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Lift trucks: How to choose the right safety belt

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LIFT TRUCKS



HOW TO CHOOSE THE RIGHT SAFETY BELT

This document is intended for occupational health and safety professionals and practitioners, maintenance personnel, and suppliers, to help them choose the most appropriate seat belt assemblies for protecting operators of counterbalanced lift trucks.



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**Lift trucks:
Wearing a safety belt can
save your life.**

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VERY REAL CONSEQUENCES

A manoeuvre performed in a lift truck being driven on an uneven surface caused it to tip over onto its side. The operator was ejected from the operator compartment and crushed by the protective structure of the lift truck. He died as a result of his injuries. He was not wearing his seat belt, which was in good working order.

CSST investigation report

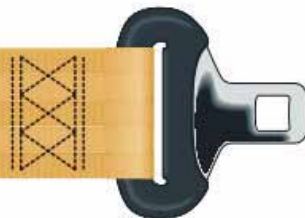
In the course of their work, lift truck operators can be exposed to risks of truck tipover or collision. These accidents can be fatal for the operators if they are not properly protected. **Section 256.1**, entitled **“Lift truck operator retention device,”** of the Québec *Regulation respecting occupational health and safety*, stipulates:

A counterbalanced high-lift truck with a centre operating station, that cannot be lifted with the operator in a sitting position (...) must be equipped with a retention device, such as a safety belt, mesh doors, enclosed cabin, bucket seat or winged seat to prevent the operator from being crushed by the structure of the truck in the event the lift truck tips over. The devices must, where applicable, be kept in good order and used.

Of the various restraint devices, seat belt assemblies are an effective means of offering protection, and it is mandatory that counterbalanced lift trucks be equipped with them. According to operators' experience¹, however, there are some inconveniences associated with wearing seat belts. To promote their use, it is therefore important that:

- ▶ they allow good body mobility;
- ▶ they facilitate buckling and unbuckling;
- ▶ the related discomforts be limited.

¹ The information and “Actual cases” presented in this document are taken from the IRSST research reports listed on page 6.



HOW TO TACKLE THE PROBLEM

First, questions must be asked about the work environment (Step A) and then about the best choice of seat belt assembly, keeping in mind the operators and work to be performed (Step B).

It is essential to include the lift truck operator in these two steps. It is also recommended that the supervisor, purchaser, maintenance personnel, and supplier be involved in the process. Lastly, before installing the selected seat belt assemblies on several lift trucks, operators should try them out in real work situations.

A THE WORK ENVIRONMENT

To minimize some of the inconveniences associated with the fact that operators have to frequently mount/dismount their lift truck and drive backward, a number of improvements can be made to the work environment, for example:

► arranging the travel aisles in such a way that the truck travels forward more than backward (e.g. avoid dead-end aisles), and making sure that the load does not block the operator's view.



ACTUAL CASE

Driving backward represented between 30% and 48% of the movements involved; some of the manoeuvres observed lasted 1.5 minutes.

ACTUAL CASE

An operator had to mount/dismount every 2.4 minutes to prepare an order and every 2.6 minutes to deliver materials to production lines, handle packaged products, or store finished products.

► clearing a space for changing direction and encourage driving forward;

► positioning merchandise pick-up and drop-off locations close together to reduce the need for moving around;

► grouping together tasks performed off the truck to avoid the need for frequent mounting/dismounting and to reduce material handling time;

► improving the labelling system to facilitate product identification and save the operator from having to dismount his/her truck, thus reducing the number of times he/she has to buckle up and unbuckle;

► assessing whether the counterbalanced lift truck is the most appropriate equipment to be used in circumstances where the operator has to mount/dismount very frequently (e.g. other options: pallet truck, order picker);

► improving the condition of the driving surface to reduce jolts that can increase the discomfort associated with wearing a seat belt.

B CHOOSING AN APPROPRIATE SEAT BELT ASSEMBLY

The seat belt assemblies installed on lift trucks are designed to keep operators at all times in a zone considered to be safe, both during normal operation and in the event of collisions or tipovers. A number of standards (e.g. SAE J386) define the specifications applicable to each component of these seat belt assemblies.



