Indicative Guidelines for Safe and Secure Transport of Hazardous Chemicals by Road

OPCW
Organisation for the Prohibition of Chemical Weapons

Indicative Guidelines for Safe and Secure Transport of Hazardous Chemicals by Road

The Outcome of the Workshops on
Chemical Safety and Security Tools Development Programme

OPCW

Organisation for the Prohibition of Chemical Weapons

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1 Preface

The Technical Secretariat (the Secretariat) of the Organisation for the Prohibition of Chemical Weapons (OPCW) is committed to promoting and building capacities in relation to chemical safety and security in States Parties, with a view to mitigating the risks arising from chemical accidents and from the potential misuse of toxic chemicals, including the threat of terrorism. In this vein, the Secretariat remains dedicated to facilitating the sharing of information and the dissemination of best practices, between and among the States Parties, for advancing a culture of chemical safety and security management (CSSM).

Pursuant to the decision by the Conference of the States Parties (the Conference) at its Sixteenth Session ("Components of an Agreed Framework for the Full Implementation of Article XI"; C-16/DEC.10, dated 1 December 2011), the Secretariat was mandated "to conduct, based on input from National Authorities and relevant stakeholders, a needs assessment on tools and guidance that would be helpful for promoting chemical safety and security." In response, the Secretariat, through capacity-building workshops and training sessions that are in line with emerging and assessed needs, has actively engaged in providing effective support to States Parties. Furthermore, since 2016, the Secretariat has regularly undertaken annual surveys on needs assessment and best practices in CSSM, including workshops that present the key results of the surveys. In 2019, building upon these efforts, the Secretariat formally launched the CSSM Tools Development Programme, which is specifically aimed at enhancing the capacities of States Parties through the provision of supportive guidelines and tools.

During the first phase of the CSSM Tools Development Programme, the Secretariat, on the basis of the assessed priority needs of States Parties, initiated the development of the "Indicative Guidelines for Chemical Safety and Security in Small and Medium-sized Enterprises to Foster the Peaceful Uses of Chemistry". The guidelines were prepared and officially launched in 2021. This was followed by the next phase of the Programme, where the transportation of hazardous chemicals by road was identified by States Parties as a key priority needing attention; accordingly, the Secretariat chose the topic to develop indicative guidelines to strengthen practices related to road transport.

The indicative guidelines on the transportation of hazardous chemicals which follow were developed as a result of two expert group workshops and a series of individual work sessions, discussions, and consultations online. At the first meeting in Wuppertal, Germany (April 2022), an agreement was reached on the approach and core structure for the guidelines, as well as on the establishment of a drafting committee. During the second meeting in Kuala Lumpur, Malaysia (February 2023), the contents of the guidelines were determined; their sequence was harmonised; and their overall goal, target audience, and reference documents were refined. Consequently, the draft version of the guidelines was shared with the nominated experts by the States Parties for a wider peer review. The comments received and the input generated were discussed and addressed during an online review workshop and were subsequently incorporated during a follow-up drafting committee workshop in November 2023.

Considering that there is currently no harmonised approach to the transportation of hazardous chemicals by road across the world and recognising that the adoption of existing regional frameworks or regulations requires substantial commitment and costs, States Parties with limited resources or with Small and Medium Enterprises (SMEs) often face challenges in securing the safe and secure transportation of hazardous chemicals. In supporting these States Parties, the Secretariat, together with an international group of experts, has put together essential principles, recommendations, and best practices.

This document thus provides practical safety and security guidance in regard to the safe and secure transportation of chemicals for all stakeholders involved in the entire logistical supply chain— senders, logistics providers, and drivers. To enhance the accessibility and the usefulness of these guidelines, they are written in plain, rather than industry-specific, language, and provide suggestions for each group involved in the five stages of the process of general transportation— preparation, loading, driving stops/breaks, and unloading. Where possible, the guidelines have been harmonised with the "Recommendations on the Transport of Dangerous Goods, Model Regulations" (UNRTDG), published by the United Nations Economic Commission for Europe (UNECE).[1] It should be noted that these guidelines are non-binding and advisory in nature, and do not impose any obligations on the States Parties concerned. It is the hope of the Secretariat that Member States will find them useful as they seek to ensure that chemicals are used for peaceful purposes only.

[1] United Nations Economic Commission for Europe (UNECE), UN Model Regulations Rev. 23 (2023), 51, https://unece.org/sites/default/files/2023-08/ST-SG-AC10-1r23e_Vol1_WEB.pdf. (accessed on 16 November 2023).

NOTE: Unless otherwise indicated, all web links cited in this document were accessed on 16 November 2023.

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2 Table of Acronyms

Acronym	Definition
ADN	European Agreement Concerning the International Carriage of Dangerous Goods by Inland Waterways
ADR	Agreement Concerning the International Carriage of Dangerous Goods by Road
AFAFGIT	ASEAN Framework Agreement on the Facilitation of Goods in Transit
AG	Australia Group
ASEAN	Association of Southeast Asian Nations
CAS RN®	Chemical Abstracts Service Registry Numbers
CCTV	Closed-circuit television
CFATS	Chemical Facility Anti-Terrorism Standards
COI	Chemical of interest
CWC	Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction (Chemical Weapons Convention)
DHS	Department of Homeland Security of the United States of America
EC	European Commission
ERG	Emergency Response Guidebook
EU	European Union
GPS	Global positioning system
HBC	Handbook on Chemicals
HCDG	High Consequences Dangerous Goods
HS	Harmonised System
ICAO	International Civil Aviation Organization
ICAOTI	Technical Instructions for the Safe Transport of Dangerous Goods by Air
IED	Improvised explosive device
IMDG	International Maritime Dangerous Goods Code
IMO	International Maritime Organization
INCB	International Narcotics Control Board
IC/INFCIRC	Information circular
IT	Information technology
ITCO	International Tank Container Organisation
MTCR	Missile Technology Control Regime
NAS	National Academies of Science, Engineering, and Medicine

Acronym	Definition
OPCW	Organisation for the Prohibition of Chemical Weapons
OTIF	Intergovernmental Organisation for Internal Carriage by Rail
PDCA	Plan-do-check-act
PHMSA	United States Pipeline and Hazardous Materials Safety Administration
PPE	Personal protective equipment
RID	Regulation concerning the International Carriage of Dangerous Goods by Rail
SDS	Safety data sheet
SQAS	Safety and Quality Assessment for Sustainability
TREM Card	Transport Emergency Card
UK	United Kingdom of Great Britain and Northern Ireland
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNRTDG	United Nations Model Regulations on the Transport of Dangerous Goods
USA	United States of America
WHO	World Health Organization

3 Executive Summary

The transport of chemicals presents safety and security risks that must be addressed. No single regulation or proliferation control list identifies every chemical that may present a safety or security concern. Transport processes should be assessed for risks presented by hazardous chemicals (e.g., those chemicals which are explosive, flammable, and/or toxic) and chemicals that have the potential to be misused, even though they are not inherently hazardous themselves (e.g., precursors). In light of these facts, these guidelines have been drafted to serve as a resource for organisations involved in road-transport processes and as a helpful resource for other stakeholders involved (that is, academia, government, and business associations). This document has been drafted to complement the United Nations Economic Commission for Europe's (UNECE's) "Recommendations on the Transport of Dangerous Goods, Model Regulations, Volume I (Twenty-third Revision, 2023), by providing advice on operational best practices and addressing questions that may assist operators in developing risk-management systems.

The Introduction provides a brief description of the chemical industry, chemical supply chains, and international chemical-transport regulations. Section 6 ("Risk Management"), describes the plan-do-check-act (PDCA) cycle for risk management. Section 7 ("Before Transport: Planning and Preparation") explains hazard and threat identification, packaging, labelling, segregation, and documentation—factors that should be considered prior to chemical transport. Section 8 ("Management Systems") includes operational risk-management questions for senders, logistics providers, and drivers. Section 9 ("Cyber Security Risks") provides insights into potential cyber threats to the supply chain. Section 9 ("Transport Considerations") further clarifies the roles and responsibilities of senders, logistics providers, and drivers during various stages of the transport process—preparation, loading, driving, breaks/stops, and unloading.

The information included in this document is provided in good faith and is based on the input and contribution of international technical experts in chemistry; engineering; toxicology; non-proliferation; transportation; and supply-chain management. The document is not intended to be a comprehensive guide into all the detailed aspects of transportation of chemicals. All figures and tables presented herein were designed and developed by contributors during the drafting of this document unless otherwise specified.

