3.12.	**LOW VIBRATION DESIGN** Whole Body Vibration should be reduced through the use of vibration proof foundations or pads. The daily exposure limit value (standardised to an 8 hour reference) shall not exceed 1.15 m/s^2, and the daily exposure action value (standardised to an 8 hour reference) shall not exceed 0.5 m/s^2. if local limits are lower then use local limits.		✓	✓
4.3.13.	**TRAINING & MAINTENANCE REQUIREMENTS** Training & Maintenance Requirements should also be specified.		✓	✓

	MINIMUM REQUIREMENTS		ROLLERS	PAVERS
4.3.14.	**LIGHTING** Long life bulbs in the lighting system Or LED – Shock proof.		✓	✓
4.3.15.	**GROUND LEVEL LOCKABLE ISOLATION SWITCH**		✓	✓
4.3.16.	**WARNING INDICATORS** • Fuel Level • Engine oil pressure • Hydraulic oil level • Engine air filter restriction • Hydraulic filter bypass • Engine inlet manifold temperature • Hydraulic oil temperature		✓	✓
4.3.17.	**SAFE ACCESS** • First access step to be rigid and as low as possible, depending on machine size/type (no more than 300 mm off the ground is sufficient) • Cab door shall be opened from a step of sufficient width for the placement of both feet no more than 500 mm off the ground. • Guard rails should ideally be 1200 mm (minimum 1100 mm). • If a step has to be used for standing on for maintenance it must be at least 320 mm wide so as to accommodate both feet beside each other and no more than 500 mm from the ground.		✓	

	MINIMUM REQUIREMENTS		ROLLERS	PAVERS
4.3.18.	**AUTOLOUBE SYSTEM** Autolube system to be fitted for all greasing points (except rotating prop shafts) – Depending on machine size/type		✓	✓
4.3.19.	**RADIATORS** A radiator cap with an effective depressurization interlock cap i.e to ensure the radiator pressure has been released before allowing removal of radiator cap; thus preventing scalds.		✓	✓
4.3.20.	**FIXED COMMUNICATIONS IN CAB** Dedicated location within cab for fixing communication equipment (to avoid retrofitting of equipment obscuring the driver's vision).		✓	✓
4.3.21.	**FIRE EXTINGUISHER** Suitable fire extinguisher(s) must be fitted in a secure and accessible manner on board.		✓	✓
4.3.22.	**ISOLATION** A lockout tagout mechanism for the electric generator.			✓
4.3.23.	**SCREED WARNING SYSTEM** Warning system (sound or light) for screed movement.			✓

	RECOMMENDED OPTIONS		ROLLERS	PAVERS
4.3.24.	**DANGER ZONE LIGHT SYSTEMS** Danger zone lights i.e 5+2 safety zones lighting for night works. The system helps to make danger zones around the vehicle more visible for pedestrians.	Picture 71 Video 40 Video 39	👍	👍
4.3.25.	**TRAFFIC LIGHT SYSTEM** System (e.g. Pave Dock Assistant) to remove the need of a banksman	Video 38		👍
4.3.26.	**FIRST AID KIT** First aid kits and cooling gels		👍	👍
4.3.27.	**BEACON** Beacon for increased visibility		👍	
4.3.28.	**BATTERY BOOSTER POINT** Battery booster point to allow machine to machine or use of booster		👍	👍
4.3.29.	**EMERGENCY STOPS** Emergency stops or pull line.			👍

Dock: Lorry drives up to the paver and docks.

Lower Dump Box: Lorry lowers the dump box.

Stop: Lorry must halt. It has docked.

Drive Off: Lorry drives away from the paver.

Raise Dump Box: Lorry raises the dump box.

Paver is moving: Symbol can appear together with all symbols.

Video 38: [Example of Traffic Light System - PaveDock Assistant (Wirtgen Group)]



Picture 71: Example of danger zone light system - Red lights

Video 40: Example of danger zone light system - 5+2 blue lights (Tarmac)

Video 39: Example of danger zone light system - 5+2 blue lights (Tarmac)

5. VEHICLES


Blind spot
Take care
Blind spot
Take care
Blind spot
Take care

5.1. ROAD TRANSPORT VEHICLES

	MINIMUM REQUIREMENTS		CEMENT TANKERS	TIPPER TRUCKS (rigid or articulated)	MIXER TRUCKS	CONCRETE PUMPS
5.1.1.	**ADVANCED EMERGENCY BRAKING SYSTEM (AEBS)** Active warning and braking system to assist in preventing collision with other road users or objects.	Video 43 Video 41 Video 44	✓	✓	✓	✓
5.1.2.	**LANE DEPARTURE WARNING SYSTEM (LDWS)** System that alerts the driver when they partially merge into a lane without using their turn signals. It uses cameras to monitor lane markings to determine if the driver unintentionally begins to drift. This system does not take control of the vehicle to help sway the vehicle back into the safety zone but instead sends an audio or visual alert to the driver.	Video 42	✓	✓	✓	✓
5.1.3.	**SIDE COLLISION AVOIDANCE SYSTEM** Safety system that helps to prevent collisions to the side of the truck. Sensors are fitted on both sides of the truck to detect vehicles in adjacent lanes traveling at any speed. The sensors detect pedestrians / cyclists when truck is turning on the side away from the driver – e.g. left for right hand drive (UK) and right for left hand drive. It triggers an audible and visual alarm in the driver's cabin.	Video 49 Video 50	✓	✓	✓	✓
5.1.4.	**SIDE AUDIBLE ALARM** External audible alarm for pedestrians and cyclists when the truck turning on the side away from the driver.	Video 48	✓	✓	✓	✓