1 RETRACTORS



Retractors serve to retract, or rewind, the slack webbing in seat belts into a housing drum.

The three main types used are:

- ▶ manual retractors;
- ▶ automatic-locking retractors (ALR);
- ▶ emergency-locking retractors (ELR).

Each of the three retractors has specific characteristics.

MANUAL RETRACTORS

Adjustment and mechanism – The operator controls the retracting and unwinding of the webbing by pressing on a button that disengages the locking mechanism. When the button is released, the webbing is immediately locked at the desired length. This length remains unchanged unless the operator readjusts it. An operator who dismounts and then returns to his/her lift truck does not therefore have to readjust the length.



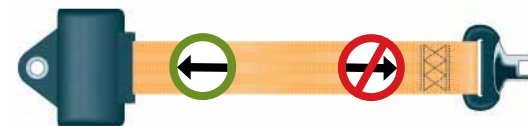
This type of retractor may, however, be less suitable in contexts where several operators of different sizes share the same lift truck. This retractor is the simplest in terms of mechanics. In theory, the simpler the mechanism, the lower the risk of system failure.

Safety, comfort and body mobility – These three aspects depend on how the operator adjusts the length of the webbing. According to Standard SAE J386², a maximum slack of 50 mm (2 in.) would be appropriate to ensure operator safety under any tipover conditions. Slack of more than 50 mm could endanger operator safety. With this type of retractor, the webbing does not automatically tighten once it has been adjusted by the operator, which is a plus in terms of comfort.

AUTOMATIC-LOCKING RETRACTORS (ALR)

Adjustment and mechanism – This type of retractor is the one most frequently used in companies. It retracts any slack webbing with no operator intervention and prevents it from unwinding at all times.

To loosen and readjust the seat belt, the user must first detach and completely rewind the webbing. He/she must then pull the webbing out to a sufficient length to buckle it. This must be done in one continuous movement so as not to engage the locking mechanism. Operators consider it a nuisance to have to readjust the belt length.



Safety, comfort and body mobility – The advantage of the automatic-locking retractor (ALR) is that it always ensures sufficient restraint on the operator, while the disadvantage is that it constantly retightens on the user if there is any slack in the webbing.

This gradual retightening can occur, for example, when driving on rough terrain, during operator movements on the seat, or when the cushion of the seat or seatback is compressed.

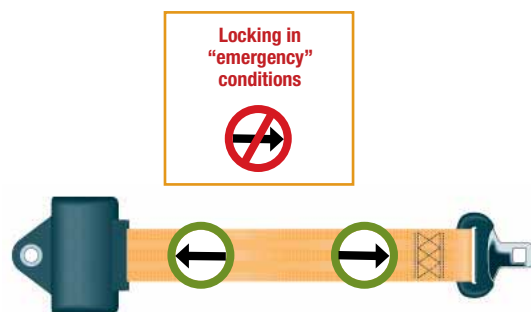
This type of retractor leaves little slack for the movements the operator needs to make in order to look backward when driving in reverse. Some operators have mentioned discomforts associated with this type of retractor.

² This standard stipulates that an emergency-locking retractor must allow a maximum unwinding of 50 mm of the belt webbing before locking; by extension, we consider that a slack of 50 mm in the webbing could keep the operator safely in his/her seat in the event of a tipover.

EMERGENCY-LOCKING RETRACTORS (ELR)

Adjustment and mechanism – An emergency-locking retractor ensures the automatic adjustment of the seat belt to the operator's body, with a minimum of tension in the belt webbing. The webbing retracts and pulls out freely from the retractor, unless one or more of the following three "emergency" conditions causes it to lock:

- acceleration or deceleration of the truck exceeds a certain threshold, regardless of direction;
- the truck is subjected to an excessive tilt relative to the horizontal; and in some cases,
- the webbing unwinds too fast, i.e. at a speed that exceeds a certain threshold.