4 Definitions

Term	Definition
Chemical safety	Measures to prevent the accidental release of hazardous chemicals and to mitigate the potential impact of any ensuing consequences on people, the environment, and property (should such events occur).
Chemical security	Measures to prevent the intentional misuse, release, or theft of hazardous chemicals and to mitigate the impact of any consequences (should such events occur).[2]
Dangerous goods	Substances, including chemical products, as found in the *"List of Hazardous Materials"* and described within the United Nations's "Recommendations on the Transportation of Dangerous Goods".[3]
Driver	The individual authorised to drive the vehicle and operate its equipment.
Hazard	"A process, phenomenon, or human activity that may cause loss of life, injury or other health impacts; property damage, social and economic disruption, or environmental degradation".[4]
Hazardous Chemicals	Chemicals that pose physical or health hazards, e.g., explosives, flammable or toxic materials.
High-consequence dangerous goods	"High consequence dangerous goods" (HCDG) are those which have the potential for misuse in a terrorist event and which may, as a result, produce serious consequences, such as mass casualties, mass destruction, or mass socio-economic disruption.[5]
Logistics provider	The company or contractor overseeing the execution of the shipment. In UNRTDG this is defined as a "carrier". This includes independent drivers who own and operate their own vehicles.[6]
Receiver	Company or institution which receives the chemical shipment that originates from the sender or logistics provider. In the UNRTDG this is defined as the "consignee" and is commonly also referred to as the "end user".

[2] Organisation for the Prohibition of Chemical Weapons, *Capacity Building Chemical Safety and Security Management Programme*, https://www.opcw.org/resources/capacity-building/international-cooperation-programmes/chemical-safety-and-security.
[3] United Nations Economic Commission for Europe (UNECE*), UN Model Regulations Rev. 23 (2023)*, 51, https://unece.org/sites/default/files/2023-08/ST-SG-AC10-1r23e_Vol1_WEB.pdf.
[4] United Nations Office for Disaster Risk Reduction (UNDRR), *Sendai Framework Terminology on Disaster Relief Reduction: Hazards*, https://www.undrr.org/terminology/hazard.
[5] UNECE, Economic Commission for Europe Inland Transport Committee, "Agreement Concerning the International Carriage of Dangerous Goods by Road", Volume I (ECE/TRANS/326), United Nations publication, 97, https://unece.org/sites/default/files/2023-08/ST-SG-AC10-1r23e_Vol1_WEB.pdf.
[6] UNECE, UN Model Regulations Rev. 23 (2023), 26, https://unece.org/sites/default/files/2023-08/ST-SG-AC10-1r23e_Vol1_WEB.pdf.

Term	Definition
Risk	In the context of chemical safety, "risk" refers to the likelihood that a hazard will lead to a negative outcome; the term "risks" also describes the severity of any resulting consequences, should they occur. In terms of chemical security, "risk" refers to the likelihood that an adversary will intentionally cause harm and to the consequences stemming from that harm.[7]
Sender	Company or institution from which the chemical shipment originates. In the UNRTDG this is defined as the "consignor" and is commonly also referred to as the "shipper".[8]
Threat	Any indication, circumstance, or event with the potential to cause the loss of, or damage to, an asset. A "threat" can also be defined as the intention and capability of an adversary to undertake actions that would be detrimental to critical assets.[9]

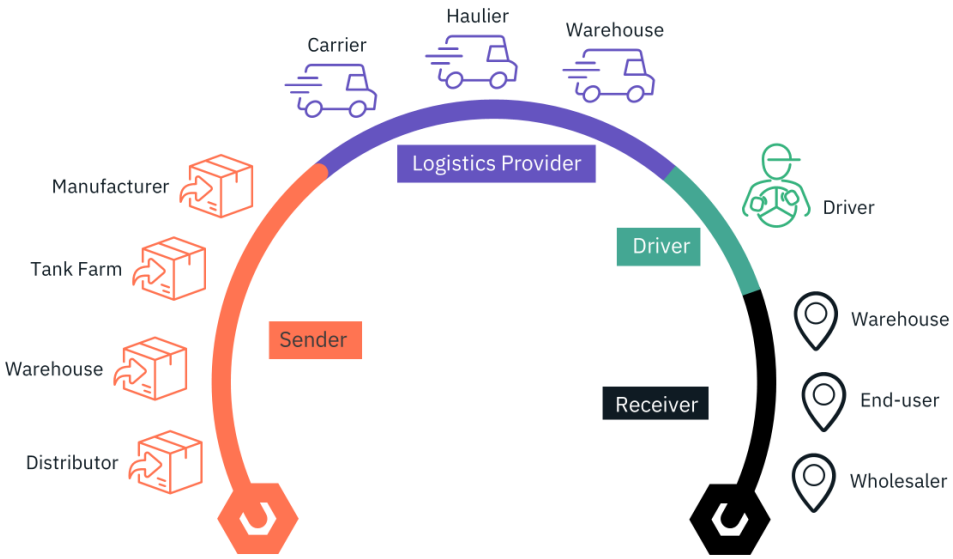


Figure 1. Transportation Roles

[7] Organisation for the Prohibition of Chemical Weapons, *Indicative Guidelines for Chemical Safety and Security in Small and Medium-sized Enterprises to Foster the Peaceful Uses of Chemistry* (2021), https://www.opcw.org/sites/default/files/documents/2021/06/OPCW%20Indicative%20Guidelines%20CSSM%2029062021%20Final_1.pdf.

[8] UNECE, UN Model Regulations Rev. 23 (2023), 27, https://unece.org/sites/default/files/2023-08/ST-SG-AC10-1r23e_Vol1_WEB.pdf.

[9] Center for Chemical Safety (CCPS), *Process Safety Glossary*, "Threat", https://www.aiche.org/ccps/resources/glossary/process-safety-glossary/threat.

5 Introduction

The chemical industry plays a major role in the global economy because most manufactured products rely on an industrial chemical process.[10] Between 2000 and 2017, global chemical production capacity increased nearly twofold, from 1.2 to 2.3 billion tonnes. Moreover, sales of chemical products (excluding pharmaceuticals) have been predicted to substantially increase from 2017 to 2030.[11] Although the growth of the chemical sector benefits the global economy, the transfer of chemicals throughout the supply chain demands increasingly more robust safety and security measures to protect businesses, workers, and surrounding communities (Figure 1).

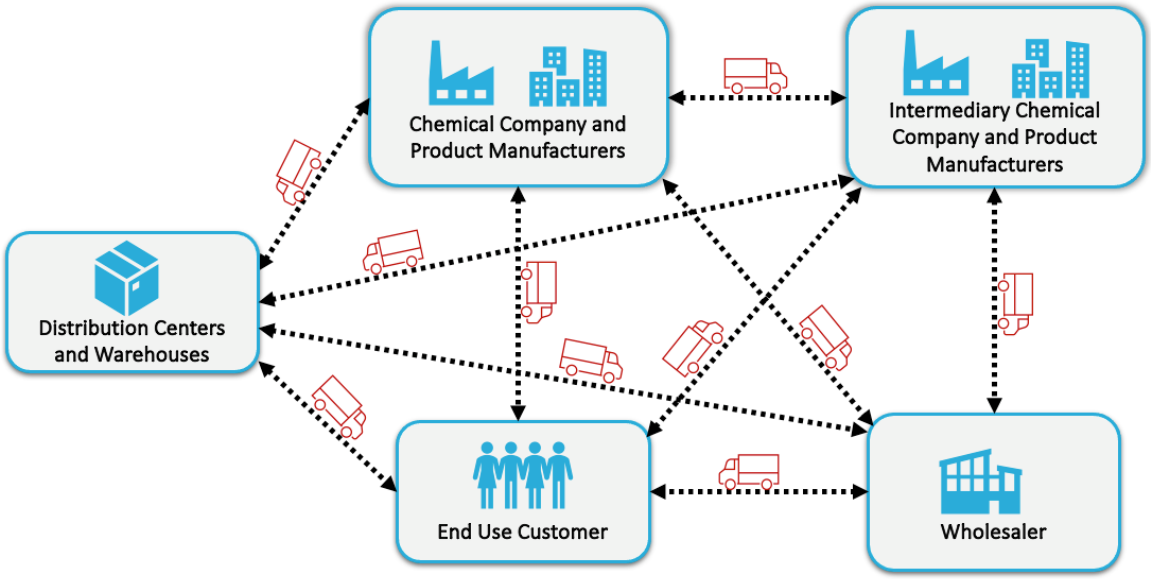


Figure 1. Simplified supply and product flow diagram depicting the relationship between senders, drivers, logistics providers, and recipients.

Chemical manufacturing begins with raw material suppliers and then moves through various manufacturers and distribution centres before finished products are delivered to end-use customers. Chemicals are transferred between the facilities by transportation modes that include rail, sea, inland waterways, air, pipelines, and roads and constitute unique operational environments. Various organisations, groups, and associations have published guidelines and recommended practices to help governments and industry manage safety and security risks

[10] International Council of Chemical Associations (ICAA), Oxford Economics, *The Global Chemical Industry: Catalyzing Growth and Addressing Our World's Sustainability Challenges,* 7, https://icca-chem.org/wp-content/uploads/2020/10/Catalyzing-Growth-and-Addressing-Our-Worlds-Sustainability-Challenges-Report.pdf.
[11] United Nations Environmental Programme (UNEP), *Global Chemicals Outlook II*: *From Legacies to Innovative Solutions*, "Synthesis Report 2019", 28, https://www.unep.org/resources/report/global-chemicals-outlook-ii-legacies-innovative-solutions.