	MINIMUM REQUIREMENTS		CEMENT TANKERS	TIPPER TRUCKS (rigid or articulated)	MIXER TRUCKS	CONCRETE PUMPS
5.1.5.	**MIRRORS** • Class I: Interior rearview mirrors • Class II Main exterior mirrors • Class III: Main exterior mirrors • Class IV: Wide-angle mirrors • Class V: Close proximity mirrors • Class VI: Front (Cyclops) mirrors / Pedestrian mirror	Picture 74	✓	✓	✓	✓
5.1.6.	**360^{O} CAMERA SYSTEM** Front, rear and side camera views in one in-cab screen. Camera systems providing bird-eye view option could be considered.	Video 52		✓	✓	✓
5.1.7.	**BLACK BOX RECORDING** Black box recording the road in front & rear camera for incident investigation (where legally allowed)		✓	✓	✓	✓
5.1.8.	**TYRE PRESSURE MONITORING SYSTEM** The system determines when the tire pressure is outside the normal inflation pressure range. The driver can monitor the tire pressure and is notified when there is a sudden drop through a pictogram display, gauge, or low-pressure warning signal.	Video 46	✓	✓	✓	✓
5.1.9.	**HANDBRAKE WARNING ALARM** When cab door is open and handbrake is not applied	Picture 73	✓	✓	✓	✓

	MINIMUM REQUIREMENTS		CEMENT TANKERS	TIPPER TRUCKS (rigid or articulated)	MIXER TRUCKS	CONCRETE PUMPS
5.1.10.	**WHEEL NUT INDICATOR** Markers on every bolt of the wheels to check if they are still properly fastened.	Video 47	✓	✓	✓	✓
5.1.11.	**REVERSING ALARM** Audible “white noise” reverse Alarm.		✓	✓	✓	✓
5.1.12.	**SEAT BELTS** Seat belt for each seat. High visibility seat belt for driver with warning alarm if not used.	Picture 76	✓	✓	✓	✓
5.1.13.	**AIR CONDITIONING**		✓	✓	✓	✓
5.1.14.	**FIRE EXTINGUISHER(S)**		✓	✓	✓	✓
5.1.15.	**ANTI-SLIPS AND TREADS / ACCESS STEPS, HAND HOLDS**		✓	✓	✓	✓
5.1.16.	**DAILY OIL & WATER CHECKS** Fills from ground level.		✓	✓	✓	✓
5.1.17.	**TRACKING SYSTEM**		✓	✓	✓	✓
5.1.18.	**MECHANICAL ISOLATION** • Safety props to secure tipper body • Mechanical device for holding forwarded cab in position for maintenance (if the cab can be returned to upright position by accident).	Picture 82	✓	✓	✓	✓

	MINIMUM REQUIREMENTS		CEMENT TANKERS	TIPPER TRUCKS (rigid or articulated)	MIXER TRUCKS	CONCRETE PUMPS
5.1.19.	**REVERSING CAMERA (OR RADAR) SYSTEM** When the driver puts the car in reverse, the camera (or radar) automatically turns on providing driver's aid when backing up.		✓	✓	✓	✓
5.1.20.	**SEATING** Air suspended driver seat.		✓	✓	✓	✓
5.1.21.	**SIDE UNDER RUN PROTECTION GUARDS**		✓	✓	✓	✓
5.1.22.	**BLIND SPOT WARNING SIGNS** Blind spot warning signs for pedestrians and cyclists on side underrun protection and at the rear of the truck	Picture 77	✓	✓	✓	✓
5.1.23.	**BEACON** Amber rotating beacon.			✓	✓	✓
5.1.24.	**INCLINOMETER** System that warns the driver if there is a risk of overturn while tipping. Active inclinometer system stops tipping in case of risky situation.	Video 58 Video 57		✓		
5.1.25.	**BODY RAISED WARNING AND BRAKING SYSTEM** System that measures warns the driver and brakes automatically when driving with the body tipped.	Video 56		✓		
5.1.26.	**TANKER ACCESS PLATFORM AND PROTECTIVE RAIL** Air operated with check valves		✓			

	MINIMUM REQUIREMENTS		CEMENT TANKERS	TIPPER TRUCKS (rigid or articulated)	MIXER TRUCKS	CONCRETE PUMPS
5.1.27.	**SAFE ACCESS LADDER** It must start no higher than 0.7 m from ground level and hinge and secure correctly when in transit. Ladders providing access to the working platform should be sloping if possible and robust enough to minimize flexing. Treads should be slip-resistant utilising non-slip tread plate. There should be a clear space behind each rung allowing safe access and egress.				✓	
5.1.28.	**SAFE ACCESS PLATFORM** • Appropriate hand holds to be provided to allow three-point contact at all times when ascending / descending ladder access and when entering and exiting crows nest platform. • Crows nest platform should be enclosed and minimum size of 400 x 800mm. • Self-closing anti-fall safety bar must be fitted on crows nest for fall protection at height (no chains).	Picture 81			✓	
5.1.29.	**LIGHTWEIGHT EXTENSION CHUTES**	Picture 78			✓	
5.1.30.	**FINGER TRAP PREVENTION DEVICE** Mechanical chute stop device for folding type mixer chutes	Video 59			✓	
5.1.31.	**EMERGENCY STOP BUTTON** Emergency stop button at the back of the truck that is easily accessible.				✓	✓

	MINIMUM REQUIREMENTS		CEMENT TANKERS	TIPPER TRUCKS (rigid or articulated)	MIXER TRUCKS	CONCRETE PUMPS
5.1.32.	**DRUM LOCK** Safety device that mechanically secure the mixer drum against automatic rotation during maintenance work.	Picture 79			✓	
5.1.33.	**LED LIGHT UNDER THE CROWS NEST PLATFORM**				✓	
5.1.34.	**INTERLOCKED HOPPER GUARDING** The concrete receiving hopper must be protected with interlocked guarding. The interlock must ensure that any opening of the grate for whatever reason would result in the pump machinery stopping and being isolated to prevent injury from contact with moving parts.					✓