The retractor includes a number of devices (e.g. a ball-bearing system) that lock the webbing in "emergency" conditions. Given the particular locking mechanism of the ELR, it is essential to follow the manufacturer's recommendations during installation.

Safety, comfort and body mobility – Based on examination of the various locking mechanisms and their respective activation thresholds recommended in Standard SAE J386, this retractor is safe in many tipover situations.

However, it may be ineffective in some foreseeable tipover conditions, mainly when the truck is travelling slowly. For this reason, if such retractor is selected, a closed cab for lift trucks may be considered, which ensures that the operator remains within the protective structure during a tipover.



FIGURE 1

This retractor allows good body mobility and is similar to the one found in cars. The operator can shift his position on the seat to obtain better visibility when driving backwards and can lean over easily to access hard-to-reach zones (figure 1). This mechanism is therefore less likely to cause discomfort.

CHOOSING A RETRACTOR BASED ON THREE CRITERIA

		SAFETY ▼ CHOICE	BODY MOBILITY AND COMFORT ▼ CHOICE	SIMPLICITY OF THE MECHANISM ▼ CHOICE
MANUAL	Safe at all times with minimum slack, but each user has to adjust the length of the webbing.	2	2	1
AUTOMATIC-LOCKING (ALR)	Safe at all times; tightens automatically on the user and locks.	1	3	2
EMERGENCY-LOCKING (ELR)	Possible locking failures in certain types of tipovers; best used in combination with a closed cab.	3	1	3

No single retractor meets all three criteria ideally. However, additional safety can be obtained by, for example:

- making sure that the belt webbing in the manual retractor is always properly adjusted;
- installing emergency-locking retractors in combination with closed cab lift trucks.

2 ANCHORAGE SYSTEMS

Anchorage systems are used to attach the various parts of the seat belt assembly to the seat. These systems must be positioned at seat level, above the suspension, partly for reasons of comfort.

3 SEAT BELT WEBBING

Usually 50 mm wide (2 in.), the belt webbing must sit on the operator's lap. It must be long enough that it can be buckled up on the person's lap and that extra webbing can be pulled out to facilitate buckling up, particularly when there is a retractor that automatically rewinds any slack.

It must also be long enough to allow for a range of operator sizes and clothing (e.g. winter coats). Webbing extensions exist, but they cannot be rewound into the retractor and must be attached and removed by the operator.



4 BUCKLE AND LATCHPLATE

To facilitate buckling up, the buckle (the female end) must always remain firmly in place. This means avoiding overly flexible stems (figure 2). More rigid, long stems (figure 3) are appreciated because they are easy to access and stay in place, which is a plus when bulky clothing is worn or when the seat is equipped with hip restraints or armrests.

Seat characteristics also play a role in making buckling up easier. In the case of a narrow seat, both the buckle and the latchplate are often positioned behind the operator, making them hard to access. When the seats are equipped with armrests, they should be of the fold-up type. If hip restraints are present, the latchplate and buckle of the seat belt should be accessible from the inner side of the restraints (figure 4); when these parts are on the outer side, the seat belt is harder to attach (figure 5). To get around this irritant, some operators pass the seat belt over the restraints, but this can reduce protection for smaller operators.



FIGURE 2



FIGURE 3



FIGURE 4

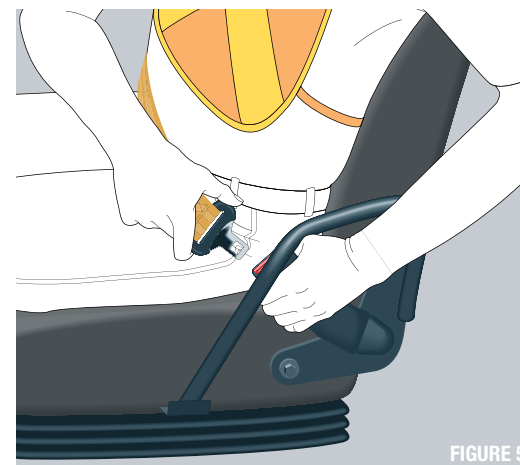


FIGURE 5

INSPECTION AND COMPLIANCE

The pre-departure inspection performed by the lift truck operator includes a visual and operational check of the seat belt assembly. Operators should be encouraged to report any breakage or malfunction. The seat belt assembly must also be checked during preventive maintenance on lift trucks, as recommended by the manufacturers.