(Figure 2 and Appendix 1).[12,13,14,15] An overview of risk management is provided in the next section.

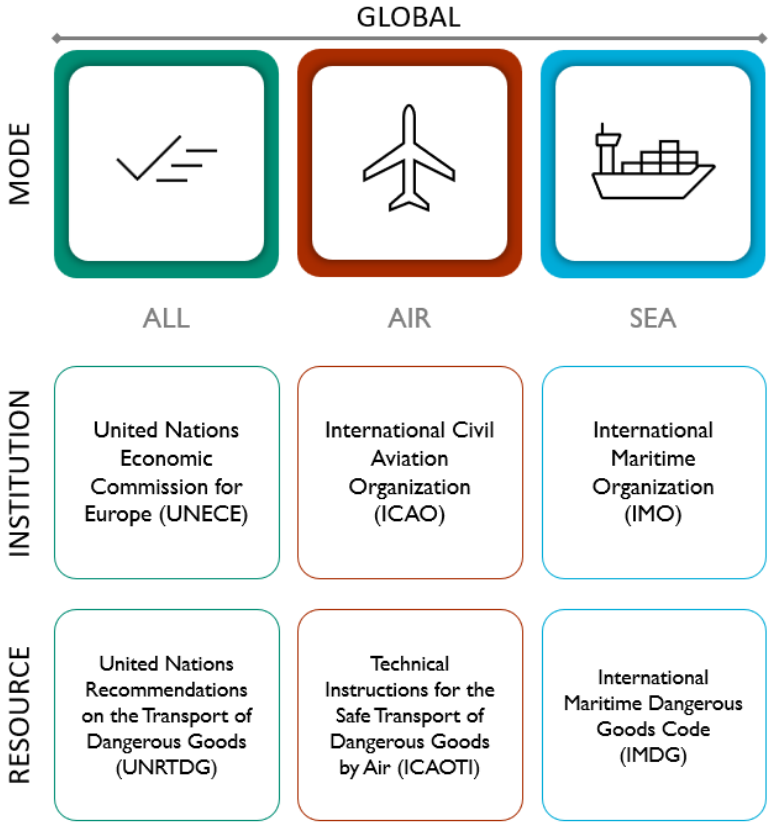


Figure 2. International organizations that publish guidelines and recommended practices for the safe-and-secure transportation of chemicals[16].

[12] USA Customs and Border Protection, *CSI: Container Security Initiative*, 2019, https://www.cbp.gov/border-security/ports-entry/cargo-security/csi/csi-brief.

[13] European Chemical Industry Council (CEFIC), *Guidance on Good Practices for Ship Vetting* (June 2011 and reviewed August 2020), 4, https://cefic.org/app/uploads/2011/01/Good-Practice-for-Ship-Vetting-veresion-2011-revised-2020.pdf.

[14] CEFIC, *Transport and Logistics Guidance*, https://cefic.org/guidance/transport-and-logistics/.

[15] United Kingdom Department for Transport, *Security requirements for moving dangerous goods by road and rail*, 18 October 2023, https://www.gov.uk/government/publications/security-requirements-for-moving-dangerous-goods-by-road-and-rail.

[16] See Appendix 1 for examples of regional and national regulations.

6 Risk Management

The risk-management cycle is often referred to as "plan-do-check-act" (PDCA) and is depicted in Figure 3.[17] Managing transportation risks begins with the commitment on the part of the leaders involved and is demonstrated by their dedicating financial and other resources to ensure the following:

1. **PLAN**: Risks (hazards, threats, and consequences) are identified, assessed, and understood.
2. **DO**: Appropriate risk-control measures (e.g., equipment, policies, procedures, and personal protective equipment (PPE)) are supplied.
3. **CHECK**: Control measures are functioning as intended.
4. **ACT**: Improvement measures (e.g., training, exercises, auditing, learning from experiences, and incident investigation) are practised.

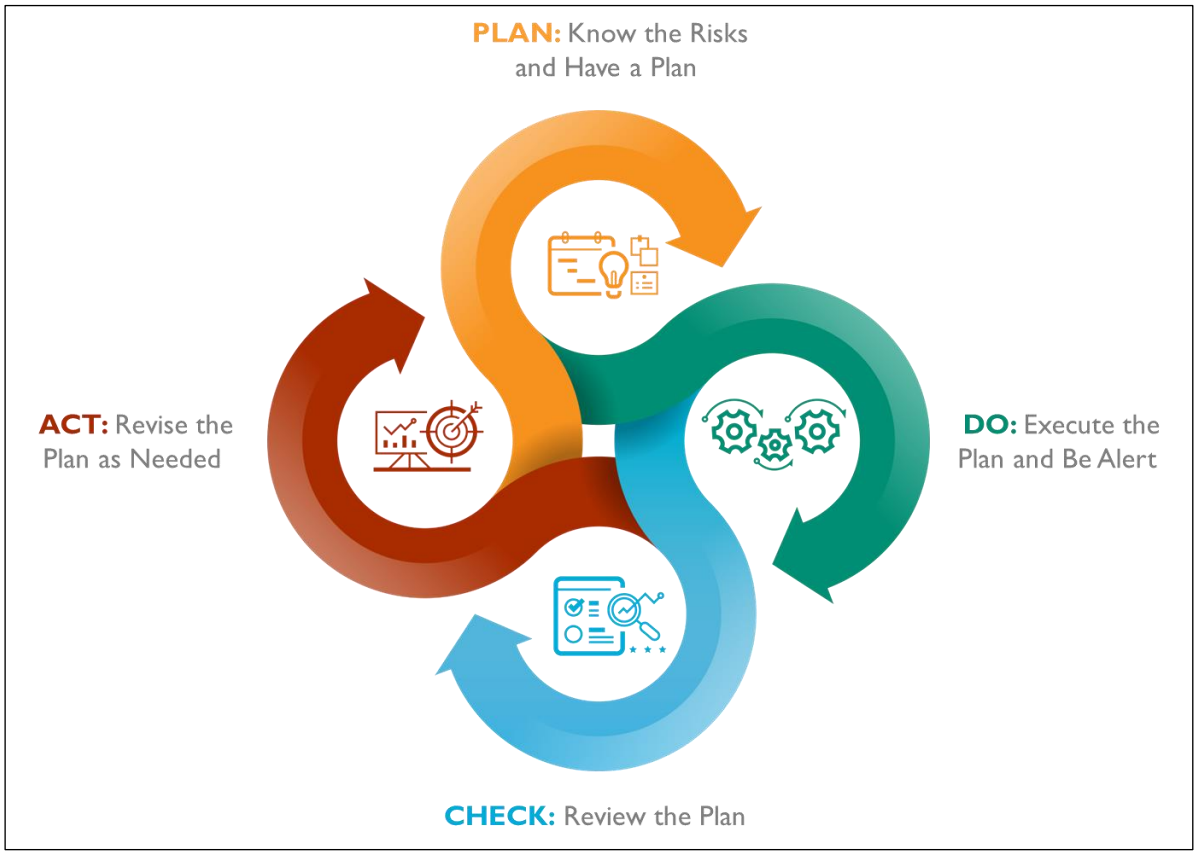


Figure 3. Plan, Do, Check, Act cycle

Management from all the actors involved in the transportation process must lead by example and give clear guidance to their personnel—from the truck driver to the warehouse operator to the logistics manager—and provide opportunities for them to freely address deficiencies and

[17] International Organization for Standardization (ISO), ISO 45001:2018, Occupational health and safety management systems: Requirements with guidance for use (2018), https://www.iso.org/standard/63787.html.

suggest improvements. Management can reward practices that support safety and security and establish deterrence measures for practices that do not.[17]

Senders, logistics providers, and drivers (corporate or independent) all have a role to play in managing transportation safety and security risks. A risk-management plan should be developed, ideally in collaboration with all relevant parties, to clarify and communicate respective roles and responsibilities. Communication between all those involved is key if the plan is to be workable and effective, especially because unforeseen situations, such as road closures, weather, equipment breakdown, terrorism, and crime may require flexible responses to maintain safety and security.

[17] These may include individual or group bonuses and safety challenge events. Or, conversely, these may lead to reprimands, wage cuts, and ultimately the termination of contracts. All measures may have negative side effects (e.g., triggering cover-ups) and must always be implemented within a culturally appropriate context.

7 Before Transport: Planning and Preparation

Figure 4. Key procedures in assessing chemical transport safety and security.

This section provides guidance on how the parties involved should plan and prepare for transport. Preparations should include the identification of hazardous chemicals and of safety and security threats. Goods should be packaged and labelled in a manner consistent with regulatory requirements and commensurate with the risks. Lastly, relevant and specific documentation should be prepared to inform relevant stakeholders in the supply chain about the risks.

