Código de buenas prácticas para la estiba segura de la carga en el transporte por carretera

International Guidelines on Safe Load Securing for Road Transport

13th INTERNATIONAL SYMPOSIUM ON HEAVY VEHICLE TRANSPORT TECHNOLOGY

Session 8b HV braking and safety

San Luis, Argentina, 30 October 2014

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Mårten Johansson

IRU International Road Transport Union
This is the IRU
Evolution of IRU Membership

- 1948: eight founder countries
- 2014: 170 Members in 75 countries
- ...and CRIPA: 27 Members + FESARTA in 38 countries
**IRU Secretariat General**

- **1948** – IRU founded in **Geneva**
- **1973** – IRU Permanent Delegation to the European Union in **Brussels**
- **1998** – IRU Permanent Delegation to Eurasia in **Moscow**
- **2005** – IRU Permanent Delegation to the Middle East and Region in **Istanbul**
- **2012** – IRU Secretariat for Africa in **Geneva**
- **2013** – IRU Permanent Delegation to the United Nations in **New-York**
IRU International Commissions & Working Parties

Commissions

- Social Affairs
- Economic Affairs
- Customs Affairs
- Legal Affairs
- Technical Affairs
- Road Safety
- Services to Transport Operators

Working Parties

- Dangerous Goods
- Intermodal Transport & Logistics
- Taxis and hire cars with driver
IRU Academy: Worldwide Excellence in Road Transport Training

International Network of IRU Academy Accredited Training Institutes (ATIs)

IRU Academy Advisory Committee

World Bank

United Nations Economic Commission for Europe
Securing and facilitating trade and international road transport

Transports Internationaux Routiers

Managed by the IRU since 1949
What is Globalisation?

What does it take to have a cup of coffee in a café?

The combined efforts of 29 companies in 18 countries

Road Transport has become a vital production tool!

Source: IRU
Road transport tonnage distances in modern economies
The aim of these Guidelines is to provide basic practical information and instruction to all key stakeholders involved in the international road transport industry to correctly load and secure goods on vehicles, from the outset, improving global road traffic safety.

The Guidelines should serve as a common basis for practical application and enforcement of load securing!
Applicable Standards

Load securing arrangements, strength and performance are based on the following standards:

<table>
<thead>
<tr>
<th>EN12195-1</th>
<th>Calculation</th>
<th>EN 12195-4</th>
<th>Lashing steel wire ropes</th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 12640</td>
<td>Lashing points</td>
<td>EN 283</td>
<td>Swap bodies – testing</td>
</tr>
<tr>
<td>EN12641-1 / EN 12641-2</td>
<td>Swap bodies Tarpaulin / curtainsiders</td>
<td>EN 284</td>
<td>Swap bodies – Non-stackable</td>
</tr>
<tr>
<td>EN 12642 L / EN 12642 XL</td>
<td>Strength of vehicle body structure (0.3P) or (0.4P)</td>
<td>ISO 1161 / ISO 1496-1</td>
<td>ISO Container</td>
</tr>
<tr>
<td>EN 12195-2</td>
<td>Web lashing</td>
<td>ISO 27955</td>
<td>Load securing in passenger cars and multi-purpose vehicles</td>
</tr>
<tr>
<td>EN 12195-3</td>
<td>Lashing chains</td>
<td>ISO 27956</td>
<td>Load securing in delivery vans</td>
</tr>
</tbody>
</table>
The IRU Guidelines address liability issues which should be included in contracts.