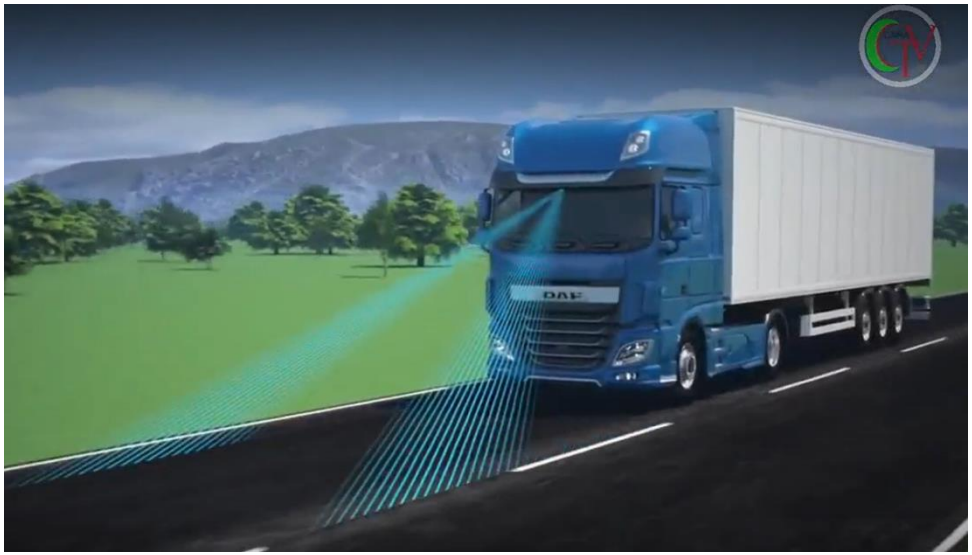
	RECOMMENDED OPTIONS		CEMENT TANKERS	TIPPER TRUCKS (rigid or articulated)	MIXER TRUCKS	CONCRETE PUMPS
5.1.35.	**DRIVER MONITORING SYSTEM** System that can detect driver fatigue or driver distraction. These systems use biological and performance measures to assess the driver's alertness and ability to conduct safe driving practices. Usually, these systems use infrared sensors and cameras to monitor the driver's attentiveness through eye-tracking. If the vehicle detects a possible obstacle, it will notify the driver and if no action is taken, the vehicle may react to the obstacle.	Video 64 Video 65	👍	👍	👍	👍
5.1.36.	**DRIVER ALERT SUPPORT** The system monitors driver behaviour and steering wheel movements. If the truck begins to sway or drift, a warning system alerts the driver, and suggests they take a break.	Video 63	👍	👍	👍	👍
5.1.37.	**MIRROR CAM** Side mirrors replaced with cameras. Large screens fitted inside the cab. The system provides wide-angle mode when manoeuvring backwards, distance lines on the display for better assessing the distance from objects behind the vehicle being driven.	Video 51	👍	👍	👍	👍
5.1.38.	**TRAFFIC SIGN RECOGNITION (TSR)** System that recognizes road signs and put symbols on the dashboard. It is also giving information around speed limit and speeding.		👍	👍	👍	👍

	RECOMMENDED OPTIONS		CEMENT TANKERS	TIPPER TRUCKS (rigid or articulated)	MIXER TRUCKS	CONCRETE PUMPS
5.1.39.	**DYNAMIC STEERING WITH STABILITY ASSIST** System that aims to minimise the risk of skidding and prevent severe accidents by providing automatic counter steering and braking in risky situations.	Video 61	👍	👍	👍	👍
5.1.40.	**WHEEL NUT SECURING DEVICE** Connecting rod behind the wheel studs to prevent the wheel studs from loosening or alternatively technology that detects wheel studs loosening (NSM)	Video 45	👍	👍	👍	👍
5.1.41.	**WHEEL NUT LOSENING DETECTOR** Technology detects wheel nut loosening and warn the driver	Picture 72	👍	👍	👍	👍
5.1.42.	**ARTICULATION ANGLE SUPPORT** System for articulated trucks that measures the position of the tractor unit relative to the trailer during unloading. If the articulation angle is too large the tipping process is stopped. The driver can continue the tipping process on their own responsibility.	Video 55		👍		
5.1.43.	**NON-TIPPING / WALKING FLOOR TRAILER** Truck design that eliminates the risk of vehicle overturn and contact with overhead structures while unloading	Video 54		👍		
5.1.44.	**DIRECT VISION CAB** Truck design that eliminates blind spots around the cab by having lower cab position, wide windscreen and full glass door on the passenger side. The new design also provides safe and comfortable cab access and egress reducing risk of fall. It is recommended for trucks mainly used in city centres.	Picture 75		👍	👍	

	RECOMMENDED OPTIONS		CEMENT TANKERS	TIPPER TRUCKS (rigid or articulated)	MIXER TRUCKS	CONCRETE PUMPS
5.1.45.	**QUICK SLIP FLOOR LINERS** Quick slip floor liners for tipper truck bodies			👍		
5.1.46.	**SAFE LORRY BODY ACCESS** Safe means of access into lorry bodies – access steps inside and out			👍		
5.1.47.	**AUTOMATIC / REMOTE CONTROLLED TARPAULIN SYSTEM** System that eliminates the need to climb on the tipper body to open / close the tarpaulin.	Picture 83 Video 67		👍		
5.1.48.	**AUTOMATIC / REMOTE CONTROLLED TAILGATE** System that minimizing the risk of hand injuries by removing the need for manually open / close tailgates. Some systems have sensors that alarm the driver if the tailgate is not fully closed.	Picture 84 Video 66		👍		
5.1.49.	**SIDE TILT CONTROL ASSISTANT** Stability roll-over control that automatically brakes the vehicle in case of risky situation			👍		
5.1.50.	**WASH OUT SYSTEM** Wash out system installed to rear of vehicle to enable driver to wash chutes off independently. Box catches debris and allows water to be filtered through. All debris collected must be disposed of at authorized location.	Video 60			👍	
5.1.51.	**CHUTE CAMERA** Additional camera aimed on chute with an automatic shutter				👍	