7.1 Identifying Hazardous Chemicals

The first step in assessing transportation safety or security risks is the identification as to whether the organisation is involved in the transport of any hazardous chemicals, such as dangerous goods (DG) and high-consequence dangerous goods (HCDG) (Figure 4).[18,19] The United Nations (UN) defines HCDGs as "those which have the potential for misuse in a terrorist event and which may, as a result, produce serious consequences, such as mass casualties, mass destruction or, particularly in the case of Class 7, mass socio-economic disruption."[20,21] Table 1 lists the classes of DG identified in the UNRTDG. Classes 3, 4, 5, 6, 8, and 9 also assign packing groups that identify degrees of danger (Table 2). The UNRTDG provides guidance for the safe packaging and handling of chemicals from these classes of hazards and specified in these packing groups.

It should be noted that some toxic chemicals, including chemical-warfare agents, and non-toxic precursors, are not in the UNRTDG's Recommendations on the "Transport of Dangerous

[18] CEFIC, *Guidance on Safety Risk Assessment for Chemical Transport Operations*, October 2013, 4, https://cefic.org/app/uploads/2019/01/Safety_Risk-Assessment-For-chemicalTransportOperations-2013-GUIDELINES.pdf.

[19] CEFIC, *Guidelines for the Security of the Transport of Dangerous Goods by Road*, December 2016, https://cefic.org/app/uploads/2018/12/Guidelines-for-the-security-of-the-transport-of-dangerous-goods-by-road-2016-GUIDELINES-ROAD.pdf.

[20] UNECE, UN Model Regulations Rev. 23 (2023), 42, https://unece.org/sites/default/files/2023-08/ST-SG-AC10-1r23e_Vol1_WEB.pdf.

[21] Class 7, radioactive hazards, are outside the scope of this document. Transport regulations for radioactive materials may require additional and/or different considerations than those for chemicals. See the International Atomic Energy Agency's (IAEA's). *Regulations for the Safe Transport of Radioactive Material*. Safety Standard Series No. SSR-6 (Rev.1). Vienna, 2018, https://doi.org/10.61092/iaea.ur52-my9o.

Goods List" and may require, prior to transport, approval from each State Party's competent authorities.

Over 3,000 entries can be found in the DG List,[22] which can be cross-referenced with the classes and divisions in the Indicative List of HCDG (Table 2 and Table 3[23]).
Some of the entries (for example, thiodiglycol) are unique to individual chemicals, materials, or formulations, while others may include multiple chemicals or materials.

Although the UNRTDG does not include specific recommendations related to chemical weapons precursors, narcotics, or other valuable chemicals,[24] additional transportation-security controls may be necessary to mitigate the risk of sabotage or theft. For example, precursor chemicals that could be used to produce DG and HCDG, are generally listed in various international lists (Appendix 1). A company may also want to consider additional security controls for valuable chemicals that could be targeted for theft and illegal resale, such as precious metal compounds or expensive pharmaceuticals.

Detailed guidance on how to perform a transportation-safety or security-risk assessment is available from other sources.[25, 26] General components of transportation safety and security risk assessments are as follows: a definition of the scope of the risk assessment; the identification of hazards, threats, and vulnerabilities; an evaluation of the likelihood and consequences of an unwanted event, as well as the adequacy of the controls intended to prevent or mitigate the event; prioritisation of risks; and the documentation of risks analysed and new risk mitigations adopted as a result of the analysis.

Table 1: Classes of DG identified in the UNRTDG.[27]

Class	Label	Hazard
Class 1		**Explosives**
Class 2		**Gases**
Division 2.1		Flammable gases

[22] UNECE, *UN Model Regulations Rev. 23 (2023)*, Section 3.2.2, 198, https://unece.org/sites/default/files/2023-08/ST-SG-AC10-1r23e_Vol1_WEB.pdf.
[23] UNECE, *UN Model Regulations Rev. 23 (2023)*, Chapter 2.0, 51, https://unece.org/sites/default/files/2023-08/ST-SG-AC10-1r23e_Vol1_WEB.pdf.
[24] Other international modal-specific guidelines on transportation safety are available for purchase from the International Maritime Organization (IMO), *International Maritime Dangerous Goods Code*, https://www.imo.org/en/OurWork/Safety/Pages/DangerousGoods-default.aspx, and the International Air Transport Association, *Dangerous Goods Regulations*, https://www.iata.org/en/publications/dgr/.
[25] Sandia National Laboratories, *Chemical Transportation Security Handbook*, Global Chemical and Biological Security, SAND2022-6657O.
[26] American Institute of Chemical Engineers (AIChE), *Guidelines for Chemical Transportation Safety, Security, and Risk Management* (2nd edition, 2008), https://www.aiche.org/resources/publications/books/guidelines-chemical-transportation-safety-security-and-risk-management-2nd-edition.
[27] UNECE, UN Model Regulations Rev. 23 (2023), Chapter 2.0, 51-52, https://unece.org/sites/default/files/2023-08/ST-SG-AC10-1r23e_Vol1_WEB.pdf.

Class	Label	Hazard
Division 2.2		Non-flammable, non-toxic gases
Division 2.3		Toxic gases
Class 3		Flammable liquids
Class 4		Flammable solids; substances liable to spontaneous combustion; substances which, on contact with water, emit flammable gas
Division 4.1		Flammable solids, self-reactive substances, solid desensitized explosives, and polymerizing substances
Division 4.2		Substances liable to spontaneous combustion
Division 4.3		Substances which, on contact with water, emit flammable gas
Class 5		Oxidizing substances and organic peroxides
Division 5.1		Oxidizing substances
Division 5.2		Organic peroxides
Class 6		Toxic and infectious substances
Division 6.1		Toxic substances
Division 6.2		Infectious substances
Class 7		Radioactive material
Class 8		Corrosive substances

Class	Label	Hazard
Class 9	  Lithium batteries  Environmental hazard  Elevated temperature	Miscellaneous dangerous substances and articles, including environmentally hazardous substances

Table 2: Packing groups assigned to Classes 3, 4, 5, 6, 8, and 9[28]

Packing Group	Description
I	Substances presenting high danger
II	Substances presenting medium danger
III	Substances presenting low danger

Table 3. Indicative list of HCDG (excluding radioactivity)[29,30]

Class	Hazard
Class 1, Division 1.1	Explosives
Class 1, Division 1.2	Explosives
Class 1, Division 1.3	Compatibility group C explosives
Class 1, Division 1.4	UN Nos. 0104, 0237, 0255, 0267, 0289, 0361, 0365, 0366, 0440, 0441, 0455, 0456, 0500, 0512, and 0513
Class 1, Division 1.5	Explosives
Class 1, Division 1.6	Explosives
Division 2.1	Flammable gases in bulk
Division 2.3	Toxic gases (excluding aerosols)
Class 3	Flammable liquids of packing Groups I and II in bulk
Class 3 and Division 4.1	Desensitized explosives

[28] UNECE, UN Model Regulations Rev. 23 (2023), Chapter 2.0, 52, https://unece.org/sites/default/files/2023-08/ST-SG-AC10-1r23e_Vol1_WEB.pdf.
[29] UNECE, UN Model Regulations Rev. 23 (2023), Chapter 2.0, 51, https://unece.org/sites/default/files/2023-08/ST-SG-AC10-1r23e_Vol1_WEB.pdf.
[30] The term "in bulk" means transported in quantities greater than 3000 kg or 3000 litres in portable tanks or bulk containers. UNECE, UN Model Regulations Rev. 23 (2023), 42, https://unece.org/sites/default/files/2023-08/ST-SG-AC10-1r23e_Vol1_WEB.pdf.

