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Vehicle Rollover Incidents

In 2007, three European industrial gas company drivers were killed when their vehicles overturned or rolled over. In 2008, two European industrial gas company drivers were killed when their vehicles overturned or rolled over.



A car had broken down and was parked in the right hand lane with no lights on at 10 p.m. at night.

To avoid a collision the driver of a partially full liquid nitrogen tanker swerved to the left and the trailer rolled over and hit the central barrier, killing the driver.

An ISO container unit full with liquid oxygen rolled over and caught fire. The driver sustained fatal injuries. While travelling on a 180° curved highway entrance ramp on an upward slope, the vehicle rolled over resulting in the trailer striking a concrete guard railing.

The impact caused valves connecting the inner liquid vessel to the pressure building coil to sever. A violent fire occurred when the liquid oxygen stream was directed towards the vehicle's engine and fuel tank. Additionally, damage to the vehicle, liquid oxygen container, and chassis resulted in a total loss.



A cylinder distribution vehicle operated by a contractor rolled over while travelling on a slip (access) road. The vehicle caught on fire at the front end destroying the cab and front third of the trailer. The fire brigade put out the fire, but the driver died in the cab.

Cylinders suffered fire and/or mechanical damage. The vehicle cab was burnt out. The road was closed for about 12 hours.

A trailer, operated by a contractor, transporting liquid CO₂ rolled over. It seems that the driver missed a curve to the right and braked. The trailer wheel went off the road into a steep gully (35cm) and rolled over. The vehicle then slid across the road and the cab roof hit a concrete barrier on the left side of the road.

The driver died in hospital some hours later.

The tractor was seriously damaged. There was no spillage of product.



In the early hours of the morning a loaded CO₂ tanker left the road and collided with a pole carrying power cables, after the driver had momentarily fallen asleep.

The driver was not wearing a seat belt and died from impact with the steering wheel.

Are these one off issues or an industry problem?

Road transportation is the highest risk activity we carry out in our day-to-day operations in the industrial gases industry. These risks fall into two main categories:

- On the road, driving
- At the customer delivery point

Those at risk are the same individuals, contract and employee drivers that spend the majority of their working day unsupervised.

European Industrial Gases Industry key figures

- 4.5 million delivery points
- 220,000 t/day production
- 10,400 delivery vehicles
- 530 million km/year-road transport
- 35 million cylinders and high volumes of bulk liquid are mostly delivered by road transport

Are these isolated events?

Statistics are available for the road transport industry in the US (all industries, not just industrial gases) indicating that there are approximately 15,000 commercial vehicle roll-overs per year. 58% of these result in driver fatalities, 95% in hazardous material spills and average direct costs of \$120,000 per event.

Major industrial gas companies experienced between 25 and 45 rollovers per year, with similar consequences and cost before programmes were introduced to focus on prevention.

In January 2008, EIGA held a Transport Symposium and invited the major industrial gas companies, hauliers and vehicle suppliers to discuss and present their experiences and their solutions.

Vehicle Rollover Causes

Main Causes of Road Accidents

An analysis of the causes of road traffic accidents in the industrial gas industry, as presented at the EIGA Transport Symposium, indicated that:

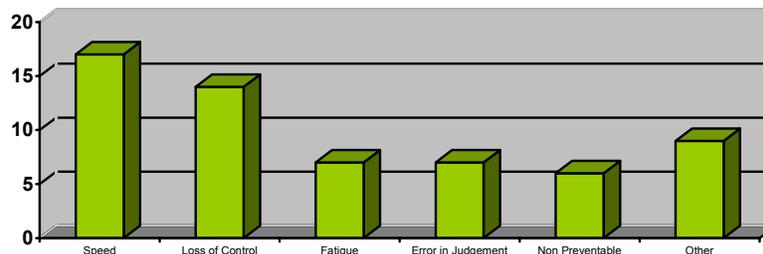
- 49% are related to human factors involving the driver or management of the driver
- 14% are related to vehicle factors, such as specification and maintenance of vehicles and incorrect loading of vehicles
- 32.5% are the result of third party actions
- 4% are related to poor road conditions, and
- 0.5% is directly related to the dangerous goods being carried.

Human factors include excessive speed, driving on the road shoulder, loss of control without excessive speed, driver failures, lack of speed and fatigue management processes, insufficient driver and management training/education programmes.

Rollover Causes

Detailed studies of the causes of vehicle rollovers within the industrial gases industry indicates that the major causes are excessive speed, lack of control, driver fatigue and error in judgment.

