



RECOMMENDED MINIMUM SAFETY FEATURES FOR CONTAINER YARD EQUIPMENT

A joint initiative from Port Equipment Manufacturers Association, TT Club and ICHCA International



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First published June 2012 | 2nd Edition December 2012
ISBN 978-1-85330-039-4

INTRODUCTION

In a concerted effort to reduce injuries and loss of life, as well as to minimise equipment damages, costs and business disruption at port and terminal operations worldwide, the Port Equipment Manufacturers Association (PEMA), the TT Club and ICHCA International agreed in 2010 to join forces in creating recommended minimum safety features for use on all quay container cranes.

The result of this first joint initiative was the June 2011 publication of the *Recommended Minimum Safety Specifications for Quay Container Cranes*, providing a baseline specification for quay container cranes in relation to safety features that should be included as standard, not optional, to reduce risks to people, cargo and equipment.

Recognising the equal importance of safety in container yard operations, this second joint document, first published in June 2012 and further revised in this edition of December 2012, is the result of research and consultation over a 12 month period under the auspices of PEMA's Safety Committee.

To achieve the aims of this project, all the relevant stakeholders have been involved. PEMA represents the yard equipment as well as technology suppliers. The TT Club and ICHCA International represent the container terminals.

Just as for quay cranes, there are many features and technologies that can dramatically improve equipment safety in container yards. However, many of these are not currently included on new or existing equipment.

Intended for use both by users and suppliers of yard equipment, this *Recommended Minimum Safety Features for Container Yard Equipment* therefore sets out to provide baseline recommendations for minimum safety features that should be included on the various types of container yard equipment, to help reduce injuries and damage and enable better risk management.

The document covers all of the major types of manual and automated container yard

equipment, including RTGs (rubber tired gantry cranes), RMGs (rail mounted gantry cranes), ASCs (automated stacking crane), AGVs (automated guided vehicles), lift trucks, reach stackers and terminal tractors/yard vehicles.

These recommendations do not carry any force of law, and are independent of the various local, national and international regulatory regimes on the safe design, manufacture, specification and operation of the various yard equipment types, which must also be satisfied. Adoption of equipment technologies to enhance safety, which is the primary focus of this document, must also go hand-in-hand with the development of robust operational safety processes.

The hope of all three parties, however, is that the equipment safety features outlined here will be embraced both by buyers and suppliers as a minimum industry standard.

DISCLAIMER

This document has been jointly developed by PEMA, TT Club and ICHCA International according to the information available at the time of publication. It does not constitute professional advice, nor is it an exhaustive summary of the information available on the subject matter to which it refers.

This document should always be read and used in conjunction with the relevant national and international legislation and any applicable regulations, standards and codes of practice. Every effort is made to ensure the accuracy of the information but neither PEMA, TT Club, ICHCA International, nor any of their members, is responsible for any loss, damage, costs or expenses incurred (whether or not in negligence) arising from reliance on or interpretation of the data.

ABOUT PEMA

The Port Equipment Manufacturers Association (PEMA) was established in late 2004 to provide a forum and public voice for the global port equipment and technology sectors, reflecting their critical role in enabling safe, secure, sustainable and productive ports,

and thereby supporting world maritime trade. Chief among the aims of the Association is to foster good relations within the world port equipment and technology community, by providing a forum for the exchange of views on trends in design, manufacture and operation of port equipment and technology.

PEMA also promotes and supports the global role of port equipment and technology by raising awareness with customers, the media and other stakeholders; forging relations with other port industry associations and bodies; and contributing to best practice initiatives and information.

PEMA's growing membership represents a cross-section of port equipment OEMs; suppliers of equipment and other terminal technologies including brakes, cables and reels, cabins, drive controls, automation and electrification systems, lighting and tyres; providers of software applications, process automation and other advanced data technologies, and consultants in the field of port design, equipment and technology.

This document is designated BP2 in the PEMA series of Best Practice Recommendations.

www.pema.org

ABOUT TT CLUB

The TT Club is the international transport and logistics industry's leading provider of insurance and related risk management services. Established in 1968, the Club's membership comprises ship operators, ports and terminals, road, rail and airfreight operators, logistics companies and container lessors.

The Club is well capitalised and backed by an AM Best-A (Excellent) financial strength rating. It has four underwriting centres in London, New Jersey, Hong Kong and Sydney and a network of claims offices in a further 16 countries. The Club is committed to excellent service and has worked with brokers over many years to tailor propositions to the specific

needs of clients. A personalised claims service is supported by a philosophy of being at the members' sides and the Club takes a sympathetic approach to paying claims. The Club also has a dedicated team of risk professionals, who run an innovative risk management and loss prevention programme to provide information on good practice, legal and industry developments.

www.ttclub.com

ABOUT ICHCA INTERNATIONAL

ICHCA International is the only global association dedicated to the promotion of safety and efficiency in the handling and movement of goods by all modes and throughout the supply chain.

Originally established in 1952 and incorporated in 2002, the Association operates through a series of local, national and regional Chapters, Expert Panels, Working Groups and Correspondence Groups and represents the cargo handling world at various international organisations, including the International Maritime Organization (IMO), United Nations Conference on Trade and Development (UNCTAD), International Labour Organization (ILO) and ISO, the International Organization for Standardization.

ICHCA International members include ports, terminals, transport companies and other groups associated with cargo handling and coordination. Members of its Panels represent a substantial cross-section of senior experts and professionals from all sectors of the cargo handling and logistics industry globally. Members benefit from consulting services and informative publications dealing with technical matters, best practice advice and cargo handling news.