Class	Hazard
Division 4.2	Goods of packing group I in bulk
Division 4.3	Goods of packing group I in bulk
Division 5.1	Oxidizing liquids of packing group I in bulk
Division 5.1	Perchlorates; ammonium nitrate; ammonium nitrate fertilizers; and ammonium nitrate emulsions or suspensions or gels in bulk
Division 6.1	Toxic substances of packing group I
Division 6.2	Infectious substances of Category A (UN 2814 and UN 2900) and medical waste from Category A (UN 3549)
Class 8	Corrosive substances of packing Group I in bulk

7.2 *Identifying Threats*

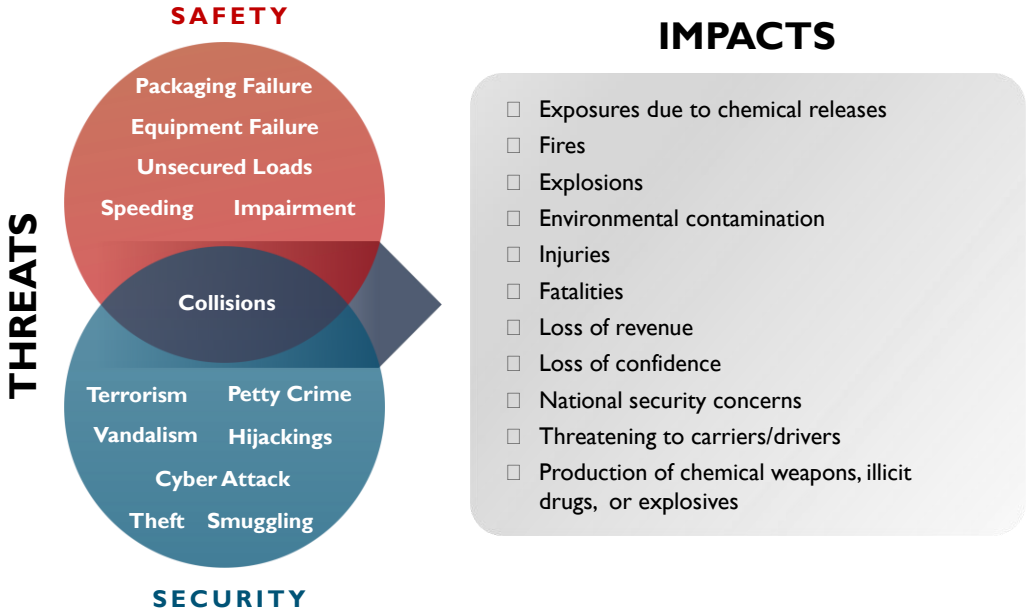


Figure 5: Some safety and security scenarios initiating events and outcomes.

Figure 5 lists some safety and security scenarios that could initiate potential events and outcomes that organisations should consider when they are organising road transport. Although the triggers for safety and security events may differ, the outcomes and consequences of such events may be similar in scale and nature.

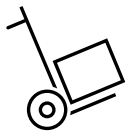
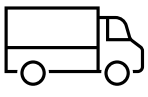
Chemical transportation may lead to chemicals entering public spaces or areas where the operating environment cannot be controlled,[31] possibly precipitating accidental or intentional incidents (Figure 5).

Table 4 includes some examples of safety and security incidents. Safety incidents are unintentional and can be caused by such factors as equipment failure, unsecured loads, changing weather conditions, speeding, or driver impairment. Security incidents are intentional

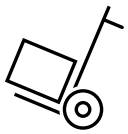
[31] United Kingdom Department for Transport, *Countering Vehicle[s] as a Weapon: Best Practice Guidance for Goods Vehicle Operators and Drivers* (6 August 2019), https://www.gov.uk/government/publications/security-guidance-for-goods-vehicle-operators-and-drivers/countering-vehicle-as-a-weapon-best-practice-guidance-for-goods-vehicle-operators-and-drivers.

and are the result of attacks by terrorists, petty criminals, and other actors who may steal, vandalise, hijack, or cyber-attack vehicles or transportation systems. Safety and security incidents may involve collisions with other vehicles or objects. Collectively, safety and security incidents can lead to a variety of negative outcomes, including the release or loss of chemicals, resulting in adverse exposures to populations and the environment; injuries; deaths; national security concerns; and business impacts. The theft of precursor chemicals could also lead to the production of chemical weapons, illicit drugs, or explosives.

Table 4. Examples of release and theft scenarios[32]

Location	Accidental Release	Intentional Release	Theft
Fixed Site Transit 	Workers dropped two bottles of a toxic industrial chemical from a loading dock as they were transferring them to a truck. Approximately 4 litres of the chemical were spilled, and 300 to 400 people were evacuated from nearby buildings.	Tamper-evident seals of two trailers were cut, which resulted in an environmental release of 63,000 litres of a volatile, flammable liquid. The incident required environmental sampling, and it was determined that soil excavation and replacement were necessary.	A truck with 225 kg of strong acid was stolen while a vehicle was parked at a chemical distribution company. Motivation for the theft is unknown.
Road Stop 	A tanker truck spilled over 20,000 litres of a strong acid at a truck stop after a valve on the tanker broke. Acid flowed into a ditch on the side of the highway.	Emergency responders discovered that a trailer containing a toxic industrial chemical was leaking. The driver was notified and donned personal protective equipment (PPE) to tighten the equipment and stop the leak. Tampering was suspected.	A transit van was stolen while it was parked on the street; it was found abandoned several days later. Some of the missing unaccounted cargo included a weaponisable rodenticide.
In-Transit/ Detour/Choke Point 	A truck spilled approximately 800 litres of a corrosive chemical on a bridge after its load shifted, resulting in a punctured container. The bridge was temporarily closed to	Upon arrival to a delivery site, a driver noticed that the trailer had been struck with a bullet. The bullet pierced the tank, resulting in leakage of gasoline onto the concrete.	While in transit to a mining customer, a truck carrying 10 tonnes of a toxic chemical was stolen. The thieves distracted the driver by staging an incident where it appeared there was a

[32] Adapted from: Sandia National Laboratories, *Chemical Transportation Security Handbook*, Global Chemical and Biological Security, SAND2022-6657O, 14, Table 1, "Examples of Release and Theft Scenarios".

Location	Accidental Release	Intentional Release	Theft
	allow responders to neutralise the chemical.		disabled vehicle on the side of the road. The truck was found empty; the chemical was recovered elsewhere.
Unloading 	A release of a toxic gas occurred when a delivery truck inadvertently connected to a tank containing incompatible material. The plume of gas that was generated resulted in a shelter-in-place order for thousands of residents and at least 120 individuals sought medical attention.	A hose on a portable 110,000-litre tank of a toxic industrial chemical was intentionally cut. This resulted in a release of gas that hospitalised a police officer and the closure of a highway for 30 minutes.	Twenty-two different chemicals were stolen while they were awaiting transfer at an industrial park. Drivers and custodial staff were among the individuals arrested as being part of the theft.

7.3 Packaging

Because packaging is often the responsibility of the sender, it is critical that robust packaging is used to contain the relevant hazards of the goods being transported (Figure 6). The packaging should be:

1. compatible with the product (e.g., not reactive);
2. properly filled and closed; and
3. of good quality, that is, suitable for normal journey conditions; impervious to stresses and strains that could be encountered under normal conditions; and not subject to breakage, puncture, or leaks.

For detailed guidance on packaging guidelines for safety, refer to the international best practices described in the UNRTDG.[33]

Hazardous chemicals should not be placed in the same packaging with incompatible chemicals. For more information on adverse chemical reactions, refer to the appropriate Safety Data Sheet (SDS) of the substances that are intended to be packed together or to the CAMEO Chemicals (Database of Hazardous Materials).[34] For chemicals that release toxic gases when in contact with water, consult Table 2—Water-Reactive Materials which Produce Toxic Gases in the

[33] UNECE, *UN Model Regulations Rev. 23 (2023)*, Chapter 2.9, 169, https://unce.org/sites/default/files/2023-08/ST-SG-AC10-1r23e_Vol1_WEB.pdf.

[34] National Oceanic and Atmospheric Administration (.gov), *CAMEO Chemicals*, *Database of Hazardous Materials*, https://cameochemicals.noaa.gov/.

Emergency Response Guidebook.[35] Local security consultants or competent authorities may be able to assist further in providing solutions for preventing tampering or theft.

Figure 6. Example of packaging and labelling of hazardous chemicals.

7.4 Labelling

Because labelling is often the responsibility of the sender, chemical-hazard communications and requirements differ from country to country and are often based on country- or region-specific regulations (Appendix 1). For many countries, the UN Hazard Number Placards are required or commonplace on chemical transport equipment, but regional differences may exist. The presence of hazard-communication placards should enable emergency responders to react appropriately to an incident; however, the same information could be used by terrorists or other actors to target specific chemicals. It is important that organisations and countries consult with a security expert or a relevant competent authority to ensure that security decisions are balanced with safety requirements.

7.5 Segregation and Load Securing

Physical segregation of packages on the vehicle and load securing are often the responsibility of the driver.

Segregation refers to the isolation of incompatible chemicals to prevent undesirable reactions during transport. The failure to segregate incompatible chemicals can result in fire, release of gas, or excessive heat; thus, incompatible chemicals should not be loaded alongside one another.[36] Indeed, some chemicals should be transported in separate vehicles. Section 7.3, "Packaging", provides resources that can help in the determination as to whether chemicals are incompatible.

[35] Pipeline and Hazardous Material Safety Administration (PHMSA), USA Department of Transport and Transport Canada, *2020 Emergency Response Guidebook*, starting 344 and following, https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/2020-08/ERG2020-WEB.pdf .

[36] For example, a reactivity search for sulfuric acid and sodium hypochlorite on the National Oceanic and Atmospheric Administration's ("*CAMEO Chemicals")* (a United States government site) reveals that, if these two chemicals are mixed, reaction products may result in an exothermic reaction that can generate toxic gas, https://cameochemicals.noaa.gov/.

