



INTERNATIONAL SAFETY PANEL
SAFETY BRIEFING PAMPHLET SERIES #36

Safe Operation of Straddle Carriers

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This briefing pamphlet was developed by ICHCA International's secretariat with the assistance of many members of the International Safety Panel and members of the Port Equipment Manufacturers' Association (PEMA).

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First published: May 2011

ISBN Number: 978-1-85330-029-5

SAFE WORKING WITH STRADDLE CARRIERS

1. Introduction

- 1.1 There are approximately 60 container terminals worldwide equipped with straddle carriers. They are a popular machine due to their mobility and flexibility but they are much larger, heavier, higher and faster than any other previous mobile machinery. Straddle carriers are, therefore, specialist items of equipment which require specialist operators. This means that drivers have to learn to specifically operate and control such machines and the implications for their safe operation have to be considered and applied by management.
- 1.2 Having such mobile machines working throughout the terminal presents a possible problem when there are other vehicles and persons on foot that may need to enter the same operational area. Accordingly, all other vehicles and especially pedestrians should be restricted or banned wherever possible. Those who need to enter the area should only do so under controlled conditions and any other vehicles/persons should be kept away from the operational area at all times.
- 1.3 The combination of these factors means that a number of hazards and accident potentials exist and the purpose of this pamphlet is to give guidance on safe working with these machines.

2. Carrier Designs

- 2.1 There are a number of different designs of straddle carriers, with different lift heights and propulsion machinery. Essentially, however, a straddle carrier is a two-way machine which literally straddles the load it is to carry and transports it around the terminal. As such, it is both a lifting device and a transporter.
- 2.2 There are designs for lifting containers up to two (see figure 1), three and four high (see figure 2).



Figure 1 – a carrier that can carry up to two high



Figure 2 – a carrier that can carry up to four high

- 2.3 There are also different positions for the driver's cab and wherever the cab is situated, the driver has to adjust his vision according to the direction of travel (see figure 3). One of the preferred methods is for the driver to be seated across the line of travel. This means that he needs to turn his head left or right according to direction of travel (see figure 4).



Figure 3 – a driver's cab



Figure 4 – driver's view

- 2.4 ISO Standard 14829 deals with the stability of straddle carriers and all straddle carriers should comply with that standard. Whilst the straddle carrier manufacturer is responsible for complying with this ISO standard, purchasers should specify and check that the carrier being purchased complies with all relevant standards.
- 2.5 There is also an automated version of a straddle carrier with at least one terminal working with such machines.
- 2.6 Access to the cab for the driver is by vertical ladder (see figure 5) but as significant accidents are known involving slipping and falling on or from the ladders, in addition to having separately designated areas for straddle carrier parking and maintenance (see 5.14 and 5.15), terminals should consider providing access gantries or similar structures that enhance safety by allowing access directly into the cab (see figures 6/7).



Figure 5 – showing ladder access to cab level



Figure 6 – arrangement for entry to cab at that level



Figure 7 – another arrangement for entry to cab at that level

- 2.7 In addition to the location of the cab, the ergonomic requirements including seating and harnesses should be considered.
- 2.8 Consideration should also be given to fitting stability alarms that warn the driver when the carrier is in danger of becoming unstable, ie during excessive braking or sharp cornering.

3. General

- 3.1 As with all areas of work activity, there should be a risk assessment of the terminal's operations. This should include work involving straddle carriers.
- 3.2 The safe system of work that results from the risk assessment should include provisions for the regular monitoring and, where necessary, a review of the arrangements made.
- 3.3 Whilst straddle carriers are very large machines, they are not always as readily visible than may be thought. Accidents happen when the potential danger of the machine is disregarded.
- 3.4 Accordingly, the colour of the machines used in a terminal should be such that they will stand out from the main background colour.
- 3.4 With the driver's cab having window frames, it has been found possible in the past for one straddle carrier to be hidden by such a frame and invisible to the driver of another at certain angles and certain distances (see figure 8).