Lastly, it is important to remember that “When modifications involve rebuild and repair of the basic unit, they shall be made in accordance with the manufacturer’s established criteria and procedures”. ASME B56.1 (1993) section 4.2.6

IN CONCLUSION

A number of factors come into play when choosing a seat belt assembly that will ensure both easy use and operator safety, mobility, and comfort. Operator participation is essential to a clear identification of needs and of the most appropriate solutions.

Many organizations – mainly joint sector-based associations, some employer and union associations, the CSST, and suppliers – have developed expertise on worker health and safety during the use of lift trucks. Remember to consult them!

A TOOL TO HELP YOU

The following worksheet is designed to help you assess the situation in your workplace and to identify any improvements to be made.

You can enter your information directly on screen and then print it out by downloading the interactive version of the PDF document of the **worksheet** (you will need Adobe Reader).

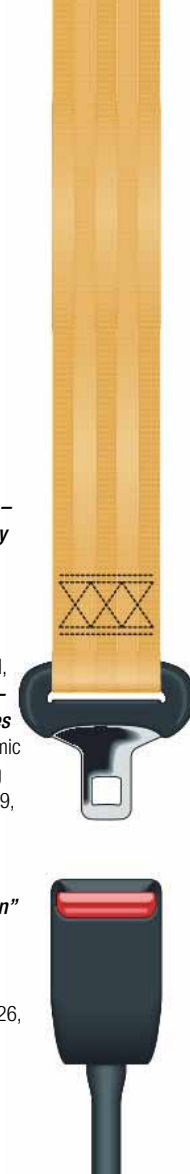
TO LEARN MORE

These documents can be downloaded free of charge from the IRSST’s Web site at: www.irsst.qc.ca

1. Rancourt, Denis; Beaugrand, Sylvie; Larue, Christian; Masson, Geneviève. **Seat Belt Assemblies for Counterbalanced Lift Trucks – Preliminary Study of Normative and Usability Criteria**. Report R-844, Montréal, IRSST, 2014, 83 pages.

2. Vezeau, Steve; Hastey, Priscille; Giguère, Denis; Gagné, Nicolas; Larue, Christian; Richard, Jean-Guy; Denis, Denys. **Chariots élévateurs – Étude ergonomique et analyse des stratégies de conduite des caristes** (lift trucks – ergonomic study and analysis of lift truck operators’ driving strategies). Report R-601, Montréal, IRSST, 2009, 133 pages.

3. Giguère, Denis. **“Les rétroviseurs sur les chariots élévateurs : installation et utilisation”** (rearview mirrors – use and installation on lift trucks) and “Feux et phares sur les chariots élévateurs” (lights – use and installation on lift trucks). Technical fact sheets RF-625 and RF-626, Montréal, IRSST, 2009, 4 pages and 6 pages.



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► Click to obtain the interactive worksheet

1. ASSESSMENT OF THE SITUATION

► **BRIEF IDENTIFICATION OF THE LIFT TRUCK** NO.: _____ MODEL: _____ DEPARTMENT: _____

► **CAB:** ☐ open ☐ closed
► **SEAT:** ☐ with suspension ☐ without suspension ☐ hip restraints ☐ no restraints or armrests ☐ fold-up armrests ☐ fixed armrests

► **SEAT BELT ASSEMBLY:** webbing retractor: ☐ manual ☐ automatic-locking (ALR) ☐ emergency-locking (ELR) ► **BELT WEBBING:** webbing length: _____ (cm) _____ (in.)