Load securing refers to measures taken to ensure a load does not slip, roll over, or fall during normal traffic conditions.[37,38,39,40]

7.6 Documentation

Documentation relevant to what is being transported should be in a language that drivers and emergency responders can understand and should be available throughout the journey.[41] Documents may be in paper or digital format. Special safety and security considerations may exist, depending on the chosen format of documents. For example, electronic tablets may present a safety risk as they could be a source of a spark or ignition and may also present cyber-security risks.

At a fundamental level, shipping documents should provide:

1. accurate information about the goods being transported, as required by transport regulations; and
2. emergency-response information, including telephone numbers and contact information.

Some authorities or regulations may request documents such as:

1. Transport Emergency Cards (TREM cards);
2. International Chemical Safety Cards (ICSCs);[42]
3. SDSs;
4. driving licences and/or other driver identification; and
5. vehicle-approval certification.

[37] International Maritime Organization (IMO), *Code of Safe Practice for Cargo Stowage and Securing (CSS Code)*, https://www.imo.org/en/OurWork/Safety/Pages/CSS-Code.aspx.
[38] European Commission, *Cargo securing of abnormal loads*, https://road-safety.transport.ec.europa.eu/eu-road-safety-policy/priorities/safe-vehicles/cargo-securing-and-abnormal-loads_en.
[39] United Kingdom Government (Gov. UK) Driver and Vehicle Standards Agency, *Securing loads on HGVs and goods vehicles*, 20 July 2023, https://www.gov.uk/guidance/securing-loads-on-hgvs-and-goods-vehicles.
[40] Chemical Business Association, *Load Securing Guidance (*August 2018), http://www.chemical.org.uk/wp-content/uploads/2018/10/CBA-Load-securing-guidance-August-2018-final.pdf.
[41] CEFIC, Transperanto, *Effective communication between truck driver and unloading/loading site*, 2023 http://transperanto.org.
[42] International Labour Organization and World Health Organization (ILO-WHO) International Chemical Safety Cards (ICSCs), https://www.ilo.org/safework/info/publications/WCMS_113134/lang--en/index.htm.

8 Management Systems

This section suggests detailed questions that can assist senders, logistics providers, and drivers assess a range of concerns related to the safe-and-secure transportation of hazardous chemicals. These questions and the points raised should help relevant stakeholders prepare for the safe transport of dangerous materials.

Management systems describe company structures and how those companies systematically execute their work in order to ensure optimum results. Generally, companies follow the PDCA cycle (see Figure 3). Senders and logistics providers should set contractual and other provisions that ensure that:

1. roles and responsibilities are clearly defined in policies; and
2. legislation and other requirements (such as those of customers) are adhered to and that the system is regularly reviewed for compliance with such requirements.

It is recommended that senders and logistics providers use the questions below to identify gaps in policies and to define expected roles and responsibilities. The questions to be asked are divided into the following sections: "General Transportation Management," "Vehicle Management," "Journey Management," "Driver Management," and "Incident Management." Although the questions below address many relevant areas of concern, it is not possible to summarise all possible scenarios.

8.1 General Transportation Management

8.1.1 Senders and Logistics Providers

1. What are your policies for the transporting of hazardous chemicals?
2. Do you have clear work-process documents (e.g., for vehicle checks, seatbelts, mobile/cell phone use)?
3. Do you have a structure in place to manage the documentation of procedures?
4. How frequently do you review your policies/processes?
5. Do your policies comply with legislative requirements?
6. Do all the relevant parties in the transportation process have adequate insurance coverage?
7. What performance indicators are you monitoring to ensure safe-and-secure operations?[43]
8. What is your auditing process?
9. How do you manage any deviations from established policies/processes? What corrective measures will be taken should deviations arise?
10. How does your company handle training and capacity development?
11. How do you manage changes in people, operations, and processes for both internal and external modifications/adjustments?
12. What is your mechanism to share lessons learned or other concerns?
13. Is there a reward-and-deterrence programme or other process in place to manage substandard behaviour and outcomes?
14. What tools, technology, and systems do you have in place to monitor and evaluate your logistics and transportation processes?
15. What are your criteria for selecting logistics providers? Do you allow subcontractors?[44]

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[43] Safety and Quality Assessment for Sustainability (SQAS), *SQAS Questionnaires*, www.sqas.org.
[44] CEFIC, *Guidelines on subcontracting of chemical road transport (2005)*, 7-9, https://cefic.org/app/uploads/2018/12/Guidelines_On-Subctonracting-Of-chemical-Road-Transport-r2005-GUIDELINES-RAOD.pdf.

16. What are your logistics providers' onboarding procedures?
17. Have you compared your management system to those of relevant stakeholders to identify any gaps? How will you address any gaps?

8.1.2 Drivers

1. Are you aware of existing policies for the goods that you are transporting? Has the sender provided you with product knowledge, including information on possible hazards and shipping requirements?
2. Have you received specific training so that you can safely and securely fulfil the requirements of your job?
3. Do you meet local, national, or specific competency requirements for driving the vehicle which you plan to use for the chemical shipment?
4. Do you know how/where to report problems/concerns?
5. Do you know how to report incidents and accidents?
6. Do you know how to react in case of incidents and accidents?
7. Do you know the procedures in place for how and when to share lessons learned or other concerns?
8. Are you aware of a reward-and-deterrence program or other processes in place to manage substandard behaviour and outcomes?

8.2 Vehicle Management

Vehicle management can include processes that can determine appropriate transportation equipment for the products being carried and those to maintain transportation equipment. The following questions, which are specific to vehicle management, raise questions relevant to senders, logistics providers, and drivers, and they can be used to identify gaps in policies and expected roles and responsibilities.

8.2.1 Senders

1. What are your recommendations in terms of vehicle specifications for your product(s)?
2. Do you have clear policies, contractual agreements, and work instructions as to who does the loading?
3. Have you defined preventative maintenance requirements and policies to logistics providers?
4. Do you have vehicle cleaning policies that include process requirements and frequency (e.g., tanker cleaning between two loads)?
5. Do you have calibration/variation policies (so that you can measure the weight of the product)?

8.2.2 Logistics providers

1. Do you have a policy and schedule for preventative maintenance?
2. Do you have quality standards for your vehicle replacement parts or vehicle maintenance?
3. Have you complied with the sender's critical safety-device requirements/policies?
4. Do you have vehicle-cleaning policies in connection with a change in load or in the event of a spillage?[45]

[45] International Tank Container Organisation (ITCO), *Guidance for Working on Top of a Tank Container (*May 2020),https://www.international-tank-container.org/storage/uploads/ITCO_Guidance_for_working_on_top_of_a_tank_container.pdf.

5. Do you provide a spill kit?
6. Do your drivers know what to do in case of an incident or accident?
7. Do you have critical safety device policies (e.g., tank inspections, permits/licences, etc.)?
8. Do you have policies (e.g., segregation) in place in case of multiple pick-ups involving one vehicle?

8.2.3 Drivers

1. Are you aware of the maintenance schedule and policies related to the upkeep of your truck?
2. Are you following vehicle-cleaning policies before a change in load or following a spillage?

8.3 Journey Management

Journey management planning begins before a shipment leaves a facility and continues after a shipment is delivered. General questions and specific topics are listed below to help identify gaps in policies and describe expected roles and responsibilities.

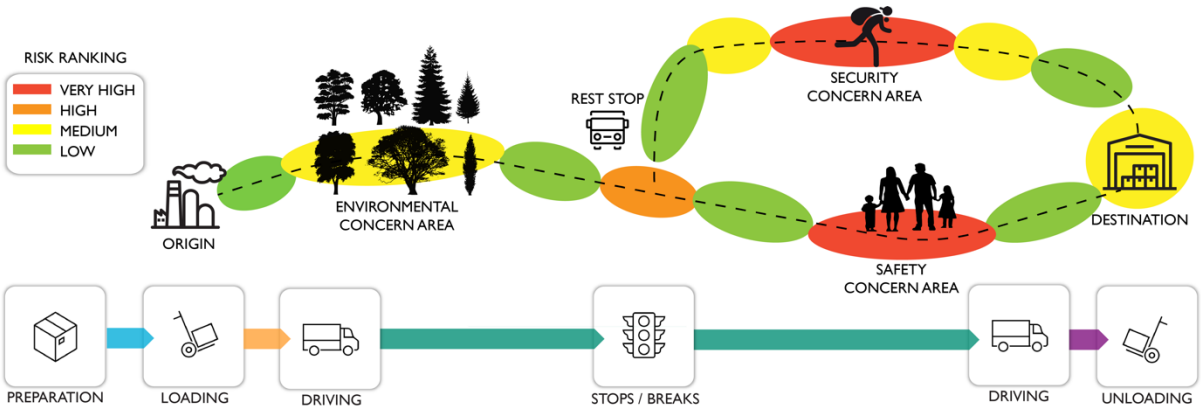


Figure 7. Routes may present safety and security concerns when traveling through high crime areas or populated areas.