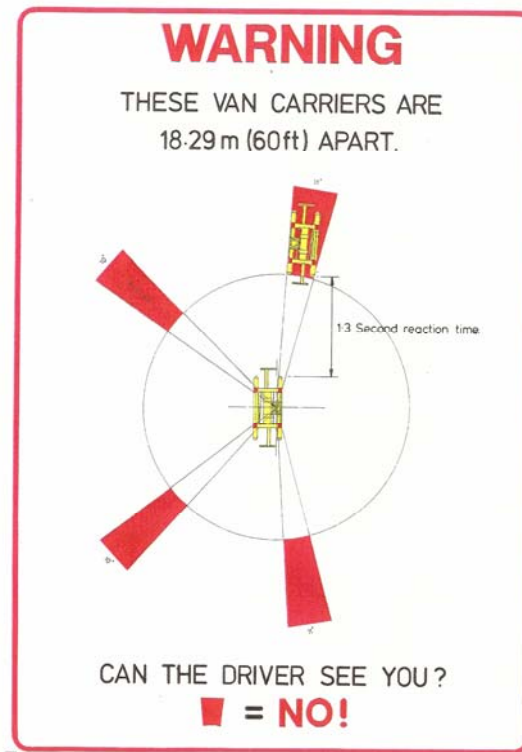


Figure 8 – illustrating possible blind spots re visibility of one straddle carrier from another

4. Hazards and Problems

- 4.1 Accidents involving straddle carriers are increasing. As there is a potential for serious personal injury and substantial equipment damage exists, a survey was conducted for the International Safety Panel (ISP) and, separately, a review of insurance damage claims was made by the TT Club.
- 4.2 One third of terminals using straddle carriers had experienced accidents involving them and that represented the largest single equipment damage cost met by insurers of port equipment. Accidents involving straddle carriers were not evenly spread between terminals and it was noted that there was a high number of claims arising from a small number of terminals
- 4.3 These and other investigations showed that the following incident types need to be considered -
 - Losing balance and toppling over
 - Striking pedestrians
 - Colliding with fixed objects (especially the container stack when cornering)
 - Colliding with moving objects
 - Colliding with ship to shore crane spreaders or hatch lids
 - Collision between straddles
 - Colliding with other vehicles
 - Fires
 - Maintenance related
- 4.4 The ISP analysis showed the following causes -
 - Lapse in concentration

- Speed related/tight turn
 - Outdated or ambiguous procedures
 - Restricted or other items being present in the working area
 - Vehicle driver in an unsafe area
 - Lack of training and/or experience –
 - Spreader too low
 - Spreader too high
 - Improper adjustment
 - Incorrect or misunderstood instructions
 - Vehicle or pedestrians in working areas
 - Poor illumination or lack of warning lights
 - Radio channel variations – using common or incorrect channels
 - Seat belts not used or not installed
- 4.5 The TT Club analysis showed that human error was the cause of the majority of such accidents with maintenance issues a much smaller cause.
- 4.6 A separate analysis by one terminal operator showed the following main causes.
- Driver behaviour
 - Procedures/systems of work
 - Traffic management
 - Driver training and competence
 - Maintenance procedures
 - Communication
 - Fatigue
- 4.7 These analyses show that a key focus of loss prevention connected with working with straddle carriers should be;
- Driver selection, including age, maturity and driving/operating experience
 - Training
 - Driving behaviour monitoring systems, including re-training after involvement in accident or other safe operational error
- 4.8 However, there are other factors that can affect safe working involving the layout of the terminal, procedures and control, lighting and communications.
- 4.9 Briefing Pamphlet *BP # 5 Container Terminal Safety* includes various recommendations regarding Straddle Carrier terminal layouts and procedures and they have been incorporated in the following.
- 5. Terminal Layout**
- 5.1 This document is not intended to be a comprehensive guide to container terminal layouts and only includes specific aspects which apply to straddle carrier operations.
- 5.2 The terminal layout should include wide avenues for the movement and manoeuvring of straddle carriers with adequate lane widths between stacks.
- 5.3 Cornering should be minimised and made as wide as possible with sharp turning angles avoided.
- 5.4 The layout should aim to control speed, where possible, and limit sharp turning angles.