The road transport industry wants legislation and liability which covers:

- correct loading and correct load securing
- correct laden weight
- shared liability between the parties responsible within the freight chain
The load securing arrangements must be based on:

- Accelerations
- Friction factors
- Safety factors
- Test methods

...these parameters are described in the standard EN 12195-1:2010
Overall principles

To avoid loads sliding, tilting and rolling the following principles must be considered:

- Securing direction
- Securing method and equipments
- Friction
- Dimensions / center of gravity
- Mass of the load
Friction factors

\[ F = \frac{m \cdot v^2}{r} \]
Road transport vehicles are particularly sensitive regarding the position of the centre of gravity of the loads, due to specified axle loads.
Vehicle structures / Estructura del vehiculo

- **Box-type vehicle**
  - EN 12642 L
  - Headboard: P = 40% of payload, maximum 5 tonnes
  - Rear wall: P = 25% of payload, maximum 3.1 tonnes

- **Cover stake vehicle**
  - EN 12642 XL
  - Headboard: P = 50% of payload
  - Rear wall: P = 30% of payload

- **Curtainsider**
  - P = 6% of payload
  - P₁ = 2.4% of payload
  - P = 0% of payload
Headboard
Packaging
Restraining methods are principally

- locking
- blocking
- direct lashing
- top-over lashing
- combinations of methods in conjunction with friction
Blocking by headboard and sides

Blocking with filler between the rows of load
Blocking

Blocking with pallets in rear direction

Threshold blocking or panel blocking
Lashing equipment

- Webbing assemblies
- Chain
- Wire rope
- Nets or covers with lashings
- Ropes
- Blocking boards
Supporting equipment

- Friction mats
- Wood runner
- Shrink film and stretch film
- Steel or plastic band straps
- Edge beams protector (aluminium, plastic, wood)
- Protective spacers
- Tag washers
Lashing method
Top-over lashing

The larger the angle the better!
Limited effect below 30!
Direct lashing
Combination of load securing methods
Calculation examples

Load prevented from sliding by top-over lashings

\[ m = \frac{n \cdot 2 \cdot \mu \cdot \sin \alpha \cdot F_T}{g(c_{x,y} - \mu \cdot c_Z) f_s} \]

Load weight prevented from sliding forward by spring lashings

\[ m = \frac{2 \cdot n \cdot F_R \cdot (\mu \cdot f_\mu \cdot \sin \alpha + \cos \alpha \cdot \cos \beta)}{g \cdot (c_x - \mu \cdot f_\mu \cdot c_z)} \]
## Check of load securing

<table>
<thead>
<tr>
<th>DEFICIENCIES</th>
</tr>
</thead>
</table>
| **Related to the load:** | a. Transport packaging does not allow proper load securing  
b. One or more load units are not properly positioned |
| **Related to the vehicle and the equipment:** | a. The vehicle is not suitable for the load  
b. Obvious defects in the vehicle superstructure  
c. Certificates of vehicle parts that are effectively used, are not available, are false or show insufficient strength  
d. Securing equipment that is effectively used, does not comply with relevant standards |
| **Related to the securing method:** | a. Securing is insufficient, but can be corrected  
b. Securing is insufficient and cannot be corrected with available equipment  
c. Expert advice is required to assess the effectiveness of the load securing system |
All persons should receive instruction, information and training on safe loading and securing practices.
Quick lashing guide on safe load securing for road transport

In accordance with EN 12195-1:2010

**Top-over lashing**

Using the table below, you must note that the angle between the lashing and the loading platform is of great importance. The tables should be used for angles between 75° and 90°. If the angle is between 30° and 75°, double amount of lashing straps are needed, or you halve the table.

If the angle is less than 30°, then another method of securing the load must be used.

<table>
<thead>
<tr>
<th>Goods weight in tonnes when</th>
<th>μ</th>
<th>Sideways</th>
<th>Forward</th>
</tr>
</thead>
<tbody>
<tr>
<td>lashing strap will stop slide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.15</td>
<td>0.31</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>0.20</td>
<td>0.48</td>
<td>0.53</td>
<td></td>
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<tr>
<td>0.25</td>
<td>0.72</td>
<td>0.82</td>
<td></td>
</tr>
<tr>
<td>0.30</td>
<td>1.1</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td>0.40</td>
<td>1.7</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>0.45</td>
<td>2.9</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td>0.50</td>
<td>5.4</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>0.60</td>
<td>no fail</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>0.65</td>
<td>no fail</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td>0.70</td>
<td>no fail</td>
<td>2.4</td>
<td></td>
</tr>
</tbody>
</table>

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**Loop lashing**

A loop lashing will secure a load with a pair of webbings. At the same time, the load is prevented from tipping. At the same time, the load can be secured with one lashing strap.