8.3.1 Senders

1. Do you have requirements for journey management planning?
2. Do you recommend approved routes to your logistics providers?
3. Do you have an hours-of-working service policy? Is it clear when vehicles need to arrive and how long loading or unloading should take?
4. Do you require a journey risk assessment? Have you set expectations for how to balance safety and security risks along a given route and possible alternative routes?
5. Do you have additional planning requirements (e.g., convoys and escorts)?

8.3.2 Logistics providers

1. How do you monitor driver compliance?
2. Do you have a pre-departure checklist?
3. Do you assess the journey plan?
4. Do you set expectations for how to balance safety and security risks along a route, or do you depend on the sender or individual driver to do so?

8.3.3 Drivers

1. Are you aware of all the policies and how to report compliance?
2. How do you manage deviations? What processes do you use?

Specific topics/policies that should be addressed include, but are not limited to, the following:

1. Before transport
    a. road-hazard mapping;
    b. road assessment;
    c. route planning (duration, stop-overs, etc.);
    d. expected responses for various safety/security scenarios (e.g., tank leaks, truck thefts); and
    e. pre-departure checklists.

2. During Transport
    a. GPS monitoring;
    b. alternative route management;
    c. use of rest areas, breaks, and stops;
    d. prohibited locations;
    e. working hours;
    f. drug/alcohol abuse;
    g. cell phone (mobile phone) policies;
    h. seatbelts; and
    i. safety/security incident reporting.

3. After Transport: After transport, a post-trip review should be undertaken and a report documenting issues should be written so that observations and information can be shared with other drivers.

8.4 Driver Management

Driver management addresses the recruitment/selection process; qualifications; training and development; language capabilities/communication; and expected product knowledge.

8.4.1 Senders

1. Do you set minimum expectations for recruitment, skill sets, and orientation/training of drivers?
2. Do you require specific safety- and-security training for drivers?

8.4.2 Logistics providers

1. What are your expectations for the recruitment, skill sets, and orientation/training of drivers?
2. Do you require specific safety/security training for drivers?
3. Is there a process to manage and review the drivers' performance?
4. Is there a national or other requirement for periodic medical examination of drivers and other personnel?
5. What is your training schedule?
6. Do you have a mechanism to receive feedback from drivers?
7. Are there requirements or policies for the presence of additional personnel in the vehicle (e.g., armed guards, back-up drivers)?

8.4.3 Drivers

1. Are you aware of what training you are required to have? Do you receive specific safety and/or security awareness training? Do you have access to refresher training?
2. Do you speak the local language where you are driving, or do you have access to translation services?

8.5 Incident Management

Incident management should set up expectations for what a driver should do in the case of a safety or security incident. In particular, mechanisms for the expected communication with first responders should be established, including the type of hazard information that drivers should carry with them. Examples include SDSs; Transport Emergency (TREM) Cards; emergency response guides; and protocols for shelter-in-place (i.e., staying put until it is safe to move). Finally, establishing post-incident investigation policies will help ensure continuous improvement of transportation safety and security.

8.5.1 Senders

1. What incident-management protocols have been established?
2. What communications plans are in place in relation to first responders?
3. What feedback mechanisms exist for incidents?
4. Do you provide an emergency number for drivers to contact? If not, does the logistics provider make this information available?
5. Do you collect, document, and disseminate the lessons learned?

8.5.2 Logistics providers

1. Have you aligned your incident management protocols with the sender's requirements?
2. Do you provide an emergency number for drivers to contact? If not, does the sender issue this information?
3. Do you collect, document, and disseminate the lessons learned?

8.5.3 Drivers

1. Are you familiar incident-management protocols, and do you have the tools to execute them?
2. Do you know how to use a spill kit and/or first aid kit; traffic cones; and fire extinguishers?
3. In general, do you know what to do in case of an incident or accident?
4. Do you know whom to call in case of an incident?

9 Cyber Security Risks

The increasing digitalisation and interconnectivity of transportation and logistics systems have made companies and logistics service providers more vulnerable to cyberattacks. These attacks can lead to serious security problems, such as theft of data, the disruption of transport processes, or the manipulation of vehicles. There are many known cyberattack techniques and tactics that can have a significant impact on organisations in the transportation industry, for example:

1. **Theft of data**: Cybercriminals can penetrate networks and steal confidential information (e.g., customer and business data), which can subsequently be used for criminal purposes, such as identity theft or extortion.

2. **Disruption of transport processes**: Cyberattacks can also cripple information technology (IT) systems, leading to significant delays in the delivery of goods, the diversion of hazardous chemicals, damage to an organisation's reputation, or unsafe conditions during transport.

3. **Manipulation of vehicles**: In some cases, cybercriminals can also penetrate and manipulate vehicles. This can lead to dangerous situations, such as the driver losing control of the vehicle or an intruder tampering with navigation and safety systems.

4. **Financial losses**: Cyberattacks can lead to significant financial losses through theft of funds, loss of business opportunities, or business closure.

Organisations should take appropriate measures to protect their electronic systems and their data from cyberattacks.[46,47,48,49,50,51] This includes implementing security protocols and procedures, training employees on cyber security, and the regular review and updating of security measures. Cyber security plans and actions can be improved by threat modelling.

[46] McCormack, Ian, *Mastering your supply chain*. National Cyber Security Centre (12 October 2023), https://www.ncsc.gov.uk/blog-post/mastering-your-supply-chain.
[47] Cybersecurity and Infrastructure Security Agency (CISA), *Shifting the Balance of Cybersecurity Risk: Principles and Approaches for Security-by-Design and -Default (*13April 2023), 5, https://www.cisa.gov/sites/default/files/2023-06/principles_approaches_for_security-by-design-default_508c.pdf.
[48] European Union Agency for Cybersecurity (ENISA), *National Cybersecurity Strategies Guidelines & tools*, https://www.enisa.europa.eu/topics/national-cyber-security-strategies/national-cyber-security-strategies-guidelines-tools.
[49] Cloud Security Alliance (CSA), *Zero Trust Principles and Guidance for Identity and Access Management* (13 2023), https://cloudsecurityalliance.org/artifacts/zero-trust-principles-and-guidance-for-iam.
[50] Center for Internet Security, *CIS Critical Security Controls (*16 January 2024), https://www.cisecurity.org/controls/cis-controls-list.
[51] Center for Internet Security, *CIS Critical Security Controls* (16 January 2024), https://www.cisecurity.org/insights/white-papers/cis-controls-mapping-to-cloud-security-alliance-cloud-control-matrix .

Organisations that develop software related to these issues should adopt secure development practices.[52,53,54]

Basic cyber security measures that all stakeholders should adopt include:[55]

1. backing up their data;[56]
2. the adoption of protective measures against malware;[57]
3. measures to protect smartphones and tablets;[58]
4. the use passwords to protect data;[59]
5. measures to avoid phishing attacks;[60] and
6. steps to put into place protective measures against ransomware.[61]

[52] Open Worldwide Application Security Project (OWASP), *Software Assurance Maturity Model (*16 January 2024), https://owasp.org/www-project-samm/.
[53] Synopsys, *Building Security in Maturity Model (*16 January 2024), https://www.synopsys.com/software-integrity/software-security-services/bsimm-maturity-model.html.
[54] National Institute of Standards and Technology (NIST), *Software Supply Chain Security Guidance Under Executive Order (EO) 14028 Section 4e (*2022), 4-7, https://www.nist.gov/system/files/documents/2022/02/04/software-supply-chain-security-guidance-under-EO-14028-section-4e.pdf.
[55] National Cyber Security Centre, *Small Business Guide: Cyber Security (*15 November 2018), , https://www.ncsc.gov.uk/collection/small-business-guide.
[56] National Institute of Standards and Technology (NIST), *Protecting Data from Ransomware and Other Data Loss Events*, https://www.nccoe.nist.gov/sites/default/files/legacy-files/msp-protecting-data-extended.pdf.
[57] Souppaya, Murugiah and Scarfone, Karen, *Guide to Malware Incident Prevention and Handling for Desktops and Laptops*, National Institute of Standards and Technology (NIST, July 2013), https://nvlpubs.nist.gov/nistpubs/specialpublications/nist.sp.800-83r1.pdf.
[58] Souppaya, Murugiah et al, *Guidelines for Managing the Security of Mobile Devices in the Enterprise (*17 May 2023), https://www.nist.gov/publications/guidelines-managing-security-mob ile-devices-enterprise-0.
[59] Grassi, Paul A. et al, *Digital Identity Guidelines* (16 October 2023), https://pages.nist.gov/00-63-3/sp800-63b.html.
[60]Temoshok, David et al, *Digital Identity Guidelines* (16 December 2022), https://csrc.nist.gov/pubs/sp/800/63/4/ipd.
[61] National Cyber Security Centre, *A guide to ransomware*, https://www.ncsc.gov.uk/ransomware/home.