► **INDIVIDUALS TO INVOLVE IN ASSESSING THE SITUATION AND LOOKING FOR IMPROVEMENTS** (enter the names):

► **OPERATORS** (day/evening/night): _____

► **SUPERVISOR** (day/evening/night): _____

► **MAINTENANCE PERSONNEL:** _____

► **OTHER:** _____

► **CURRENT SEAT BELT ASSEMBLY - ASSESSMENT OF THE SITUATION:**

► **ENVIRONMENT IN WHICH USED:** ☐ dust/dirt ☐ jolts/vibrations ☐ no particular conditions

Work performed using the lift truck, description: _____

This work requires: ☐ mounting/dismounting frequently ☐ backing up over long distances

The type of lift truck used is well-suited to the work performed (e.g. preparing orders): ☐ yes ☐ no

► **ASSESSMENT OF USE:**

Ease with which it can be buckled and unbuckled: _____

Comfort or problems related to: the work, the environment, the seat, the fact of wearing bulky clothing and equipment, personal needs, etc. _____

► **TECHNICAL ASSESSMENT:**

Current condition of the seat belt assembly: ☐ functional and in good working order ☐ inadequate

Breakage incidents, complaints, relations with suppliers: _____

► **RECOMMENDATIONS :** ☐ replace the belt ☐ replace the seat ☐ use another type of lift truck ☐ no change required

LIFT TRUCKS: HOW TO CHOOSE THE RIGHT SAFETY BELT

2. IMPROVEMENT OPTIONS

AT WORK, ARE LIFT TRUCK OPERATORS ...	WHAT ADJUSTMENTS WOULD HELP REDUCE THESE CONSTRAINTS?	N/A or already done	To do	COMMENTS
Obligated to back up frequently or over long distances?	<input type="checkbox"/> yes ► Encourage driving forward, e.g. by: <input type="checkbox"/> no ► Eliminating dead-end aisles ► Clearing spaces for changing direction ► Positioning merchandise pick-up and drop-off locations close together ► Other:	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
Obligated to mount and dismount their lift truck often?	<input type="checkbox"/> yes ► ► Group together tasks performed off the truck <input type="checkbox"/> no ► Improve the labelling system to avoid the need for frequent dismounting the truck ► Other:	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
Subjected to jolts/vibrations?	<input type="checkbox"/> yes ► ► Flatten the driving surface <input type="checkbox"/> no ► Other:	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	
RÉTRACTORS	WHICH TYPE OF RETRACTOR IS THE MOST APPROPRIATE TO THE WORK CONTEXT?	N/A or already installed	Best retractor to install	COMMENTS
Manual	► Operators must properly adjust the length of the belt webbing to ensure their safety at all times. May be less suitable in contexts where several operators often share the same lift truck. The webbing does not retighten on the operator, which is a plus in terms of comfort.	<input type="checkbox"/>	<input type="checkbox"/>	
Automatic-locking (ALR)	► Ensures operator safety at all times. Can cause discomfort and restrict operator mobility, mainly when vibrations are present.	<input type="checkbox"/>	<input type="checkbox"/>	
Emergency-locking (ELR)	► Best combined with a closed cab to ensure safety at all times. A plus in terms of operator comfort and mobility (e.g. for backward visibility). More complex mechanisms.	<input type="checkbox"/>	<input type="checkbox"/>	
COMPONENTS	WHICH MEASURES SHOULD BE TAKEN TO ENSURE PROPER INSTALLATION AND EASY USE?	N/A or already done	To do	COMMENTS
Anchorage systems	► The anchorage systems should be located above the suspension at seat level.	<input type="checkbox"/>	<input type="checkbox"/>	
Seat belt webbing	► The belt webbing should be long enough to fit all operators, even when they are wearing bulky clothing.	<input type="checkbox"/>	<input type="checkbox"/>	
Buckle and latchplate (easy access)	► The seat should be wide enough that the buckles and latchplates are not located behind the operator. ► The buckle (female end) should be attached to a rigid stem sticking out on the operator's side. ► The armrests should be of the fold-up type. ► If there are hip restraints: the buckle and latchplate should be positioned on the inner side of the restraints to make it easier to buckle up over the operator's body.	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	

TESTING OF THE SELECTED IMPROVEMENT OPTIONS: Before making definite changes to the work environment or to a number of lift trucks, test the selected options under real working conditions.