	RECOMMENDED OPTIONS		CEMENT TANKERS	TIPPER TRUCKS (rigid or articulated)	MIXER TRUCKS	CONCRETE PUMPS
5.1.52.	**LADDER PLATFORM WITH STEP AND RAILING ELEVATION**	Picture 80			✓	
5.1.53.	**CARGO CAMERA** Additional camera that allows the driver to check from the cab if the load is evenly distributed within the tipper body.			✓		
5.1.54.	**POWER LINE PROXIMITY ALERT** The system warns the operator by audible signal and warning light when the boom enters a high-risk zone, with a warning distance (that can be configured) from a high voltage line. The system automatically stops the boom movement if it is too close to an electrical power line.	Picture 85				✓
5.1.55.	**PUMP STABILITY CONTROL SYSTEM** System that provides real-time support for pump operators to prevent rollover accidents. Depending on the position of the support and boom, only non-critical movements are allowed. The safe working area is indicated on a colour display.	Video 71 Video 60				✓
5.1.56.	**SELF ADJUSTING WHITE NOISE REVERSING ALARM**	Video 20 Video 53	✓	✓	✓	✓
5.1.57.	**LIGHTWEIGHT AND FLEXIBLE BOOM END HOSE** Device that helps to prevent potential injury caused by hose whip.	Video 68				✓

	INNOVATIONS TO CONSIDER		CEMENT TANKERS	TIPPER TRUCKS	MIXER TRUCKS	CONCRETE PUMPS
5.1.58.	**ALCOHOL IGNITION INTERLOCK DEVICE** Breathalyzer permanently installed in the truck cabin and connected to ignition system. A negative test result before starting the journey is necessary to start the engine.	Video 74	☆	☆	☆	☆
5.1.59.	**REMOTE CONTROLLED TELESCOPIC CHUTES** System that minimizes the need for manual handling of mixer chutes	Video 70 Video 69			☆	
5.1.60.	**LADDER FREE MIXER TRUCK** Truck design that minimizes the need to climb up the back of the truck for daily cleaning.	Picture 86			☆	
5.1.61.	**MIXER DRUM SPEED CONTROL** System that automatically reduces the drum speed while the mixer truck is travelling to prevent rollover accidents				☆	
5.1.62.	**AUTOMATIC TANKER HATCH / AUTO LOADING LID** System that minimizes the need to climb up the tanker to open and close hatches. Tanker hatch is operated from ground level.	Video 73	☆			



Video 42: Example of Lane Departure Warning System (DAF)

Video 43: Example of Advanced Emergency Braking System (Mercedes)

Video 41: Example of Advanced Emergency Braking System (DAF)

Video 44: Example of Advanced Emergency Braking System (Volvo)

Video 46: [Examlpe of Tyre Pressure monitoring System (Volvo)]

Picture 72: Example of Wheel Loss Sensors and Brackets (Wheely Safe)

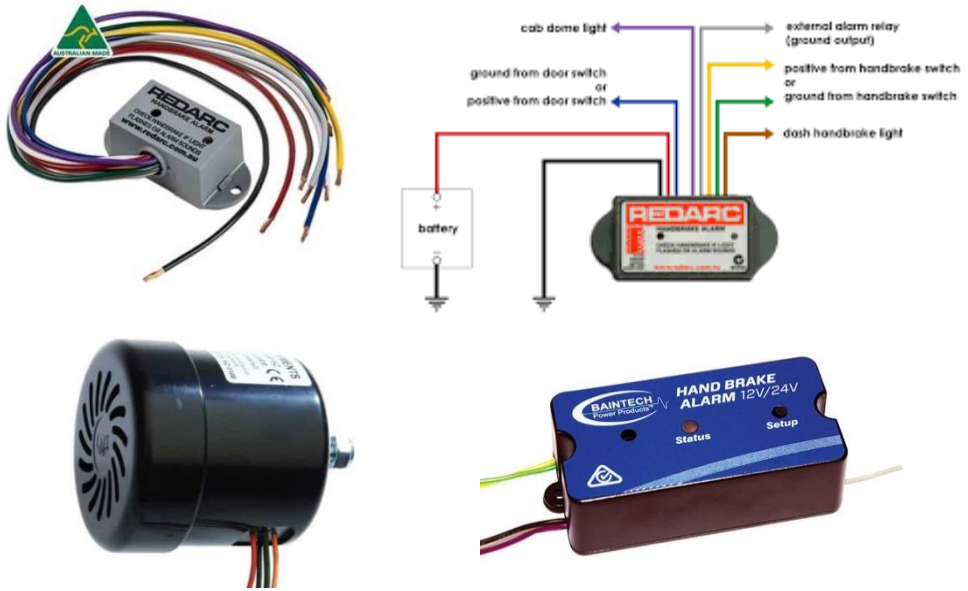
Video 47: [Example of adjustable Wheel Nut Indicator (HexChex)]

Video 45: [Example of Wheel Nut Securing Device (Zafety Lug Lock)]

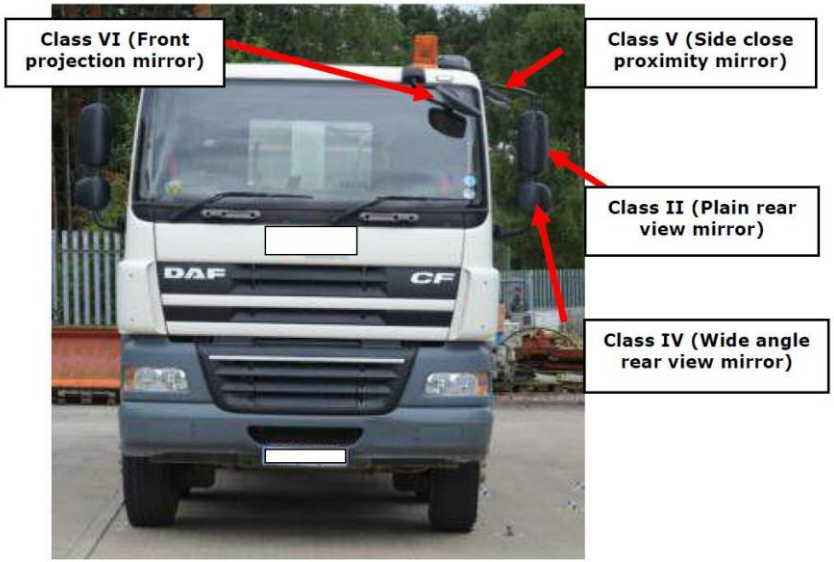
Video 49: [Example of Side Collision Avoidance System - Side Collision Avoidance Support (Volvo)]