10 Transport Considerations

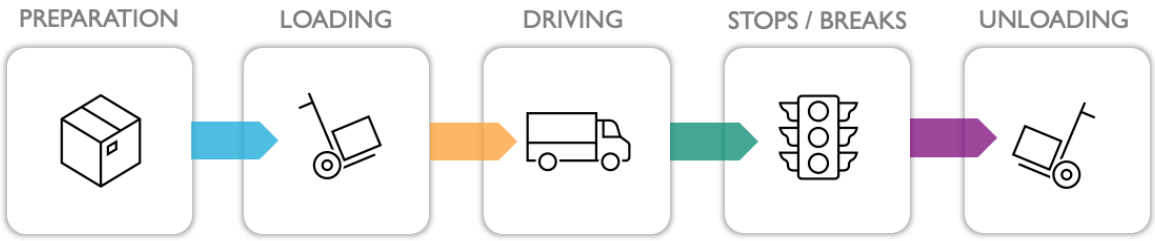
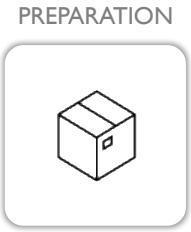


Figure 8. Stages of chemical transportation

This section provides practical suggestions for stakeholders who are responsible for the shipment of chemicals. This section is organised by the stages inherent to the process of transport (as depicted in Figure 8. Stages of chemical transportation).

NOTE: The lists in this section are formatted as a numbered outline to make the document easier to navigate. This should not be confused with a linear or complete process. Regional or company-specific situations may warrant additional specifications.

10.1 Preparation



Preparation is an important stage in the prevention of safety and security incidents.[62] This step includes hazard identification, packing, labelling and marking, fulfilling documentation requirements, and route selection. All parties should understand the risks involved with the goods to be transported and should communicate appropriate information about the risks in order to ensure that relevant stakeholders have the necessary skills and training. The instructions/questions below should assist various stakeholders to maximise their preparations for transport.

10.1.1 Hazard Identification

10.1.1.1 Senders

1. Check with competent authorities to confirm whether goods are covered by national/regional legislation (e.g., transport, export control, security, etc.) and are consistent with best practices for road transit.
2. Inform the logistics provider about relevant hazards and describe actions to be taken in the event of a chemical release or theft.
3. Ensure that the chemical hazards have been identified.

10.1.1.2 Logistics Providers

1. Understand the hazards inherent to the goods that will be transported.
2. Confirm that the goods can be legally shipped in accordance with the relevant regional and/or international regulations and that their transport is consistent with best practices for road transit.

[62] Directive (EU) 2022/1999 of the European Parliament and of the Council of 19 October 2022 on uniform procedures for checks on the transport of dangerous goods by road (codification) (Text with EEA relevance), https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32022L1999&qid=1715679249656.

3. Implement processes that should be undertaken in the event of a chemical release or theft, if necessary.
4. Train drivers in the required safety and security precautions.

10.1.1.3 Drivers

1. Understand the hazards of the goods to be carried.
2. Request chemical-hazard information in a language that you can understand.
3. Be aware of actions to take in the event of a chemical release or theft.

10.1.2 Packaging and Marking

10.1.2.1 Senders

1. Ensure that packaging meets regulatory requirements and/or international best practices, as required (refer to Section 7.3 of this document).
2. Ascertain that the packaging is compatible with the goods to be transported.
3. Confirm that incompatible chemicals have not been placed in the same package.
4. Check that specific vehicle requirements, such as the provision of placarding and marking, have been communicated to the logistics provider:

10.1.2.2 Logistics Providers

1. Implement specific requirements communicated by the sender.
2. Ensure that vehicles and equipment have been appropriately marked (placarding and marking).
3. Practice proper segregation and/or load securing.[63,64]

10.1.2.3 Drivers

1. Familiarise yourself with the requirements for hazard identification on the vehicle, which include:
    a. marking; and
    b. placarding.
2. Implement any specific load packing and marking requirements, including:
    a. segregation;
    b. load securing;
    c. confirmation that damaged and leaking packages have not been loaded onto the vehicle; and
    d. confirmation that the vehicle is not overloaded.

10.1.3 Tanks and Marking

10.1.3.1 Senders

1. Check that the identity of the goods to be transported has been communicated to the logistics provider.
2. Confirm that any vehicle requirements (such as tank type and placarding) have been communicated to the logistics provider.
3. Check that the appropriate markings are present.
4. Verify vehicle suitability prior to loading, including:
    a. provision of specifications;
    b. presence of valid test certificates; and
    c. physical inspection.

[63] See Section 7.4 for further details.
[64] See Section 7.4 for further details.

10.1.3.2 Logistics Providers

1. Ensure that vehicles and equipment are suitable and have been appropriately marked.
2. Check that the vehicles have been maintained according to national requirements.
3. Verify that drivers have been suitably trained in the operation of the specific vehicles being used.
4. Ensure that a sufficient number of qualified drivers are available.

10.1.3.3 Drivers

1. Ensure that all markings and placarding are affixed to the vehicle as necessary.[65]
2. Be available to aid emergency services in case of an incident or accident.
3. Comply with national legislative provisions, including:
    a. driving hours;
    b. speed limits;
    c. security provisions;
    d. stops and parking;
    e. licence validity; and
    f. no use of drugs or alcohol.

10.1.4 Qualifications

10.1.4.1 Senders

1. Understand/verify logistics providers' safety and security records.
2. Confirm that necessary driver qualifications have been communicated to contract companies.
3. Create a plan or checklist to check driver qualifications on the day of shipment.

10.1.4.2 Logistics Providers

1. Understand the skills and resources that drivers need.
2. Check the qualifications and backgrounds of drivers handling hazardous chemicals (in terms of criminal records; any history of financial problems or drug or alcohol abuse).
3. Ensure that drivers have completed all necessary training and that their training is up-to-date.

10.1.4.3 Drivers

1. Complete necessary training and acquire the qualifications to carry specific types of hazardous chemicals.
2. Ensure that all necessary training and certifications are kept up-to-date.

10.1.5 Resources

10.1.5.1 Senders

1. Ensure that any specialised equipment or handling has been clearly communicated to the logistics provider.
2. Check that specific personal protective equipment (PPE) requirements for onsite work and the work itself are communicated prior to arrival.

10.1.5.2 Logistics Providers

1. Ensure that drivers have all the equipment that they need to ensure the safe and secure carriage of goods and for them to confirm that all the equipment is in good condition.
2. Verify that appropriate first-aid and spill-containment kits are available.

[65] Refer to Section 7.3.

3. Ensure that all supplied safety equipment is suitable for the employee and that it supports any specific cultural needs. For example, ascertain that masks can be worn by someone with a beard or by someone wearing headwear.

10.1.5.3 Drivers

1. Understand how and when to use safety and security equipment, such as, locks, GPS equipment, and respirators.
2. Know how to use any supplied spill-containment kits.
3. Ensure that safety equipment and other equipment (e.g., vehicles) are in good working condition.

10.1.6 Security Information

10.1.6.1 Senders

1. Ensure, if involved in route management, that sensitive information (e.g., the route, shipment time and type, and quantities of goods) is controlled and that access to that information is limited.
2. Confirm that relevant security requirements have been communicated to the logistics providers.

10.1.6.2 Logistics Providers

1. Ensure that sensitive information (e.g., the route, shipment time and type, and quantities of goods) is controlled and that access to that information is limited.
2. Confirm that relevant security information about requirements has been communicated to the subcontractors.
3. Confirm that drivers have a point of contact to discuss sensitive information.
4. Verify that relevant security information about requirements has been communicated to the drivers.

10.1.6.3 Drivers

1. Request relevant information to protect the shipment from security threats.
2. Understand the reasons for information security.
3. Follow the information security plan, including information about cyber-security (see Section 9, “Cyber Security Risks”).

10.1.7 Route Selection

10.1.7.1 Senders

1. Ensure that regulatory requirements for safety and security along the route are communicated to the logistics provider.
2. Check that any specific restriction on dates and time are communicated to the logistics provider.
3. Confirm that the logistics provider is aware of when and how frequently the shipments will occur so that the delivery route can be varied as needed.
4. Verify whether there are any national requirements for security escorts along part or all of the route and ensure that these requirements are communicated to the logistics provider.
5. Update safety and security information periodically.

10.1.7.2 Logistics Providers

1. Ensure that planned routes have been checked for safety, security, and regulatory compliance.
2. Check that the route infrastructure is suitable for the vehicle being used (e.g., check for the presence of tunnels, bridges, ditches, pipes, canals, etc.).

3. Confirm that any route requirements have been clearly communicated to the driver and that the relevant documentation has been provided.
4. Check if tracking services (e.g., GPS) are available/possible. Ask:
    a. Are tracking services available for tractors/lorries and/or trailers?
    b. Has the availability of tracking services been confirmed and have these services been tested?
5. Understand when and how frequently shipments will occur so that the selection of the appropriate route can take place.
6. Understand whether security escorts are required or needed on all or parts of the route. If so, communicate security-escort requirements to the driver.

10.1.7.3 Drivers

1. