NCEC is conducting a project on behalf of the UK Department for Transport (DfT), part of which aims to raise awareness and promote the reporting requirements for dangerous goods incidents that occur on the road network.

Welcome to our third quarterly newsletter to support this.

Road (ADR) Incident Reporting Requirements

What would you do in this scenario?

The police contact your head office to inform you that one of your tankers, carrying UN1011 BUTANE, has been involved in a road traffic collision causing a major A road to be closed while they assess the scene. There are no injuries, but the tanker is badly dented and there are reports of a hissing sound of escaping gas. They are looking for your company to aid with resolving the leaking tanker so they can reopen the road. Your company rapidly provide a replacement tanker and arrange recovery of the damaged tanker. The road remained closed for 4 hours and there was a lot of chatter on social media.

Later that week, after a debrief about the incident, your transport manager asks if the high publicity of the incident and involvement of the emergency services means that the Competent Authority has already been informed of what happened. Your answer should be: 'we must conform to the International Carriage of Dangerous Goods by Road (ADR) notification requirements, by independently reporting the facts of the incident to the Competent Authority, regardless of whether they are aware via social media'. You refer your transport manager to this bulletin, and earlier editions, to give them more awareness of the reporting requirements.

The Agreement concerning ADR states that it is a legal requirement to report certain serious incidents involving dangerous goods to the Competent Authority when they meet the criteria outlined in ADR 1.8.5. In Great Britain, this authority is the Department for Transport (DfT). In Northern Ireland, operators would be required to report to the Health and Safety Executive for Northern Ireland (HSENI). It must be reported within **one month** of the incident occurring. To ensure that your organisation is accurately fulfilling its legal responsibilities, you may implement an internal best practice incident reporting process so that key stakeholders are promptly alerted when an incident meets the criteria outlined in ADR 1.8.5.

A report is required when an incident involving dangerous goods fits into one of the following events **AND** it is serious enough to meet at least one criterion.

Event	Criteria
Immediate risk of, or confirmed loss of product	• Transport category 0 / 1: > 50 kg or litres • Transport category 2: > 333 kg or litres • Transport category 3 / 4: > 1,000 kg or litres *There are also additional stipulations for Class 6.2 and Class 7 materials.*
Personal injury or fatality	• Death • Unable to work for at least three consecutive days • Hospital stay of one day or more • Intensive medical treatment
Material or environmental damage is sustained	• Damage value more than €50,000
Involvement of the authorities	• Evacuation or route closure for three hours or more

This table provides a brief summary of criteria, however for full legal definitions please refer to ADR 1.8.5.

ADR 1.8.5 covers more than the movement of goods on public roads. It also encompasses **loading and unloading operations.** Therefore, there may be reporting obligations on the loader, filler, carrier, or consignee.

Some scenarios that may require reporting to the DfT (or other Competent Authority) are detailed below for you to consider. They are designed to demonstrate the breadth of dangerous goods incidents that must be reported.

- A tanker was leaking a continuous flow of nitrogen gas due to a welding fault. The leak was noticed due to frosting on the tank while the driver stopped at a service station for a rest break. Although the leak was small (estimated to be 2 litres a minute), the structural damage to the container means that the incident should be reported to the Competent Authority due to the imminent risk of product loss.

- A curtain sided lorry carrying a shipment of UN3480 LITHIUM ION BATTERIES spontaneously ignited on a major motorway near Cambridgeshire. No injuries were reported but the smoke plume and subsequent damage to the tarmac caused the northbound carriageway of the motorway to be closed by the fire and rescue service (FRS) for approximately 5 hours. Due to the attendance of the authorities and the road closure for greater than 3 hours, the Competent Authority would need to receive a report of this incident.

- A culture sample of UN2814 INFECTIOUS SUBSTANCES, AFFECTING HUMANS, (EBOLA), was damaged in transport on the way to a university. As this is a Class 6.2 substance, the size of the product release does not matter, and the incident must be reported to the Competent Authority because of the possibility of the disease spreading throughout the population.