Video 50: [Example of Side Collision Avoidance System - Sideguard Assist (Mercedes)]

Video 48: [Example of Side Audible Warning Alarm (Brigade)]

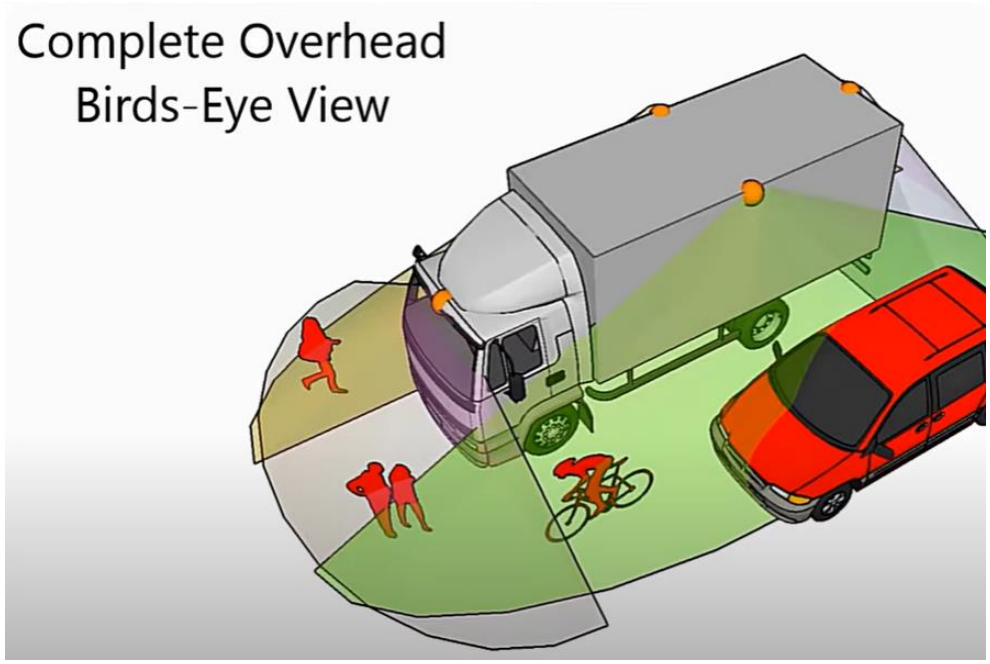


Picture 73: Examples of retrofittable handbrake alarms




Picture 74: Example of blind spot mirrors


Video 51: [Example of MirrorCam (Mercedes)]



Video 52: [Example of 360° Blind Spot Camera System with Bird-eye view feature (Brigade)]

Picture 75: Examples of Direct Vision Trucks

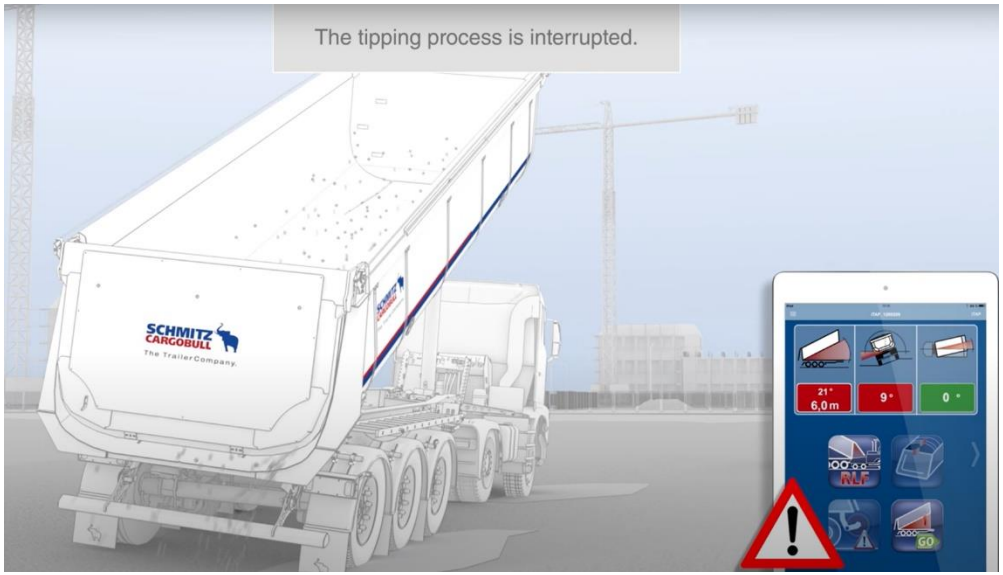
Picture 77: Examples of Blind Spot Warning Signs

Video 54: [Example of Non-tipping Trailer - Eliminating risk of vehicle overturn]

Video 53: [Example of self-adjusting white noise reversing alarm – (Brigade)]