This document is designated GS9 in the ICHCA International General Series of publications.

www.ichca.com

1. BACKGROUND

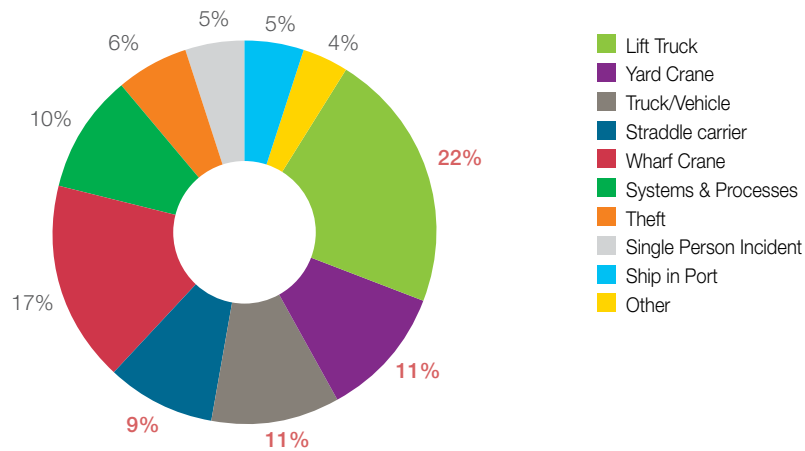


Chart 1: TT Club global analysis of yard equipment claims in ports and terminals

With over 2,000 insured operations, including over 400 ports and terminals globally, the claims data gathered by the TT Club provides a real perspective on the types and causes of accidents globally. An analysis of claims from TT Club port and terminal members globally identified that 53% of the cost of these insurance claims are yard equipment related. This statistic was the catalyst for the container yard equipment standard safety features project. As analysed by the TT Club, the major causes of accidents and claims for the different equipment types are:

TRUCKS/VEHICLES • Collisions with vehicles • Collisions with people • Overturning	YARD CRANES • Collisions • Hitting equipment and people • Knocking boxes from stacks
LIFT TRUCKS • Collisions with other equipment • Collisions with people • Tipping forwards • Dropping boxes	STRADDLE CARRIERS • Collisions with other straddles • Collisions with other vehicles • Collisions with container stacks • Overturning

2. SCOPE & AIMS

It is recognised that there are many features available for container yard equipment that can dramatically improve the safety of people, equipment and cargo. However, many of these features are not currently included on new or existing equipment.

PEMA, the TT Club and ICHCA are committed to supporting and promoting technological advances and best practice that will enhance safety and performance in the operational port and terminal environment.

This document therefore aims to provide a benchmarked recommended minimum safety specification for all major types of yard equipment.

The document provides an overview of recommended safety features for all yard equipment types, plus detailed lists and graphics for individual equipment types.

The lists cover systems, structures, features, equipment and technology that have been proven to reduce injury or damage and which are currently not standard.

The recommendations are not exhaustive, but constitute a shortlist based on experience, accident records and insurance claims analysis. The ultimate goal of this initiative is that these recommended safety features, which have been proven to reduce injury and damage, should be adopted by the industry.

It is important to stress that applicable international, national and local regulatory standards are mandatory, while these *Recommendations* are voluntary. The Machinery Directive, which is mandatory in all EU member countries and also now accepted in many countries around the world, represents one such key regulatory standard which these *Recommendations* seek to support.

A principal aim in producing these *Recommendations* is to provide baseline safety features that can be used in the procurement of new yard equipment. Many, if not all, of these



safety features can also be retrofitted to existing yard equipment and this is equally recommended.

The objective is for suppliers to include the features on this list as standard in all their quotations for new equipment. Terminals and buyers are also encouraged to include these features as standard in their tender specifications.

Inevitably, equipment procurement is price sensitive, requiring significant budget, and buyers will not always be familiar with the most effective safety technologies.

Furthermore, the process frequently is complex: any quote needs to be carefully assessed against the invitation to tender, and subsequent change requests can be costly. For these

reasons, the tender specifications should provide a minimum safety baseline.

If all equipment suppliers were to adopt these features, it is not anticipated that competitiveness would be affected, nor should it significantly affect the equipment base price.

The resulting safety enhancements would reduce injuries and damage costs over the life of the equipment, and improve the reputation both of the port and container terminal industry and the equipment manufacturers through the increased focus on safety.

Yard equipment manufacturers that include the recommended minimum safety features in their initial quotations, and not as optional, will be entitled to state in their tender quotation:

“This tender quotation includes all the minimum safety features recommended by PEMA, the TT Club and ICHCA International”.



3. MINIMUM SAFETY FEATURES

3.1 YARD EQUIPMENT RECOMMENDED SAFETY FEATURES OVERVIEW

Table 1:
Recommended minimum yard equipment safety features

STANDARD SAFETY FEATURE	RTG	RMG	ASC	STRADDLE CARRIER	LIFT TRUCK	AGV	TERMINAL TRACTOR
Travel anti-collision	•	•	•	•		•	
Operator cabin air filtration system				•	•		•
Wind speed detection and alarm	•	•	•				
Equipment braking/ parking	•	•	•	•			
Measure container weight and eccentricity	•	•	•	•	•		
Temperature and/or smoke detection	•	•	•	•			
Fire detection and suppression	•	•	•	•	•	•	•
Risk area access protection	•	•	•	•			
Control for even load balance on rope	•			•			
Storm pins for trolley fixing	•	•	•				
Stop of trolley movement if container approaches sill beam		•	•	•			
Reefer rack anti-collision				•			
Rear drive anti-collision					•		
Fifth wheel locking indication							•
Seat belt				•	•		•