- A mechanical failure caused the brakes on a road tanker to lock on and the subsequent loss of control resulted in the tanker lying against a dry, grassy embankment. The heat from the brakes set fire to the grass. The tanker contains UN1086 VINYL CHLORIDE. Although there is currently no escape of the product, there is a risk of a boiling liquid expanding vapour explosion (BLEVE) due to the heat and the product's potential to polymerise. Therefore, a 1.6 km evacuation zone is created, causing several hundred households to leave their homes while the emergency services make the scene safe. This would require reporting to the Competent Authority due to the presence of the emergency services and the evacuation of residents for greater than 3 hours.

- During loading, approximately 5L of UN3257 ELEVATED TEMPERATURE LIQUID, N.O.S splashed on to an operative causing second and third degree burns to their hands, arms and chest despite them wearing the appropriate personal protective equipment. They were initially placed into a coma at the hospital and treated for a week to reduce the effects of swelling from the burns. As the employee was in hospital for greater than one day, the Competent Authority should be notified.

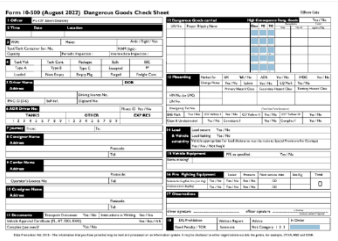
If you are the person responsible within your organisation for reporting dangerous goods incidents to the Competent Authority, you should familiarise yourself with the full criteria of ADR 1.8.5, which defines when you need to submit a report. It is a legal requirement for incidents and accidents meeting the requirements of ADR 1.8.5 to be reported to the Competent Authority who, on receipt of the report, are entitled to request further relevant information. The online reporting form for Great Britain can be found here:

Transporting dangerous goods - GOV.UK (www.gov.uk)

If an incident occurs during an international journey covered by ADR 1.8.5, a report must be submitted to the Competent Authority of the territory where the incident occurred.

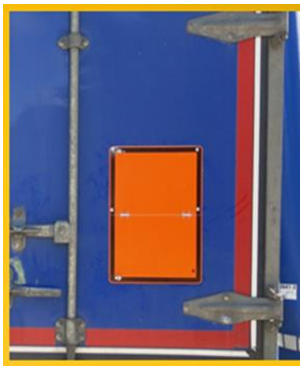
If you have any questions on the reporting requirements of ADR 1.8.5 or other regulatory obligations, please contact the DfT at dangerousgoods@dft.gov.uk or call 020 7944 2271 / 2058.

Emerging Trends in Enforcement Issues



There are many elements to a roadside inspection and a 10/500 form is completed at the roadside by police. The structure of this form allows industry to understand what is required. However, enforcement agencies have noticed several emerging trends, whilst conducting compliance checks on vehicles carrying dangerous goods.

ADR Orange plates



Whilst ADR orange plates have been an issue for some time, particularly in terms of them being unclean, poorly fixed, not visible, or incorrectly oriented, there is an emerging trend towards the use of magnetic plates. ADR 5.3.2.2.1 covers the specification and size requirements for these plates, which includes that the plate shall not become detached from its mount in the event of 15 minutes engulfment in fire. Research has shown that magnets lose their magnetic properties at around 80 degrees Celsius so, unless the magnetic plates are of a porcelain variant, they will likely not comply with ADR stipulations.

ADR also states that these plates must be displayed in the vertical plane, but some companies are putting them on the bonnet of vans, which again is not compliant. It has been noted that companies are using these on hire vehicles, where the hire companies do not know their vehicles are being used to carry dangerous goods. It is important that orange plates conform to ADR stipulations and are placed correctly.

Electronic transport documents

The development and implementation of electronic transport documents is progressing well, and they are becoming a popular choice amongst hauliers carrying dangerous goods. ADR already copes neatly with their use, but it has been noted by enforcement agencies that with new opportunities come new risks. Common trends identified include the driver not knowing how to access the documents, the device present not producing all the information required under ADR or an unserviceable / missing device (low battery or damaged / stolen).

Whilst there is no need for this documentation to be immediately accessible like Instructions in Writing, ADR 1.8.1.2 does require participants to provide the necessary information without delay so it is imperative that the driver must be able to gain access during an enforcement check. It is therefore important that drivers are well trained and that there is a contingency plan in place in case there is an issue with the device itself. Packaged goods can be very difficult to identify without the information contained within these documents, which can create significant problems if there is an issue with the load.