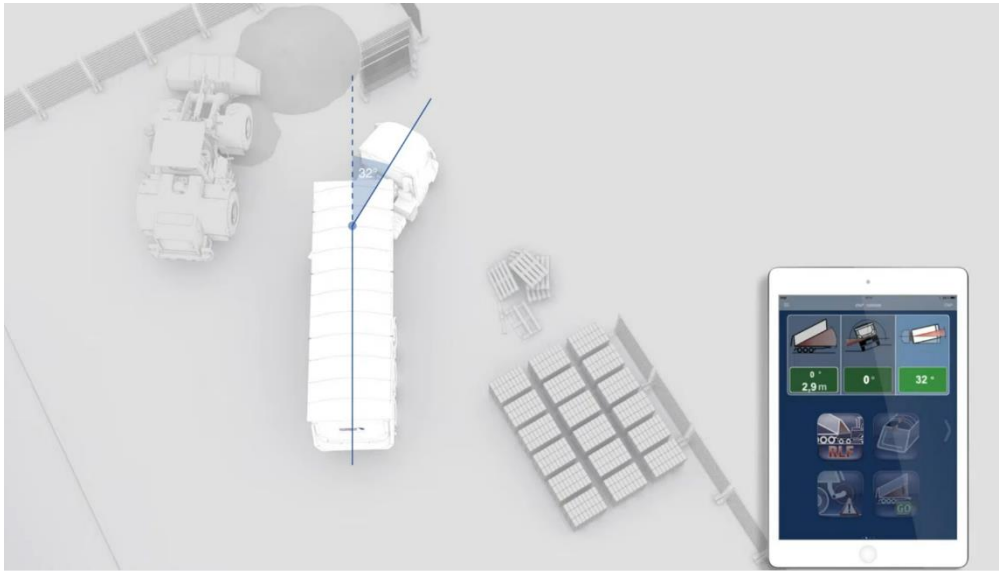
Picture 76: Examples of high-visibility seat belt

Video 58: [Example of Active Inclinometer for tipper trucks – System warns the driver and stops tipping]



Video 57: [Example of inclinometer - Tilt Angle Assistant (Schmitz)]

Video 56: [Example of Body Raised Warning System - Tipping Angle Assistant (Schmitz)]



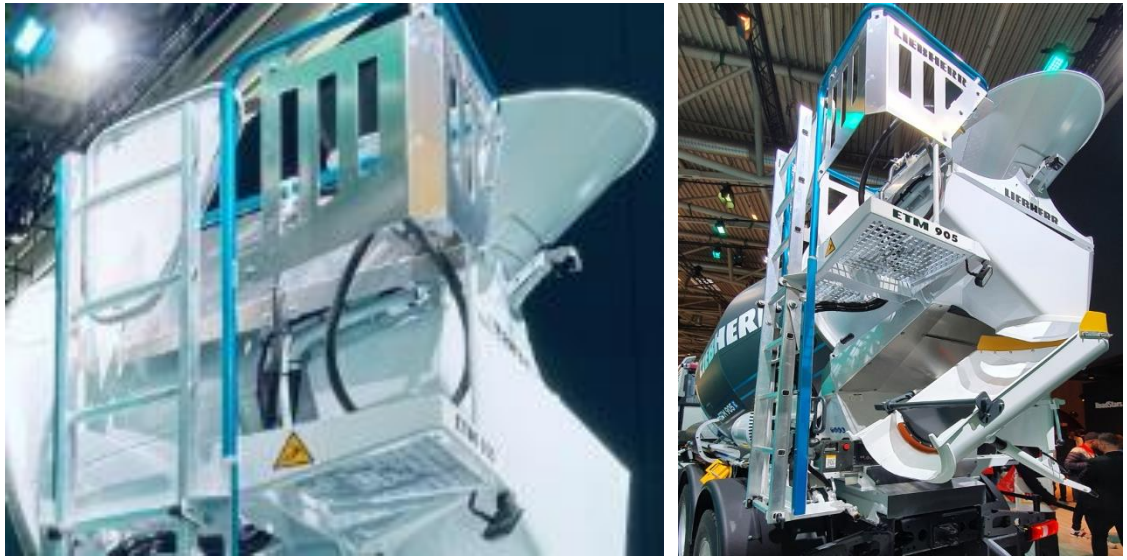
Video 55: [Example of Articulation Angle Support (Schmitz)]

Picture 78: Examples of lightweight extension chutes

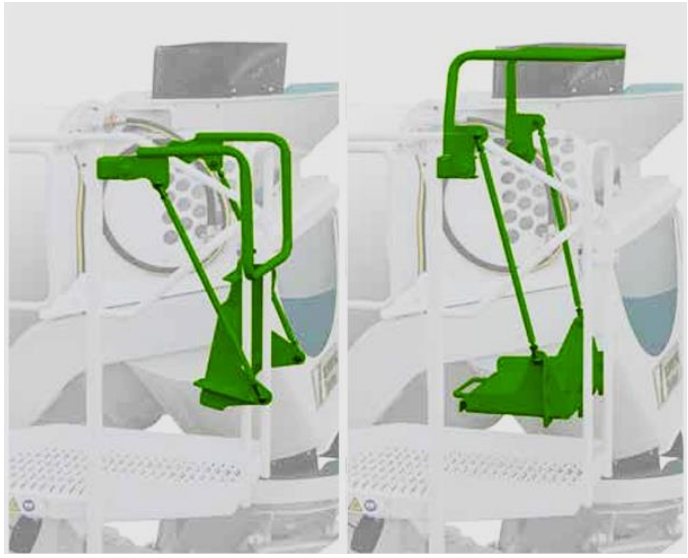
Video 59: [Example of Finger Trap Prevention Device for folding type chutes]

Picture 79: Example of drum lock (Imer)

Video 60: [Example of chute washout system - Away Wash (Jonesco)]