Combination of materials in the contact surface

<table>
<thead>
<tr>
<th>Friction factor, μ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plane wood – fabric base laminat/plywood</td>
</tr>
<tr>
<td>Plane wood – grooved aluminium</td>
</tr>
<tr>
<td>Plane wood – stainless steel sheet</td>
</tr>
<tr>
<td>Plastic pallet – fabric base laminat/plywood</td>
</tr>
<tr>
<td>Plastic pallet – grooved aluminium</td>
</tr>
<tr>
<td>Plastic pallet – stainless steel sheet</td>
</tr>
<tr>
<td>Steel and metal – steel – fabric base laminat/plywood</td>
</tr>
<tr>
<td>Steel crate – grooved aluminium</td>
</tr>
<tr>
<td>Steel crate – stainless steel sheet</td>
</tr>
<tr>
<td>Concrete – concrete rough</td>
</tr>
<tr>
<td>Concrete smooth – sawn wood battens</td>
</tr>
<tr>
<td>Anti-slip material</td>
</tr>
<tr>
<td>Other material</td>
</tr>
</tbody>
</table>

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Lashing equipment

Values in this guide have been calculated on the assumption that the;

... lashing points resist 2000 daN
(2 tonnes under stress)

... webbings have a Lashing Capacity (LC) of 1600 daN
(1.6 tons under stress)

... webbings with $S_{TF} = 400$ daN
(tightened to 400 kg).
Wooden box / plywood platform