Lack of Dangerous Goods Safety Advisor (DGSA) notification following an enforcement check

It has become apparent that many DGSAs are not being alerted to positive or negative roadside interactions with enforcement agencies, which in turn makes it difficult for them to produce accurate annual reports and know when they need to undertake company visits.

Enforcement Officers are therefore being encouraged to ask for the name of the appointed DGSA from the transport manager of the company, prompting a phone conversation, but it is alarming that many do not actually know who their DGSA is.

This is part of an initiative called Closing the Gap, which forms part of Vison Zero (a national police initiative for zero road deaths), as a breach to ADR poses a risk to the community. This promotes an early intervention to save lives and prevent unnecessary injuries. This is a small part of this overall campaign but critical due to the harm this type of incident can cause.

Note: Our sincere thanks to Terry Harvey, Suffolk Police / Chair of the Carriage of Dangerous Goods Practitioners Forum and Jason Dearsley, Essex Police / Vice Chair of the Carriage of Dangerous Goods Practitioners Forum for providing the content of this article.

Lithium-ion Batteries – A Changing Landscape

Does your company transport lithium-ion (Li-ion) batteries or goods that contain Li-ion batteries? Are you aware of the risks of Li-ion batteries and handle them appropriately? Would you be able to identify a damaged Li-ion battery and know what measures to take?

There is an urgent need to develop new sources of energy and energy storage solutions to reduce dependency on fossil fuels. Li-ion batteries are a relatively new technology, yet there has been an increase of Li-ion batteries in domestic and commercial electrical equipment because of their high energy density. They have a wide range of uses from mobile phones to electric scooters to energy storage systems supplying the National Grid. However, these batteries can present a significant risk if they are not handled, packaged, classified, and declared appropriately. This article intends to promote awareness of the inherent risk of thermal runaway in Li-ion batteries and the provisions defined for their transport by road under ADR.

There are many different chemistries of lithium batteries and cells, but they generally fall into two categories: lithium metal batteries and Li-ion batteries. They are all transported as Class 9 dangerous goods. However, each are assigned different UN numbers in Table A of ADR, depending on whether not they are contained in or packed with equipment (UN 3090 and 3091 for lithium metal and UN 3480 and 3481 for Li-ion). The primary difference between these categories is that Li-ion batteries are rechargeable and do not contain lithium metal. Li-ion batteries can also form part of vehicles which would fall under the dedicated UN numbers UN 3166, 3171 and 3536 – see ADR Table A for further detail. However, this article will focus on Li-ion batteries transported under UN3480 and UN3481:

UN Number	**Proper Shipping Name**	**Special Provisions**
3480	LITHIUM ION BATTERIES (including lithium ion polymer batteries)	188, 230, 310, 348, 376, 377, 387, 636
3481	LITHIUM ION BATTERIES CONTAINED IN EQUIPMENT OR LITHIUM ION BATTERIES PACKED WITH EQUIPMENT (including lithium ion polymer batteries)	188, 230, 310, 348, 360, 376, 377, 387, 390, 670

Thermal runaway

The increase in transport of Li-ion batteries has seen an increase in the number of fires involving Li-ion batteries and their chemical properties present an unusual hazard: thermal runaway. Each battery contains several cells which are connected to provide the electrical output. The cells are composed of a Li-ion electrode, a graphite electrode, and an electrolyte. The Li-ion and graphite electrodes have different charges so must be kept apart physically by a separator. When one cell within a battery is compromised such that the separation between

the electrodes fails, it short-circuits and releases a significant amount of heat energy. If the energy cannot dissipate, it will uncontrollably propagate between cells in thermal runaway. The heat from one battery can cause other batteries to undergo thermal runaway. Heat vaporises and decomposes the electrolyte into a toxic, corrosive, and flammable mixture which will increase the pressure inside the battery, until it ultimately explodes. The vapour released from the battery can immediately ignite leading to long, directional flames. Alternatively, the vapour cloud can concentrate within a confined space, reach an ignition source, and produce an extremely dangerous vapour cloud explosion.

A curtain-sided lorry carrying Li-ion batteries spontaneously caught fire on one of the busiest motorways in the UK, causing closure of the motorway for more than 6 hours while the FRS brought the fire under control. The trailer was burnt to a shell. The driver successfully uncoupled the cab and was unharmed. The cause of the fire is likely to have been a Li-ion battery that short-circuited.