STANDARD SAFETY FEATURE	RTG	RMG	ASC	STRADDLE CARRIER	LIFT TRUCK	AGV	TERMINAL TRACTOR
Auto steering system	•						
Anti-truck lifting	•	•	•				
Truck driver safe location			•				
Container yard profiling/ height control			•				
Visibility improvement	•	•		•			
Safe speed control system						•	
Fail safe brake control						•	

Table 2:
Recommended optional yard equipment safety features

OPTIONAL SAFETY FEATURE	RTG	RMG	ASC	STRADDLE CARRIER	LIFT TRUCK	AGV	TERMINAL TRACTOR
Load & position indication to prevent entry into prohibited zones					•		
Protection to avoid people being caught under wheel	•						

A NOTE ON APPLICABLE STANDARDS

Behind these voluntary statements there are national and international standards that impact equipment safety and these must be reviewed and their implications incorporated. Applicable international, national and local regulatory standards, such as the EU Machine Directive, as well as local Authority requirements, should be considered in all cases.

3.2 RTG SAFETY FEATURES

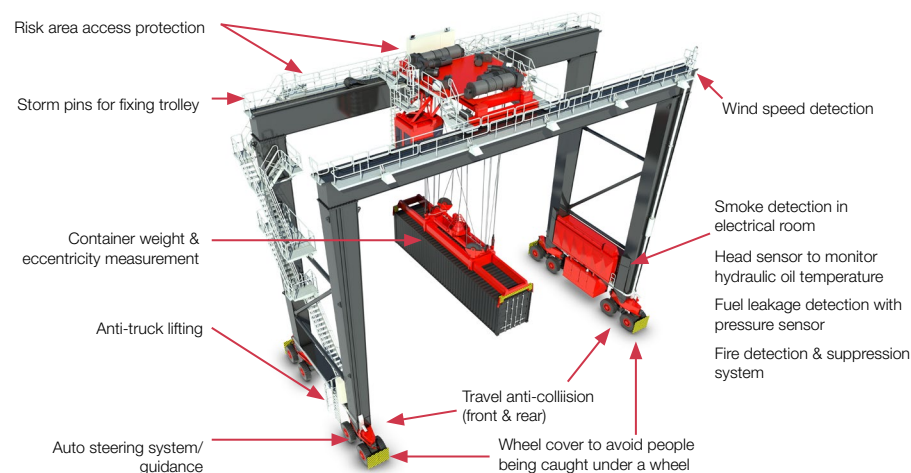


Table 3:
RTG recommended minimum safety features

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
Crane colliding with objects near vicinity.	Travel anti-collision. ⁽¹⁾	A minimum of 2 detection zones: • Warning or slow down • Stop Detection range shall be such to allow enough time for the crane to come to a "normal" stop. Detection zones shall be designed for pathway and cross-travel anti-collision. Annual test of stopping distance required due to wear, tear and aging of the braking system.
Person being run over.	Protection to avoid persons being run over by a wheel.	Mechanical wheel cover to protect people from being caught under wheel (as a secondary added option to electrical warning and stopping solutions).

⁽¹⁾ Anti-collision should be a general requirement for all equipment types. In all cases, obstacles should be monitored in the direction of travel.

RTG recommended minimum safety features cont'd

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
Damage and injury caused by operating RTGs in high winds.	Wind speed detection and alarm to enable driver to stop the operation, park and safely shutdown equipment. ⁽²⁾	An anemometer shall be installed in clear air at the top of the crane giving audible and visual indication in the driver's cab that the safe operating wind limit has been reached. An audible alarm shall also be installed to indicate to persons on the berth that this limit has been reached. The anemometer shall be rated well over the expected worst case windstorm. Wind speed, direction and time shall be recorded. The maximum operating wind speed should be set at 22m/s. Equipment must not shut down automatically, even if the alarm sounds continuously. This allows the equipment to travel to the storm pin/tie-downs or parking position.
Uncontrolled movement caused by sudden high wind.	Equipment braking/parking that is resistant to improper use and manipulation as well as environmental aspects and influences.	Equipment braking system shall be designed to hold the equipment with a wind speed of 40m/s wind. Design shall take into account uneven weight distribution that the braking force is transferred to track. A fail safe spring-applied brake design, where torque is applied by several springs, should be specified.
Overloaded or misdeclared container weights and eccentrically loaded containers.	Measure the weight and eccentricity of each container/load.	System to measure, indicate and record the actual weight and eccentricity of each container/load. Data to be capable of being transferred to the terminal operating system. ⁽³⁾
Electrical and machine room fire.	Temperature and/or smoke detection in the electrical and machine room.	Temperature and smoke detection alarm systems inside the electrical control room which give audible and visual alarms in the driver's cabin, electrical room and on the ground level of the gantry structure. In case of temperature/smoke detection, information should be transmitted to the maintenance office.

⁽²⁾ The terminal should be equipped with a centralised detection system to record wind speed, direction and time to support all terminal equipment.

⁽³⁾ A container weight and eccentricity measurement system installed on lift equipment should be a control system for safe yard operations. It should not be deemed to assume legal responsibility for overloaded or wrongly declared container weights and eccentrically loaded containers.