- Weight 2,2 ton
- Length 2,0 m
- Breadth 2,0 m
- Height 2,4 m
<table>
<thead>
<tr>
<th>Combination of materials in the contact surface</th>
<th>Friction factor, $\mu$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sawn wood</strong></td>
<td></td>
</tr>
<tr>
<td>Sawn wood – fabric base laminate/plywood</td>
<td>0.45</td>
</tr>
<tr>
<td>Sawn wood – grooved aluminium</td>
<td>0.40</td>
</tr>
<tr>
<td>Sawn wood – shrink film</td>
<td>0.30</td>
</tr>
<tr>
<td>Sawn wood – stainless steel sheet</td>
<td>0.30</td>
</tr>
<tr>
<td>$\mu$</td>
<td>Sideways</td>
</tr>
<tr>
<td>------</td>
<td>----------</td>
</tr>
<tr>
<td>0.15</td>
<td>0.31</td>
</tr>
<tr>
<td>0.20</td>
<td>0.48</td>
</tr>
<tr>
<td>0.25</td>
<td>0.72</td>
</tr>
<tr>
<td>0.30</td>
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<td>1.7</td>
</tr>
<tr>
<td>0.40</td>
<td>2.9</td>
</tr>
<tr>
<td><strong>0.45</strong></td>
<td><strong>6.4</strong></td>
</tr>
<tr>
<td>0.50</td>
<td>no risk</td>
</tr>
<tr>
<td>0.55</td>
<td>no risk</td>
</tr>
<tr>
<td>0.60</td>
<td>no risk</td>
</tr>
<tr>
<td>0.65</td>
<td>no risk</td>
</tr>
<tr>
<td>0.70</td>
<td>no risk</td>
</tr>
</tbody>
</table>
Tipping
• Weight 2,2 ton
• Length 2,0 m
• Breadth 2,0 m
• Height 2,4 m
<table>
<thead>
<tr>
<th>H/B</th>
<th>Sideways</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>H/L</th>
<th>Forwards</th>
<th>Towards the rear</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 row</td>
<td>2 rows</td>
<td>3 rows</td>
<td>4 rows</td>
<td>5 rows</td>
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<td>0.6</td>
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<td>no risk</td>
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<tr>
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<td>no risk</td>
<td>no risk</td>
<td>no risk</td>
<td>5.8</td>
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<td></td>
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<td>no risk</td>
</tr>
<tr>
<td>0.8</td>
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<td>no risk</td>
<td>4.9</td>
<td>2.1</td>
<td>1.5</td>
<td></td>
<td></td>
<td>0.8</td>
<td>no risk</td>
<td>no risk</td>
</tr>
<tr>
<td>1.0</td>
<td>no risk</td>
<td>no risk</td>
<td>2.2</td>
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<td>1.0</td>
<td>no risk</td>
<td>no risk</td>
</tr>
<tr>
<td>1.2</td>
<td><strong>no risk</strong></td>
<td>4.1</td>
<td>1.4</td>
<td>0.91</td>
<td>0.73</td>
<td></td>
<td></td>
<td><strong>1.2</strong></td>
<td><strong>no risk</strong></td>
<td>no risk</td>
</tr>
<tr>
<td>1.4</td>
<td>no risk</td>
<td>2.3</td>
<td>0.99</td>
<td>0.71</td>
<td>0.58</td>
<td></td>
<td></td>
<td>1.4</td>
<td>5.3</td>
<td>no risk</td>
</tr>
<tr>
<td>1.6</td>
<td>no risk</td>
<td>1.5</td>
<td>0.78</td>
<td>0.58</td>
<td>0.49</td>
<td></td>
<td></td>
<td>1.6</td>
<td>2.3</td>
<td>no risk</td>
</tr>
<tr>
<td>1.8</td>
<td>no risk</td>
<td>1.1</td>
<td>0.64</td>
<td>0.49</td>
<td>0.42</td>
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<td>0.90</td>
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<td>0.42</td>
<td>0.36</td>
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<td>no risk</td>
</tr>
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<td>4.5</td>
<td>0.75</td>
<td>0.47</td>
<td>0.37</td>
<td>0.32</td>
<td></td>
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<td>0.83</td>
<td>7.2</td>
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<tr>
<td>2.4</td>
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<td>0.64</td>
<td>0.42</td>
<td>0.33</td>
<td>0.29</td>
<td></td>
<td></td>
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<td>0.68</td>
<td>3.6</td>
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<td>2.6</td>
<td>2.4</td>
<td>0.56</td>
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<td>0.26</td>
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<td>2.6</td>
<td>0.58</td>
<td>2.4</td>
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<td>2.8</td>
<td>1.8</td>
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<td>0.34</td>
<td>0.28</td>
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<td></td>
<td>2.8</td>
<td>0.51</td>
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</tr>
<tr>
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<td>1.4</td>
<td>0.45</td>
<td>0.31</td>
<td>0.25</td>
<td>0.22</td>
<td></td>
<td></td>
<td>3.0</td>
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<td>1.4</td>
</tr>
<tr>
<td>3.2</td>
<td>1.2</td>
<td>0.41</td>
<td>0.29</td>
<td>0.24</td>
<td>0.21</td>
<td></td>
<td></td>
<td>3.2</td>
<td>0.40</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Load weight in tons where **one** top-over lashing strap will stop tipping motion
- Weight 2,2 ton
- Length 2,0 m
- Breadth 2,0 m
- Height 2,4 m
Other lashing equipment

Values for LC and $S_{TF}$ are marked on the lashing equipment.

*If the LC for a chain is not known, the LC can be set to 50% of the breaking load.*

Recalculating

If equipment with a different capacity to LC 1600 or $S_{TF}$ 400 are used, the figures in the sliding and tipping tables have to be multiplied with the following factors.

When recalculating, never use larger LC or $S_{TF}$ than the lashing points can hold.

Methods

**Top-over lashing**

*For sliding:*

$$\frac{\text{Actual } S_{TF}}{400} = \text{Multiplication factor}$$

*For tipping the smallest of the following factors shall be used:*

$$\frac{\text{Actual } S_{TF}}{400} \quad \text{or} \quad \frac{\text{Actual LC}}{1600} = \text{Multiplication factor}$$
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