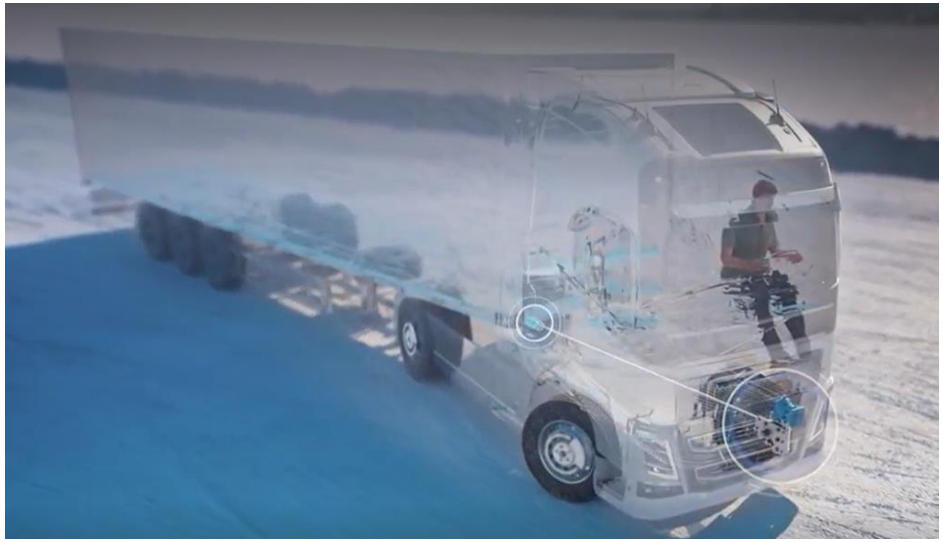


Picture 81: Example of guarded crows nest platform with self-closing anti-fall safety bar – Guardrail is designed to prevent drivers standing on the middle rail



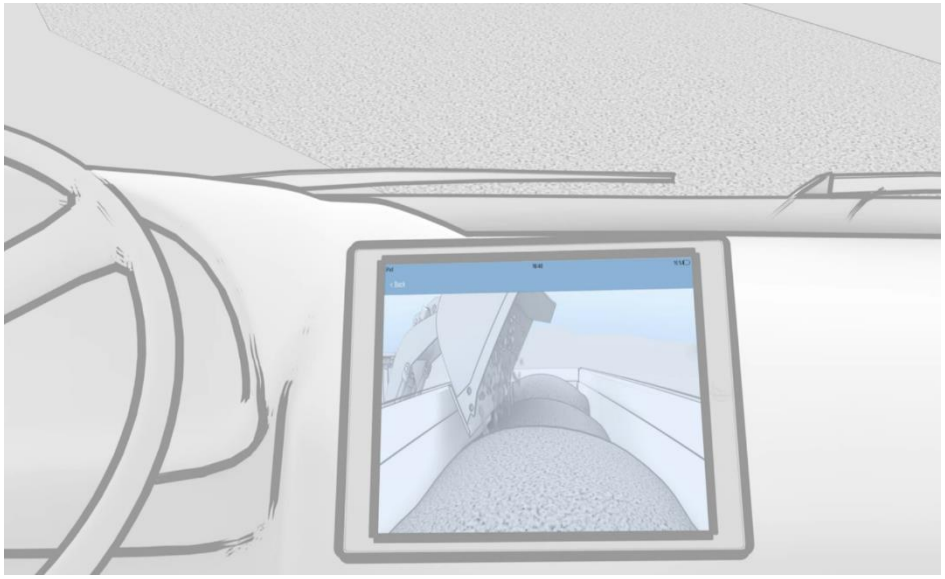
Picture 80: Example of ladder platform with step and railing elevation (Stetter)

Picture 82: Examples of tipper body props

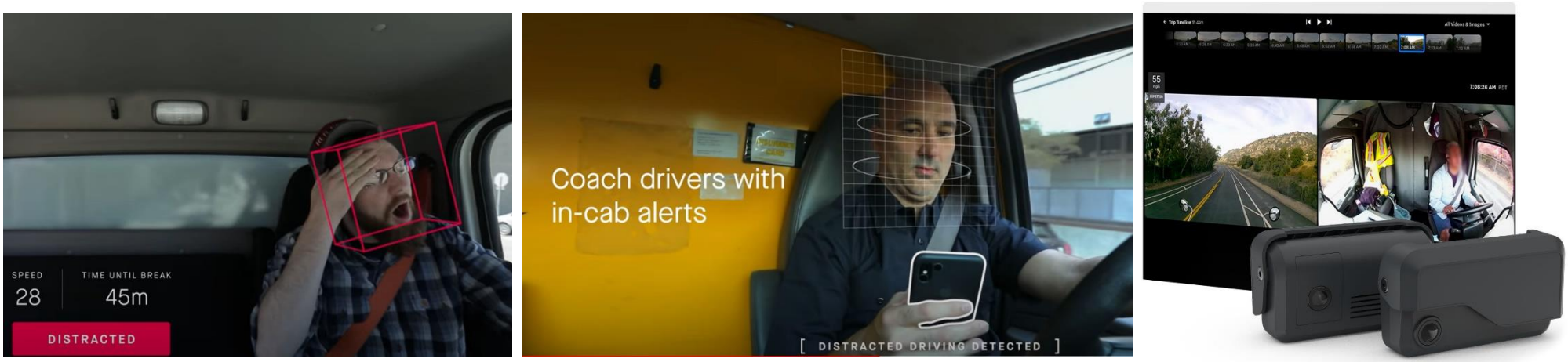


Video 61: [Example of Dynamic Steering with Stability Assist (Volvo)]

Video 63: [Example of river Alert Support (Volvo)]



Video 62: [Example of Cargo Camera for tipper trucks (Schmitz)]



Video 64: [Example of Driver Fatigue Monitoring System - Driver monitoring with AI dashcam (Samsara)]

Video 65: [Example of Driver Fatigue Monitoring System (Movon)]

Picture 83: Examples of Automatic Tarpaulin Systems

Video 67: [Example of remote controlled electric tarpaulin (Schmitz)]