RTG recommended minimum safety features cont'd

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
Equipment fire due to hydraulics or fuel.	Protecting against the risk of fires with reliable detection and suppression.	For hydraulic systems: A head sensor at the hydraulic system that can stop activities after hydraulic oil reaches 90°C degree to avoid the risk of fire. For fuel systems: A pressure sensor after the fuel pump to warn the operator of fuel leakage and stop the engine immediately. Use of fire detection and suppression system in engine compartments.
Falling or jamming between movable parts of the RTG while personnel are entering enclosed non access or operating areas.	Prevent unintended access to risk areas.	Spring set self-closing gates with positive means to open. Any access gates to risk areas shall be interlocked to prevent access when not in parked positions or when in operation and to prevent equipment operation when open. Use of safety relevant door switches is recommended, ideally with locking function until dangerous movement has come to a complete halt. Pedestrian restraint to prevent access to crane risk areas.
Tipping of a container.	Control for even load distribution.	Control for load balance on all ropes. Lifting engines to shut off if load is unbalanced or if the allowable eccentricity of the centre of gravity is exceeded.
The trolley is carried away by wind.	Device to fix the trolley to the bridge.	Storm pins for fixing the trolley in the parking position on crane bridge.
Collision with container in stack or other fixed structures when long traveling.	Auto steering system.	DGPS, reliable optical distance measurement or two-dimensional scanning sensor to maintain RTG on track.

RTG recommended minimum safety features cont'd

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
Lifting truck/trailer when hoisting container due to twist locks not being unlocked.	Anti-truck lifting.	Reliable optical sensor measurement system with specific detection zones to monitor truck/trailer wheels or wheel axles. Sensor mounted on inside of truck lane sill beam to stop hoist activity when truck/trailer lifting is identified. If a container weighing system is used in lifting equipment the measured container weight can be compared with the pre-indicated weight and lifting movement can be stopped in case of extreme increased weight (container still locked with trailer).

General note: An emergency stop should be a general requirement for all large equipment types and is a basic safety requirement on all such machines.

3.3 RMG SAFETY FEATURES

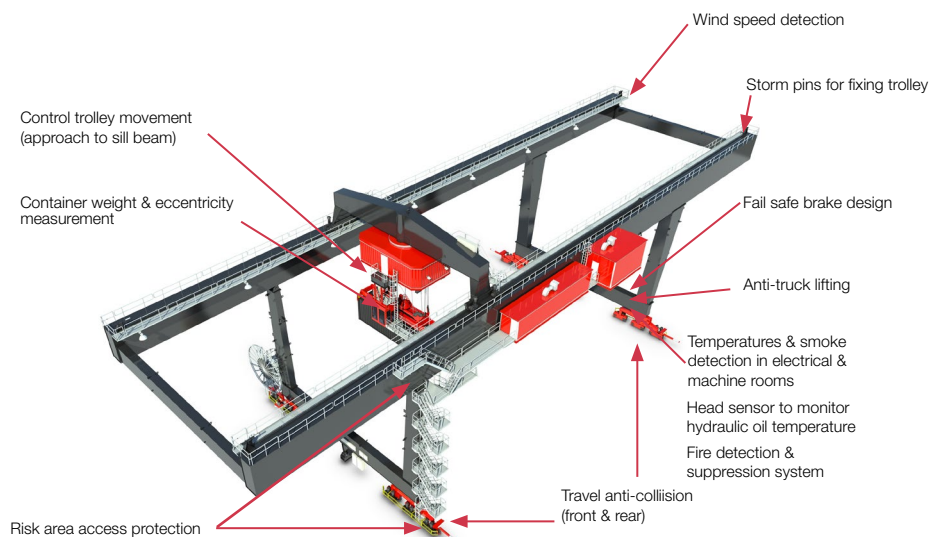


Table 4:
RMG recommended minimum safety features

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
Equipment colliding with objects on tracks or near vicinity.	Travel anti-collision. ⁽¹⁾	A minimum of 2 detection zones: • Warning or slow down • Stop Detection range shall be such to allow enough time for the crane to come to a "normal" stop. Annual test of stopping distance required due to wear, tear and aging of the braking system.

⁽¹⁾ Anti-collision should be a general requirement for all equipment types.

RMG recommended minimum safety features cont'd

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
Damage and injury caused by operating RMGs in high winds.	Wind speed detection and alarm to enable driver to stop the operation, park and shut down the equipment safely. ⁽²⁾	An anemometer shall be installed in clear air at the top of the crane giving audible and visual indication in the driver's cab that the safe operating wind limit has been reached. An audible alarm shall also be installed to indicate to persons on the berth that this limit has been reached. The anemometer shall be rated well over the expected worst case windstorm. Wind speed, direction and time shall be recorded. The maximum operating wind speed should be set at 22m/s. Equipment must not shut down automatically, even if the alarm sounds continuously. This allows the equipment to travel to the storm pin/tie-downs or parking position.
Uncontrolled movement caused by sudden high wind.	Equipment braking/parking that is resistant to improper use and manipulation as well as environmental aspects and influences.	Braking system shall be designed to stop and hold equipment with a wind speed of 40m/s from behind. Design shall take into account uneven weight distribution that the braking force is transferred to track. This means no wheel skidding under normal braking. Fail safe spring-applied brake design, where torque is applied by several springs, should be specified.
Overloaded or misdeclared container weights and eccentrically loaded containers.	Measure the weight and eccentricity of each container/load.	System to measure, indicate and record the actual weight and eccentricity of each container/load. Data to be capable of being transferred to the terminal operating system. ⁽³⁾
Electrical and machine room fire.	Temperature and/or smoke detection in the electrical and machine room.	A temperature and smoke detection alarm system inside the electrical control and machinery rooms which give audible and visual alarms in the driver's cabin, electrical and machinery rooms, outside the machinery house access door and on the landside sill beam. In case of temperature/smoke detection, information should be transmitted to the maintenance office.