- 5.5 Wherever possible, container stacks at corners where straddle carriers will be turning should be stepped down to aid visibility of other carriers.
- 5.6 Lanes should be clearly marked.
- 5.7 A suitable grid or grid system just outside, or on the edge of, the main operational area should be provided where containers can be transferred to or from road vehicles.
- 5.8 Straddle carrier/road vehicle interface systems should be so designed that the straddle carrier approach is always from the rear of the road vehicle.
 - 5.8.1 The road vehicle driver should be out of his cab and in a designated safe area whilst his vehicle is being loaded/unloaded by the straddle carrier.
- 5.9 The slots of the grid should be carefully spaced and should be clearly marked out. The distance between slots should be determined in the light of allowing an access area between slots, the width of straddle carriers and other operational factors.
- 5.10 There should be a clearly defined safe area away from other vehicles and, particularly, from straddle carriers where external truckers can lock/unlock twistlocks.
- 5.11 There should be no buildings or other obstructions in the operational area.
- 5.12 There should be adequate lighting for the movement and operation of straddle carriers throughout the operational area
- 5.13 Lighting pylons, which of necessity need to be scattered through the operational area, should be protected from being struck by straddle carriers, other terminal equipment and other vehicles
 - 5.13.1 In order to protect lighting pylons from straddle carriers, the barriers should be
 - of sufficient height and strength
 - sufficiently distant from the pylon to avoid an overhanging container carried by a straddle carrier striking it
 - at a sufficiently safe distance from overhead high voltage lines
 - 5.13.2 The pylons should be conspicuously marked at lower level for ordinary vehicles and at driver height for straddle carriers
- 5.14 There should be designated parking / change over areas for driver access/egress to/from equipment
- 5.15 There should be separate designated areas for parking straddle carriers when not in use and separate areas for maintenance activities.

6. Terminal Procedures

- 6.1 Wherever possible, one-way traffic flows should be arranged as they could prevent collisions. If this is not practical and results in excessive travel time of the straddle carriers, roadways should be designed to accommodate two-way traffic and widths of around 30m are required.
- 6.2 Pedestrian and other vehicle traffic in the operational area should be prohibited but, if necessary, should be under strict control (see 6.4.1).

6.3 Traffic Management

- 6.3.1 Particular attention should be paid to the traffic management and control of straddle carriers. Tight turns, excessive speed and the carrying of containers at high levels have all contributed to straddle carriers overturning.
- 6.3.2 Consideration should be given to imposing speed limits together with monitoring procedures and enforcement to ensure that the limits are being observed.
- 6.3.3 Drivers have a restricted view of end frame and corner fittings of containers onto which another is being placed and stacking a container onto certain types of containers (e.g. open top, flatrack and tank containers) requires accurate placement to ensure that the container is safely stacked. BP #30 Safe Handling of Tank Containers gives greater detail regarding tank containers and a BP regarding the safe handling of flatracks is in preparation. Best practice is not to over stow flat racks when the ends are up.

6.4 Safe Access

- 6.4.1 It is, however, recognised that there are occasions where access to the operational area by other terminal vehicles and even pedestrians is necessary. In these circumstances the terminal must have procedures which will ensure safety for the personnel concerned as well as maintaining safe operations. The following is one method by which this can be achieved.
- Access to the container stacking area is authorised by a shift manager or similar designated person. All staff requesting access onto (or moving within) the straddle carrier working area are identified and in communication with Control by radio on a safety channel.
 - Permission on an identifiable basis is requested before entering (or moving within) an operational area and Control must log each access (or movement) request and limits such requests to as many as can be managed on site at any time. All personnel wear high visibility clothing and a safety helmet.
 - Control is responsible for informing all straddle carrier drivers on the working channel that access (or movement) is about to take place and that the container stacking area is frozen – typically two additional rows each side of the isolation area are frozen.
 - Control is responsible for confirming that the container stacking area is frozen and that it is safe to transit the working area. The actual site has a specialist terminal vehicle (with hazard lights) parked at one end and a marker at the opposite end.
 - In mixed yards where this is not practical, the area may not be frozen but alerts are issued to straddle carrier drivers and permits (similar to hot work permits) are issued placing time limits on the work and ensuring that the necessary safety precautions are in place.
 - Staff may be given permission to transit the frozen working area once confirmation has been received that the necessary precautions are in place. These may include a temporary stoppage of straddle carrier movements.
 - If staff members are to remain on site and there is a necessity to unfreeze the terminal, a “Safe Area” is created. The “Safe Area” is bounded by vehicles showing flashing lights or illuminated trailers or barrier boxes. These are positioned at either end of the lanes where the staff members are working. Such a “Safe Area” must be set up BEFORE informing Control that the freeze associated with their individual access may be lifted.
 - When staff wish to move from a “Safe Area” they request permission from Control who will arrange the move by freezing the container stacking area in accordance with the previous paragraphs whilst they leave.