Rollovers by Cause



The studies have further shown that:

- Trailer **high centre of gravity contribute** to rollovers but are **not the cause**
- **Driver fatigue** and **speed for conditions** are the main causes of rollovers
- Rollovers can initiate at **relatively low speeds** with **little or no warning to the driver**
- **Driver training programs alone have not been effective** at reducing rollovers.

Vehicle Rollover Prevention

The root causes of these incidents are attributable to both driver and management behaviours and actions.

Rollover prevention needs therefore to focus on both drivers and managers and their behaviours and on the design and engineering of vehicles used to transport gases.

People and Behaviours

Because drivers are not closely supervised and spend much of their working day alone, prevention must focus on developing interdependency skills for drivers, including:

- dynamic risk assessments, which should be carried out by drivers during customer site deliveries or at truck stops or service areas
- self observation by drivers while they are driving
- end of shift reviews with colleagues and supervisors
- reporting and discussion of driving near misses with colleagues and supervisors.

The benefit of unlocking this potential is recognition of risk by drivers and acknowledgement of their ability to change their own behaviours.

Managers and supervisors can support behaviour modification in drivers through analysis of driving behaviours from tachographs or trip computers and from driver observation by qualified driver trainers; and through company driver safety programmes.

Analysis of driving behaviours should focus on:

- speeding and driving too fast for road and weather conditions
- hard braking which may indicate inadequate stopping distances being allowed.

Driver Safety Programmes

Company driver safety programmes may include:

- monthly group safety training
- incentive bonus for no speeding or incidents
- driver recognition awards for one million accident-free kilometres
- industry-wide driver award programmes
- supervisor coaching - 1 on 1
- disciplinary action.

Pre-requisites to ensure the success of these programmes should include supportive site culture and leadership behaviours; a culture of education rather than training; understanding of risks and behaviour; compliance to standards; including practical rollover prevention training.

Training and training material should be globally consistent but locally tailored.

Defensive Driver Training

Defensive Driving Training is critical and should cover areas such as:

- anticipation of the actions of other road users
- awareness of environmental influences and other road users
- conforming to the traffic situation without stress
- avoidance of aggressive driving behaviour by drivers
- anticipation of the mistakes of other drivers.

Driver Fatigue

All managers responsible for drivers need to demonstrate an understanding of the subject of fatigue.

Those managing commercial drivers must ensure that:

- all drivers complete fatigue awareness training
- drivers meet the requirements of company standards and/or local legislation on driving, working and rest hours
- driving records, e.g. tachographs/on-board computers, are analysed on a regular basis to ensure compliance with driving, working and rest hours.

Schedule management and manning levels must take into consideration limitations on driver working hours.

Driver ill health, medication or conditions such as sleep apnoea should be considered and screening should be conducted if possible.

Rollover Prevention through Planning

Planning and scheduling of product deliveries should take into consideration vehicle routes, customer access roads and delivery times of day, e.g. avoiding or making drivers aware of accident black spots.

Rollover Prevention through Engineering

There are an increasing number of types of equipment technology that can prevent vehicle rollovers.

Trailer design can lower the centre of gravity of the vehicle and load and improve stability.



Lower Centre of Gravity Trailer Design

Stability Control Systems work in different ways to override the driver's actions electronically when the system detects that the conditions for a vehicle rollover are being approached. They currently include:

Electronic Braking Systems (EBS) improves:

- response and control
- stopping distances and stability.

Electronic Stability Control (ESC) stabilizes the vehicle by selective braking on each wheel. S systems are sophisticated and often quite expensive. They reduce the risk of rollover, skidding, spinning and jack-knifing and are constantly 'on'.

Roll Stability Protection (RSP) is an integral stability control function that reduces power, activates the engine brake and/or applies tractor and trailer brakes. They significantly reduce the risk of rollover by applying the appropriate brakes. The system senses lateral 'G' loads and self calibrates for whether the vehicle is loaded or unloaded. Systems require ESC.



Systems can be fitted to the trailer or to the truck and trailer. Trailer systems are much simpler and give at least 50% of the benefit at virtually 'no cost option' on new trailers or low cost to retrofit to older trailers. System 'Interventions' can be recorded for later analysis with the drivers.



EIGA is a signatory to the European Road Safety Charter and is committed to improve general knowledge of road safety issues, and issuing newsletters with lessons learned from the analysis of relevant noteworthy accident reports. More information on the European Road Safety Charter can be found at <http://www.erscharter.eu/> and through the European Commission Road Safety website http://ec.europa.eu/transport/road_safety/index_en.htm.

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