⁽²⁾ The terminal should be equipped with a centralised detection system to record wind speed, direction and time.

⁽³⁾ A container weight and eccentricity measurement system installed on lift equipment should be a control system for safe yard operations and should not be deemed to assume legal responsibility for misdeclared container weights.

RMG recommended minimum safety features cont'd

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
Equipment fire due to hydraulics	Protect against the risk of fires with reliable fire detection and suppression.	For hydraulic systems: A head sensor at the hydraulic system that can stop activities after hydraulic oil reaches 90°C degree to avoid the risk of fire. Use of fire detection and suppression system in engine compartments.
Falling or jamming between movable parts of the equipment while personnel entering enclosed non access or operating areas.	Prevent unintended access to risk areas.	Spring set self-closing gates with positive means to open. Any access gates to risk areas shall be interlocked to prevent access when not in parked positions or when in operation and to prevent equipment operation when open. Use of safety relevant door switches is recommended, ideally with locking function until dangerous movement has come to a complete halt. ITV pedestrian restraint to prevent access to crane risk areas.
The trolley is carried away by wind.	Device to fix the trolley to the bridge.	Storm pins for fixing the trolley in the parking position on crane bridge.
For cantilever designs: a container hits the sill beam, a container is lowered onto the sill beam.	Device that stops trolley movement and lifting if a container approaches the sill beam.	Protection device that controls container height, distance to sill beam and takes into account container rotation. If a container reaches a predetermined proximity to the sill beam, the device should switch off appropriate mechanisms. Mechanisms can be switched on only for movement in opposite direction.
Lifting truck/trailer when hoisting container due to twist locks not unlocked.	Anti-truck lifting.	Reliable optical sensor measurement system with evaluation of spec. detection zones to monitor truck/trailer wheels or wheel axles. Sensor mounted on inside of truck lane sill beam to stop hoist when truck/trailer lifting is identified. If a container weighing system is used in lifting equipment the measured container weight can be compared with the pre-indicated weight and lifting movement can be stopped in case of extreme increased weight (container still locked with trailer).

General note: An emergency stop should be a general requirement for all large equipment types and is a basic safety requirement on all such machines.

3.4 ASC SAFETY FEATURES

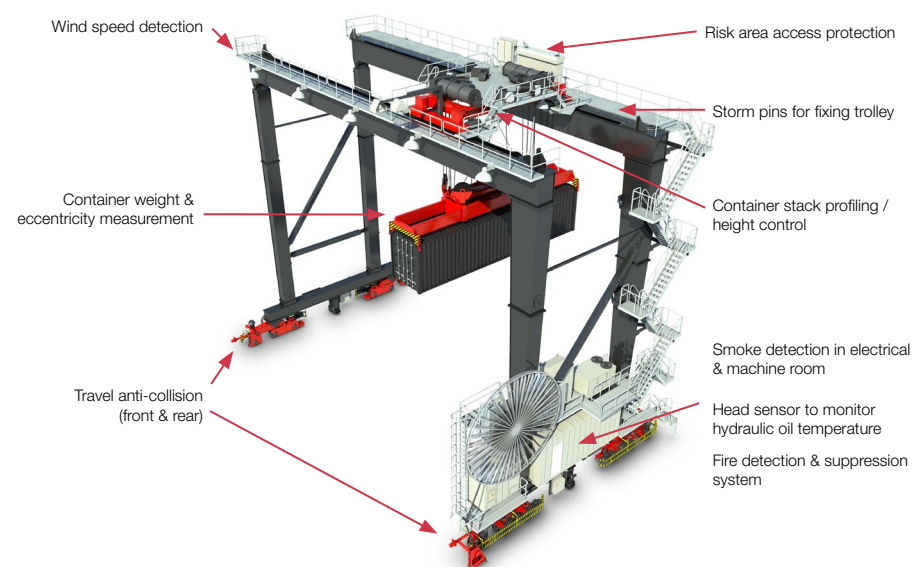


Table 5:
ASC recommended minimum safety features

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
Equipment colliding with objects on tracks or near vicinity	Travel anti-collision. (1)	A minimum of 2 detection zones: • Warning or slow down • Stop Detection range shall be such to allow enough time for the crane to come to a "normal" stop. Annual test of stopping distance required due to wear, tear and aging of the braking system.

(1) Anti-collision should be a general requirement for all equipment types. In all cases, obstacles should be monitored in the direction of travel.

ASC recommended minimum safety features cont'd

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
Damage and injury caused by operating the equipment in high winds.	Wind speed detection and alarm to enable to stop the operation, park and shutdown the equipment safely. ⁽²⁾	An anemometer shall be installed in clear air at the top of the crane giving an audible and visual indication in the remote control center that the safe operating wind limit has been reached. The anemometer shall be rated well over the expected worst case windstorm. The wind speed, direction and time shall be recorded. The maximum operating wind speed should be set at 22m/s. Equipment must not shut down automatically, even if the alarm sounds continuously. This allows the equipment to travel to the storm pin/tie-downs or parking position.
Overloaded or misdeclared container weights and eccentrically loaded containers.	Measure the weight and eccentricity of each container/load.	System to measure, indicate and record the actual weight and eccentricity of each container/load. Data to be capable of being transferred to the terminal operating system. ⁽³⁾
Electrical and machine room fire.	Temperature and/or smoke detection in the electrical and machine room.	A temperature and smoke detection alarm system inside the electrical control and machinery rooms which give audible and visual alarms in the electrical and machinery rooms, on the crane. In case of temperature/smoke detection, information should be transmitted to the maintenance office.
Equipment fire due to hydraulics.	Protecting equipment against the risk of fires with reliable fire detection and suppression.	For hydraulic systems: A head sensor at the hydraulic system that can stop activities after hydraulic oil reaches 90°C degree to avoid the risk of fire. Use of fire detection and suppression system in engine compartments.