- It is important that the terminal operating system should be part of the freezing process.

6.5 Vehicles

- 6.5.1 Specialist vehicles displaying hazardous warning lights are the only vehicles allowed in Reefer Straddle Carrier Operating Areas when straddle carriers are working. These lights must be working at all times when the vehicle is on site.
- 6.5.2 The freezing of the area or locations, or when this is not practicable, warning lights should be used for procedures such as container inspection or work in reefer stacks where pedestrians necessarily work. If the work is regular, permanent safe access should be provided.
- 6.5.3 External truckers and their vehicles should not be permitted to enter container stacking areas.
- 6.5.4 The entry of road vehicles to the grid slots should be controlled to ensure that the grid does not become a road vehicle waiting area. Waiting areas that do not obstruct other facilities should be provided elsewhere for such vehicles.
- 6.5.5 Control systems for grid movements should be designed to obviate the need for operational pedestrian staff on the ground.
- 6.5.6 The number of vehicles allowed on each grid at any one time will vary according to the number of straddle carriers in use. The ratio of road vehicles to carriers should not normally exceed 3 to 1, although this will depend upon grid locations and the traffic operating system.
- 6.5.7 To reduce as far as possible the number of people at risk, control staff should ensure that:
- Any passengers carried in visiting container vehicles alight from the vehicle before it is driven onto the grid slot and that the passengers wait in a waiting-room or other safe place provided by management
 - Container securing equipment, such as twistlocks, is released, in a safe place, before the road vehicle moves on to its grid slot and is not re-secured until the road vehicle has left the slot.
 - The road vehicle driver leaves his cab and stands a safe distance from his vehicle and forward of his cab (in clear view of the straddle carrier driver), or in a clearly marked safe area before the unloading and loading of the containers begins
 - The road vehicle driver remains in that position until the straddle carrier has left.

7. Driver Selection, Training, Fitness and Behaviour

- 7.1 The main cause of straddle carrier accidents has been found to be driver error.
- 7.2 No person should be employed as a driver unless he has been formally trained and is fit, competent and authorised.

7.3 Selection

- 7.3.1 Driving a straddle carrier is not like driving any other vehicle or machine on the terminal or in private life. The vehicle is much larger than other fully mobile machinery, with two way operation and with a unique operator position.
- 7.3.2 A high level of concentration and skill is needed

- 7.3.3 Not everyone will be capable of operating a straddle carrier effectively and safely
- 7.3.4 It is important, therefore, that an effective selection procedure is in place with suitable criteria established to identify those who should go forward for training, competency and fitness assessments
- 7.3.5 Simulators can assist in making this judgement.
 - 7.3.5.1 Simulators are becoming cheaper and more widely used. Quay crane simulators are available from a number of supplier's. A number of suppliers also provide straddle carrier driver training simulators. PC based simulators that cost only about Euro 30,000 are now available instead of having to pay up to Euro1m as in the past. Instead of committing an enormous amount of time and money in training new drivers to then find that they do not have the skills to be safe and become proficient, by using a simulator potential drivers can be tested and screen out those without the necessary skills. The investment in simulators will save injuries and damage and also increase loading rates since the drivers will be better trained.