Due to the positive feedback loop involved in thermal runaway, it is extremely difficult to control a Li-ion battery fire. Water has a high heat capacity so readily cools the fire but does not prevent the chemical reaction from continuing. Equally, preventing the chemical reaction using powder further contains the heat, so chance of reignition is high. Foam formulations are being developed and investigated as a future option, but it must completely smother the fire and specialist foams are unlikely to be rapidly available on the road network. There is currently no industry standard to fight a Li-ion battery fire.

Causes of thermal runaway

Due to the difficulties in fighting an established Li-ion battery fire, it is best to prevent damage to a Li-ion battery before it occurs. Studies have identified common causes of thermal runaway:

- Internal manufacturing defects - contamination
- Physical damage - mechanical abuse e.g. bending or thermal abuse
- Substandard quality - unstable chemistry within the cells
- Electrical abuse - over-charging / discharging
- Internal electrical failure i.e. a short-circuit.

ADR 2.2.9.1.7 describes the conditions that all Li-ion batteries must be tested to in order to reduce the likelihood of Li-ion battery failure. One of these requirements (2.2.9.1.7a) is that manufacturers should ensure the batteries pass the physical and chemical tests according to the UN Manual of Tests and Criteria, Part III, Section 38.3, which vary slightly according to whether they are classified as UN3480 or UN3481. The manufacturer should then submit a Li-ion Batteries Test Summary Certificate verifying the test results.

Other incidents can arise from packaging failures, non-declaration, or mis-declaration of Li-ion batteries. They should be labelled on the outer packaging with Class 9A labelling or marked according to ADR 5.2.1.9.2 if Special Provision 188 (the cells have a Watt hour rating of <20Wh and the battery has a Watt hour rating of <100Wh) applies. In addition to the typical packaging requirements that determine the material performance levels, there is an additional requirement that cells or batteries must be protected against short circuit for all UN3480 / UN3481 applicable packaging instructions (P903, P908, P909, P910, P911, LP903, LP904, LP905, LP906). The level of danger posed by damaged Li-ion batteries is known, as ADR requires such Li-ion batteries to be transported under Special Provision 376. This also mandates that any severely damaged Li-ion batteries (for example, those leaking electrolyte)

must be transported in more sturdy packaging (P911 compared to P903, for example) that amongst other prescriptions, must withstand projectile damage due to the heightened risk of explosion.

Measures to prevent thermal runaway

Methods to verify the integrity of the Li-ion batteries and maintain safety during transport could include: handling with care; visual checks of the batteries to notice any obvious bulging, visible leaks, smoke / “steam” of a vapour cloud or flames; ensuring packages are not ruptured nor show signs of damage and conform to relevant packaging instructions; obeying relevant labelling and marking standards; or preventing the load from exceeding ambient temperature during transport (recommended maximum 40^{o}C). There is an element of reliance on the manufacturer producing suitably high-quality batteries, but this can be mitigated by knowing your customer and ensuring compliance with the UN Manual of Tests and Criteria.

Industry standards, transport regulations and codes are slowly being updated to prevent incidents occurring in the future, however there are several actions that could be carried out today to improve safety and protect people, the environment, assets and reputation (PEAR) during the transport of Li-ion batteries. We would first encourage you to raise awareness within your company of the inherent risk of thermal runaway. You could also assess your vulnerabilities to thermal runaway, implement a best practice guide on handling shipments containing Li-ion batteries as well as develop an emergency response procedure that mitigates the risks and hazards of thermal runaway – including the release of toxic, corrosive, and flammable gases which, if not immediately ignited, may produce a vapour cloud explosion.

If you have any questions on the ADR requirements for lithium-ion battery transport or other regulatory obligations, please contact the DfT at dangerousgoods@dft.gov.uk or call 020 7944 2271 / 2058.

Celebrating 50 years of Emergency Response

The National Chemical Emergency Centre (NCEC) was formed in 1973 at a time of increasing activity within the chemical sector, with an associated rise of incidents related to the transport of Dangerous Goods. When an incident involving a road tanker transporting oleum (highly concentrated sulfuric acid), resulted in a fatality, arrangements were put in place to ensure that emergency services would have fast access to the information they may need to keep themselves and others safe if a similar incident were to happen in the future.