⁽²⁾ The terminal should be equipped with a centralised detection system to record wind speed, direction and time to support all terminal equipment.

⁽³⁾ A container weight and eccentricity measurement system installed on lift equipment should be a control system for safe yard operations. It should not be deemed to assume legal responsibility for overloaded or wrongly declared container weights and eccentrically loaded containers.

ASC recommended minimum safety features cont'd

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
Falling or jamming between movable parts of the equipment while personnel entering enclosed non access or operating areas.	Prevent unintended access to risk areas.	Spring set self-closing gates with positive means to open. Any access gates to risk areas shall be interlocked to prevent access when not in parked positions or when in operation and to prevent equipment operation when open. Use of safety relevant door switches is recommended, ideally with locking function until dangerous movement has come to a complete halt. ITV pedestrian restraint to prevent access to crane risk areas.
The trolley is carried away by wind.	Device to fix the trolley to the bridge.	Storm pins for fixing the trolley in the parking position on crane bridge.
For cantilever designs: a container hits the sill beam, a container is lowered onto the sill beam.	Device that stops trolley movement and lifting if a container approaches the sill beam. Container yard profiling/ height control.	Protection device that controls container height, distance to sill beam and takes into account container rotation. If a container reaches a predetermined proximity to the sill beam, the device switches off appropriate mechanisms. Mechanisms can be switched on only for movement in the opposite direction.
Lifting truck/trailer when hoisting container due to twist locks not unlocked.	Anti-truck lifting.	Reliable optical sensor measurement system with evaluation of spec. detection zones to monitor truck/trailer wheels or wheel axles. Sensor mounted on inside of truck lane sill beam to stop hoist when truck/trailer lifting is identified. If a container weighing system is used in lifting equipment the measured container weight can be compared with the pre-indicated weight and lifting movement can be stopped in case of extreme increased weight (container still locked with trailer).
Collision with truck driver (pedestrian) at road end of stack.	Truck driver safe location.	Detection sensor technology or pressure sensitive mats, confirmation button to ensure that truck driver is in a safe location during container handling or ASC functions will be stopped.

General note: An emergency stop should be a general requirement for all large equipment types and is a basic safety requirement on all such machines.

3.5 STRADDLE CARRIER SAFETY FEATURES

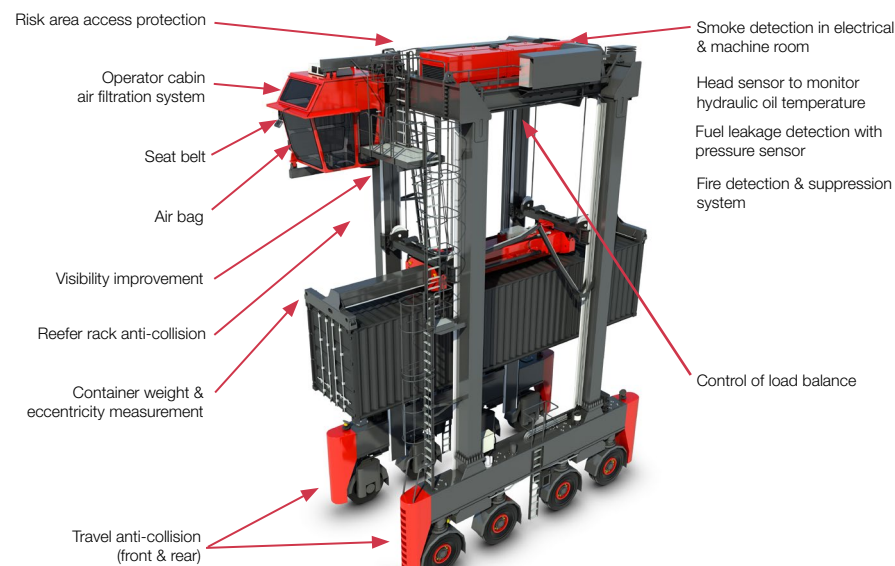


Table 6:
Straddle carrier recommended minimum safety features

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
Equipment colliding with reefer rack and objects on tracks or near vicinity.	Travel anti-collision. ⁽¹⁾	A minimum of 2 detection zones: • Warning or slow down • Stop Detection range shall be such to allow enough time for the straddle carrier to come to a "normal" stop. Annual test of stopping distance required due to wear, tear and aging of the braking system.

⁽¹⁾ Anti-collision should be a general requirement for all equipment types. In all cases, obstacles should be monitored in the direction of travel.