Picture 84: Examples of Automatic / Remote-controlled Tailgates

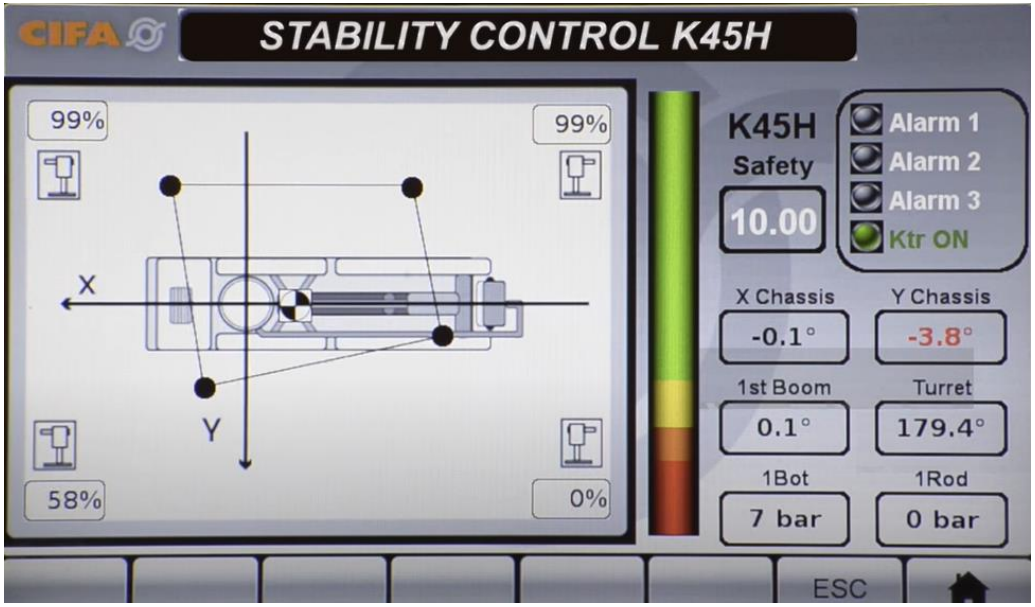
Video 66: [Example of remote-controlled tailgate (Schmitz)]

Picture 85: Example of Powerline Proximity Alert System (Sky NG Radio)

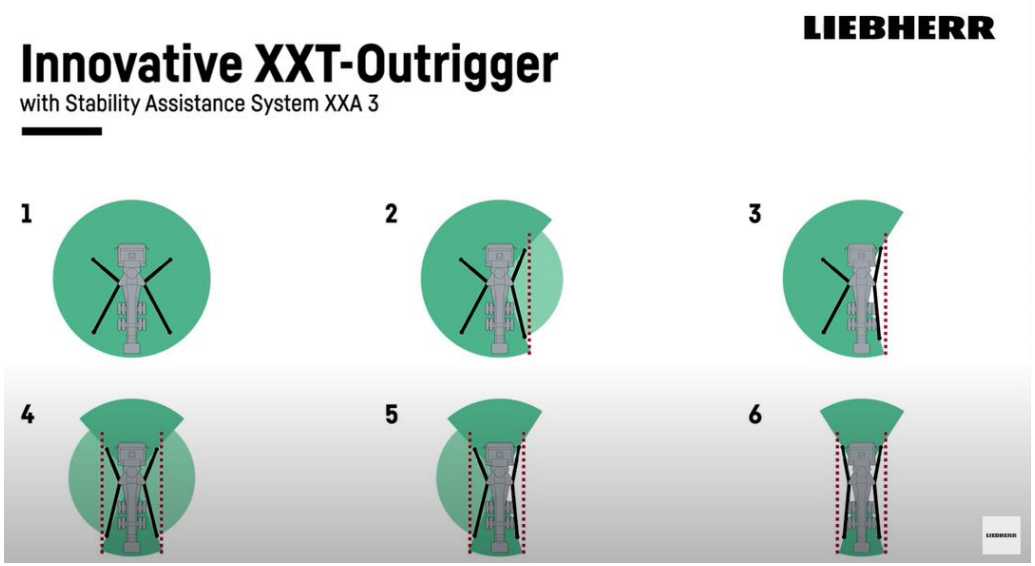
Video 68: [Example of Lightweight and Flexible Boom End Hose (Mandals)]

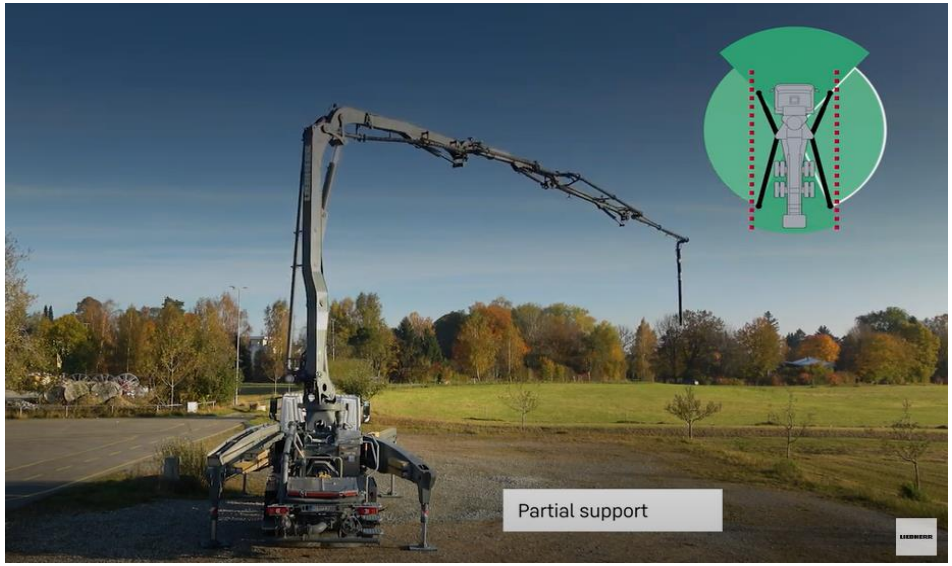
Video 70: [Example of Telescopic Chutes - Ezextenz]

Video 69: [Example of Telescopic Chutes (Immer)]



Video 71: [Example of Pump Stability Control System – Smartronic (CIFA)]





Video 72: [Example of Pump Stability Control System - XXA Stability Assistance (Liebherr)]

Video 74: [Example of Alcohol ignition interlock (Dräger)]

Picture 86: Example of ladder free mixer truck (Hymix)

Video 73: [Example of Automatic Tanker Hatch System - Auto Loading Lid (Felbinder)]


Safety
Begins
with Me