NCEC work with the Department of Transport (DfT) and Chemical Industries Association as part of the Chemsafe scheme, providing support to the UK emergency services when they are dealing with incidents involving hazardous materials through a 24/7 hotline.

We thought it would be interesting to provide a few examples of the type of transport incidents involving dangerous goods that we have provided advice on. Of course, you can consider which of these incidents would require notification under the requirements of ADR 1.8.5 – answers are at the end of the article.

700 litre ink trail

As indicated in our earlier bulletins, load security is a significant issue in the carriage of dangerous goods. In this call, two containers of UN 1210, Printing Ink, Flammable, PG III, had come loose from their tethers within a curtain-sided heavy goods vehicle (HGV). The movement had caused one to become damaged and leak approximately 700 litres of product, resulting in a trail for an unknown distance of the HGV's journey between Manchester and Bristol, as the spill was only noticed when the driver stopped in a lay-by on the A4174. The leak was ongoing, pooling in and below the HGV while in the lay-by. The containers had originated from Germany and the product name was described as Druckfarbe. There was no placarding on the outside of the vehicle, but the container displayed a hazard warning diamond.

The FRS had already placed a 30m cordon around the HGV and closed the A4174 and the Environment Agency and the Health and Safety Executive had already been notified of the incident. However, the Fire Officers still required additional advice from NCEC regarding spill remediation, specifically if they should contain the spill or dilute it and wash to drain.

We informed the caller that without a trade name (Druckfarbe translating to "printing ink"), we would expect the product to be a type of organic solvent with pigment suspended in it, and therefore the main hazard of the material would be flammable vapours. However, the packing group indicated that this was at the less hazardous end of the flammability range (flash point between 23 and 60^{o}C). Still, we clarified that ignition sources should be removed and, since the organic vapours may produce a narcotic effect when inhaled, breathing apparatus should be worn in areas where the vapours could accumulate e.g. the load area of the vehicle. We counselled against washing the product to drain due to environmental risks posed by an organic material and the potential for a vapour cloud and subsequent explosion in the drains.

Instead, we recommended that the spill should be absorbed in inert material where practicable, and the damaged container sealed with putty to prevent further leakage.

Multi-load Bridge Strike

A curtain-sided HGV had collided with a railway bridge on a major A road in Leicestershire and had become wedged underneath. The HGV had suffered substantial damage in the collision which caused the curtain to tear and damage to the receptacle(s) being carried, resulting in the load leaking across the road. A corresponding solvent-type odour could be smelt by the fire officers present. The road was closed due to the incident and a provisional 50-metre cordon was in place.

NCEC was contacted by the FRS as they required specialist advice on the potential for a reaction between the various mixed load products carried on the HGV. There were 13 products on the HGV, which were only described by their UN number and proper shipping name:

UN Number	Proper shipping name
1170	Ethanol
1263	Paint
1719	Caustic Alkali, Liquid, N.O.S.
1805	Phosphoric Acid, Solution
1824	Sodium Hydroxide, Solution
1903	Disinfectant, Liquid, Corrosive, N.O.S.
3077	Environmentally Hazardous Substance, Solid, N.O.S.
3082	Environmentally Hazardous Substance, Liquid, N.O.S.
3262	Corrosive Solid, Basic, Inorganic, N.O.S.
3264	Corrosive Liquid, Acidic, Inorganic, N.O.S.
3266	Corrosive Liquid, Basic, Inorganic, N.O.S.
3295	Hydrocarbons, Liquid, N.O.S.
3469	Paint, Flammable, Corrosive

In addition, hydrogen peroxide and peroxyacetic acid were due to have been packed onto the HGV but it was not initially clear if they had been left behind at the depot, which illustrates how not following ADR to the letter results in confusion.

We observed that the shipment primarily consisted of a large quantity of solvent, paint-based hazardous materials (UN 1170, 1263, 3295 and 3469), which would pose a flammable risk, a risk that would be further exacerbated if the oxidising peroxide-like substances were included in the shipment. We noted the incompatibility of the acids (UN 1805 and 3264) and alkalis (UN 1824, 3262 and 3266) and provided advice on how to use a thermal imaging camera to pinpoint unexpected heat generated by an ongoing chemical reaction. Furthermore, we predicted that any gases created from reactions would be rapidly evolved, although we did not think it likely that there would be any toxic gases (such as chlorine) produced.