Straddle carrier recommended minimum safety features cont'd

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
Drivers adversely affected by emissions or other air pollutants at waterside.	Operator cabin air filtration system.	The cabin shall be provided with a proven positive pressurised air filtration system with high efficiency particulate and gas absorbers or similar to protect the operator from harmful emissions from ship air pollutants.
Uncontrolled movement caused by sudden high wind.	Equipment braking/parking insensitivity against improper use and manipulation as well as environmental aspects and influences.	Equipment braking system shall be designed to hold the equipment with a wind speed of 40m/s wind. Failsafe spring-applied brake design, where torque is applied by several springs, should be specified.
Overloaded or misdeclared container weights and eccentrically loaded containers.	Measure the weight and eccentricity of each container/load.	System to measure, indicate and record the actual weight and eccentricity of each container/load. Data to be capable of being transferred to the terminal operating system. ⁽²⁾
Electrical and machine fire.	Temperature and/or smoke detection on the machinery/electrical platform.	A temperature and smoke detection alarm system which give audible and visual alarms in the driver's cabin and on the machinery platform. In case of temperature/smoke detection the information should be transmitted to the maintenance office.
Equipment fire due to hydraulics or fuel.	Protecting equipment against the risk of fires with reliable fire detection and suppression.	For hydraulic systems: A head sensor at the hydraulic system that can stop activities after hydraulic oil reaches 90°C degree to avoid the risk of fire. For fuel systems: A pressure sensor after the fuel pump to warn the operator of fuel leakage and stop the engine immediately. Use of fire detection and suppression system in engine compartments.

⁽²⁾ A container weight and eccentricity measurement system installed on lift equipment should be a control system for safe yard operations. It should not be deemed to assume legal responsibility for overloaded or wrongly declared container weights and eccentrically loaded containers.

Straddle carrier recommended minimum safety features cont'd

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
Falling or jamming between movable parts of the equipment while personnel are entering enclosed non access or operating areas.	Prevent unintended access to risk areas.	Spring set self-closing gates with positive means to open. Any access gates to risk areas shall be interlocked to prevent access when not in parked positions or when in operation and to prevent equipment operation when open. Use of safety relevant door switches is recommended, ideally with locking function until dangerous movement has come to a complete halt.
Tipping of a container.	Control for even load distribution.	Control for load balance on all ropes. Shut-off of lifting engine if load is unbalanced or allowable eccentricity of the centre of gravity is exceeded.
Injury from equipment accidents.	Seat belt.	Seat belt protecting driver from intense brake actions or equipment accidents.
Equipment collision in yard.	Driver protection and visibility.	Air bags to prevent serious injury if straddle topples. High visibility reflective stripes on side and rear of legs. Eye level LED brake lights.

General note: An emergency stop should be a general requirement for all large equipment types and is a basic safety requirement on all such machines.

3.6 REACH STACKER AND LIFT TRUCK SAFETY FEATURES

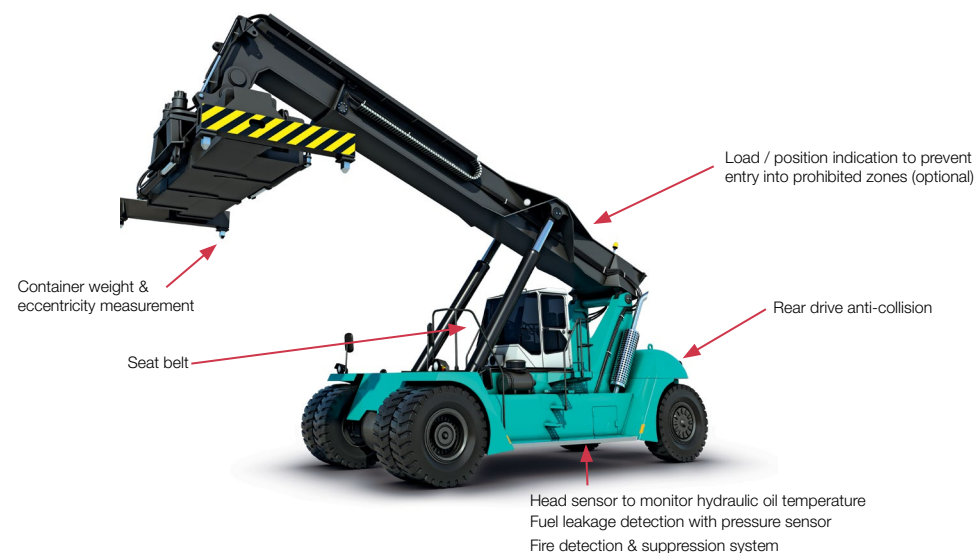


Table 7:
Reach stacker and lift truck recommended minimum safety features

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
Overloaded or misdeclared container weights and eccentrically loaded containers or loads.	Measure the weight and eccentricity of each container/load.	System to measure, indicate and record the actual weight and eccentricity of each container/load. Data to be capable of being transferred to the terminal operating system. ⁽¹⁾

⁽¹⁾ A container weight and eccentricity measurement system installed on lift equipment should be a control system for safe yard operations. It should not be deemed to assume legal responsibility for overloaded or wrongly declared container weights and eccentrically loaded containers.

Reach stacker/lift truck recommended minimum safety features cont'd

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
Equipment fire due to hydraulics or fuel.	Protect equipment against the risk of fires with reliable fire detection and suppression.	For hydraulic systems: A head sensor at the hydraulic system that can stop activities after hydraulic oil reaches 90°C degree to avoid the risk of fire. For fuel systems: A pressure sensor after the fuel pump to warn the operator of fuel leakage and stop the engine immediately. Use of fire detection and suppression system in engine compartments.
Equipment colliding with objects.	Rear drive anti-collision.	A minimum of 2 detection zones: • Warning • Emergency brake assistant Detection range shall be such that it will allow enough time for the lift truck to come to a "normal" stop. Annual test of stopping distance required due to wear, tear and aging of the braking system.
Risk of injury from equipment accidents.	Seat belt.	Seat belt protecting driver at intense brake actions or equipment accidents.
Damages resulting from equipment entering prohibited zones with axle loads restrictions.	Load and position indication to prevent entry into specific/prohibited zones (optional).	Alarm and stop before equipment enters specific/prohibited zones with axle load restrictions through the use of load indicators linked to DGPS or other localisation systems.