7.4 Training

- 7.4.1 All drivers shall receive formal training
 - 7.4.1.1 Where possible, part of the training should involve the use of simulators.
 - 7.4.1.2 The emphasis should be placed on safe operation and good driving techniques
- 7.4.2 No person should be authorised unless he has been trained and passed as competent
- 7.4.3 The level of competency required will be commensurate with the size, complexity and procedures of the terminal and the machines to be driven
- 7.4.4 Regular refresher training should be carried out, typically once every 3 years

7.5 Fitness

- 7.5.1 Prospective drivers should be fit to drive. Briefing Pamphlet #xx gives guidance on standards of fitness for drivers.
- 7.5.2 Procedures should be in place to assess a person's fitness to drive and only those meeting a set standard should be authorised to drive straddle carriers.
- 7.5.3 Such assessments should be carried out by qualified medical staff and should include vision testing, inclusive of depth perception and night vision.
- 7.5.4 All such records must remain confidential.
- 7.5.5 Procedures should also include periodic monitoring of continuing fitness.

7.6 Behaviour

- 7.6.1 Straddle carrier driving is mainly a remote activity which has less reliance on physical supervision and monitoring.
- 7.6.2 However, there is a need to monitor and identify unsafe behaviour and procedures need to be put in place to do so. It is important that it is regularly carried out and that it is continued over time.

- 7.6.3 Guidance should be given to front line management on the correct response and how to effectively correct such behaviour.
- 7.6.4 Drivers with serious safety rule violations should have their authorisation removed and not reinstated until a competency based further training programme and assessment has been satisfactorily completed
- 7.6.5 For personnel operating any type of machinery or equipment, a drug and alcohol policy should be determined and implemented. This policy, which should be aimed at fostering ownership and commitment, should be developed in conjunction with employees and management.

7.7 Supervisory and Line Management Training

- 7.7.1 Supervisors and Line Management should be trained to provide good quality supervision.

8. Communications

- 8.1 An important element in efficient and safe operations is communications
 - 8.1.1 Drivers should be involved in the process of rule making and its application
- 8.2 Drivers and supervisors should be knowledgeable of the terminal rules and procedures as it applies to their activities.
- 8.3 “Near miss” reporting should be encouraged
 - 8.3.1 Each such incident should be treated as though it was an accident and be recorded, investigated and lessons learnt
- 8.4 Short talks by supervisors prior to work starting (often known as Toolbox Talks) should be encouraged and, where possible, planned and organised

9. Maintenance

- 9.1 Routine maintenance and inspection schedules should be established
 - 9.1.1 This should include appropriate daily checks.
 - 9.1.2 There should be special emphasis on safety critical items such as seating, brakes, wheels, tyres and hazard warning lights, operating lights and audible alerts.
- 9.2 An appropriate pre-use check list should be established with safety critical items clearly identified.
- 9.3 Thorough examinations of the lifting appliance part of straddle carriers should be carried out according to national laws but not less than once per year.
- 9.4 Maintenance of the vehicle part of straddle carriers should be carried out in accordance with national laws or manufacturers’ recommendations.
- 9.5 A routine cleaning schedule should be established to cover at least access ladders, windows and driver’s cab as well as height markers, reflective surfaces, safety notices/placards and high visibility paint or colours.
- 9.6 Safe systems of work should be established for engineering staff working at heights and also

working on wheels out on the terminal and away from the workshop.

9.6.1 Tyres should not be worked on away from the workshop unless the tyre pressures have been adequately reduced.

9.7 Terminal lighting should be subject to regular maintenance provisions.

Appendix One

Bibliography

ILO Publications –

ILO Convention 152 “Safety and Health in Dockwork”
ILO Code of Practice “Health and Safety in Ports”

ISO Publications –

ISO 14829 – Straddle carrier stability

ICHCA International Publications –

BP#1 ILO Convention 152
BP#5 Container Terminal Safety
BP#7 Safe Cleaning of Freight Containers
BP#11 International Convention for Safe Containers
BP#15 Substance Abuse
BP#20 Unseen Dangers in Containers
BP#25 Illustrated Guide to Container Size and Type Codes
BP#30 Safe Handling of Tank Containers
BP#33 Safe Working with Reefer Containers
RP#8 Safe Walkways in Ports and Terminal Areas
RP#9 Personal Protective Equipment