After a discussion with the FRS, we concluded that their monitoring equipment should be used to check the safety of the scene. In addition to the thermal imaging camera, they also deployed a gas monitor, which showed no hazardous gases had evolved from the spill. Due to the presence of environmentally hazardous substances (e.g. UN 3077 and UN 3082) and the risk of creating heat of mixing, we advised that the spill should be contained or absorbed in sand and not diluted and washed to drain.

Whist we were able to provide advice to resolve this incident, there were many aspects of this carriage operation that could have breached the legal requirements and therefore the enforcement authorities may have taken action against the operator and/or driver.

Corrosive Leak from a Curtain-Sided HGV

An unidentified substance was leaking from a curtain-sided HGV on the eastbound carriage way of a strategic motorway, causing the closure of all but one lane of the motorway. The HGV was carrying different Class 8 (corrosive) materials in various sized containers (including 950-litre intermediate bulk containers (IBCs)) and it had not been established exactly which of the containers on the load were leaking.

The chemicals being carried were:

UN Number	Proper shipping name	Trade name
1760	Corrosive Liquid, N.O.S., PG III	Circopure N SFM (Sulfuric Acid, Methane Sulfonic Acid)
2031	Nitric Acid, With Less Than 65 % Nitric Acid, PG II	Acidsan 26% w/w Nitric Acid Solution
3265	Corrosive Liquid, Acidic, Organic, N.O.S., PG III	Lactic Milchsaeure DL

The police intended to open the curtain side of the HGV to assess the extent of the spill and determine how best to contain the material so that the vehicle and its load could be moved so they could look to fully open the motorway to traffic. Before they did so, they contacted NCEC for assistance in identifying the possible leaking product and any relevant hazards.

NCEC began by recognising a common risk with mixed loads of Class 8 substances, i.e. if acids and alkalis are mixed, they will undergo an acid-base reaction which will produce a lot of heat and potentially toxic gas or vapour by-products. As more information became available about the load, we determined that all the products were acidic and therefore an acid-base reaction would be unlikely. We recognised that strong acids and metals inside the HGV may be incompatible and react to produce hydrogen, adding a further hazard of flammable gas to the acidic liquid and vapour. We also highlighted that the nitric acid could increase fire risk in contact with combustible material, such as wood, paper, or cellulose.

We discussed the most practical remediation options and recommended using a chemically inert material (such as sand or earth) to absorb the spilled material, which would make it more manageable to collect and dispose of as hazardous waste. We explained that the Environment Agency would need to be contacted to carry out pH monitoring if the police intended to wash the residues to drain with water as, despite dilution, the wastewater would remain acidic.

The police ultimately took the decision to open the curtain and inspect the load. They discovered that it had completely shifted and there were several damaged containers that required removal, along with a re-assessment of the integrity of the remaining load before the HGV could continue its journey. Due to the location of the incident, the management of specialist clean-up was passed on to National Highways.

Reporting serious incidents during loading, filling, carriage, or unloading is required under ADR regulations in the UK. Understanding where and how incidents occur through accurate reporting is key to further developing policy and response practices. For transport related calls taken on the Chemsafe line, NCEC immediately warns DfT of any significant disruption to the transport network. In addition to this, we conduct transport mapping of incidents notified to us to highlight any patterns or trends in incident occurrence.

NCEC is proud to still be supporting the emergency services through Chemsafe 50 years on and, whilst it is no substitute for individual company emergency response arrangements, it does provide a safety net for first responders and prevents escalation.

Answers to the above calls:

Only one of the incidents would likely not be reportable:

- *700 litre ink trail: As this is a transport category 3 substance, it would not be reportable as the volume of product lost is below the reportable threshold.*

Both the other incidents would likely be reportable for the following reasons:

- *Multi-load Bridge Strike: This would almost certainly require reporting due to the road closure, which was likely to be protracted, given the situation.*
- *Corrosive Leak from a Curtain-Sided HGV: This would likely be reportable due to the volume of product at immediate risk of, or confirmed, loss from multiple 1000 litre containers of Category 2 and 3 substances.*

We hope you found this newsletter useful and informative. If you have any questions regarding the information in the newsletter, please contact us at ncec@ricardo.com.