3.7 AGV SAFETY FEATURES

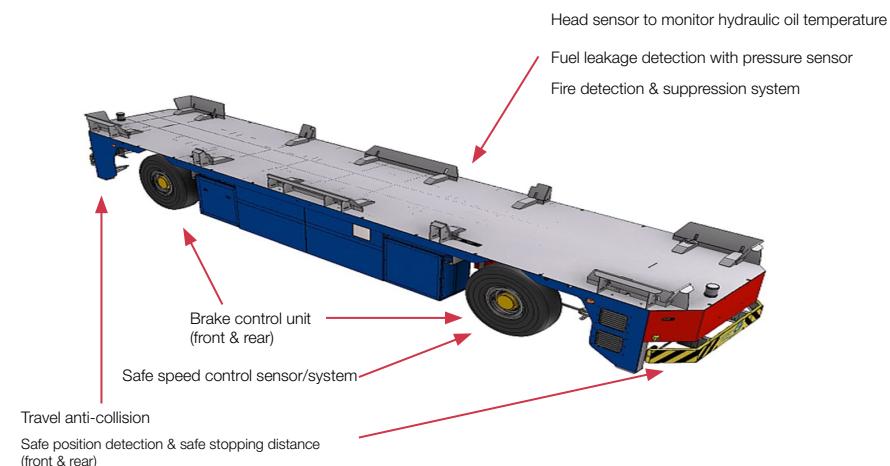


Table 8:
AGV recommended minimum safety features

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
AGV colliding with objects on tracks or near vicinity.	Travel anti-collision. (1)	Use of a Safe Position Detection system and Safe Stopping Distance System including safe stop modes. Detection range shall be such that it will allow enough time for the AGV to come to a "normal" stop. Annual test of stopping distance required due to wear, tear and aging of the braking system.

(1) Anti-collision should be a general requirement for all equipment types. In all cases, obstacles should be monitored in the direction of travel.

AGV recommended minimum safety features cont'd

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
Equipment fire due to hydraulics or fuel.	Protect equipment against the risk of fires with reliable fire detection and suppression.	For hydraulic systems: A head sensor at the hydraulic system that can stop activities after hydraulic oil reaches 90°C degree to avoid the risk of fire. For fuel systems: A pressure sensor after the fuel pump to warn the operator of fuel leakage and stop the engine immediately. Use of fire detection and suppression system in engine compartments.
Damages on drive systems due to no safe brake control.	Fail safe brake control unit.	For controlled drives: check the brake function in a fixed time frame while starting brake monitoring programme.
AGV running at uncontrolled speeds.	Safe speed control sensor/system.	Safe encoder sensor for speed detection to prevent uncontrolled high speed.

3.8 TERMINAL TRACTOR SAFETY FEATURES

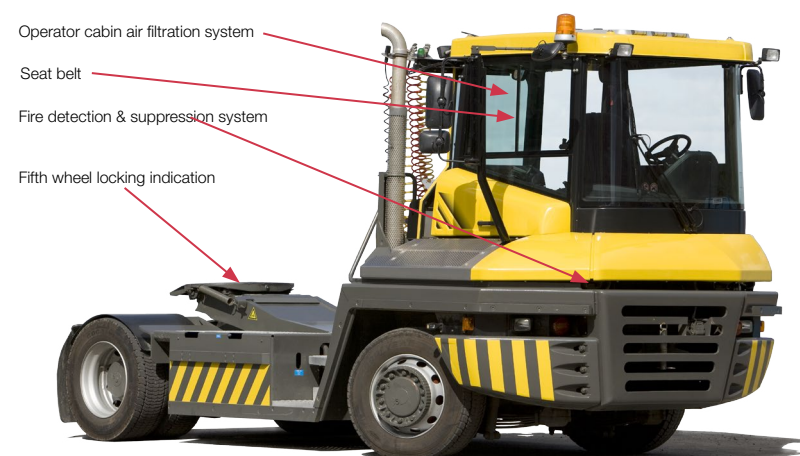


Table 9:
Terminal Tractor recommended minimum safety features

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
Drivers adversely affected by emissions or other air pollutants at waterside.	Driver cabin air filtration system.	The cabin shall be provided with a proven positive pressurised air filtration system with high efficiency particulate and gas absorbers or similar to protect the driver from harmful emissions from ship air pollutants.
Damage due to loss of trailer.	Fifth wheel locking indication.	Install reliable detection sensor (mechanical, inductive) to control safe locking of trailer.

Terminal tractor recommended minimum safety features cont'd

SAFETY RISK	SAFETY FEATURE	FUNCTIONAL REQUIREMENT
Equipment fire due to hydraulics or fuel.	Protecting against the risk of fires with reliable detection and suppression.	For hydraulic systems: A head sensor at the hydraulic system that can stop activities after hydraulic oil reaches 90°C degree to avoid the risk of fire. For fuel systems: A pressure sensor after the fuel pump to warn the operator of fuel leakage and stop the engine immediately. Use of fire detection and suppression system in engine compartments.
Risk of injury from equipment accidents.	Seat belt.	Seat belt protecting driver from intense brake actions or equipment accidents.



NOTES

This document has been jointly developed by PEMA, TT Club and ICHCA International according to the information available at the time of publication. It does not constitute professional advice, nor is it an exhaustive summary of the information available on the subject matter to which it refers.

This document should always be read and used in conjunction with the relevant national and international legislation and any applicable regulations, standards and codes of practice.

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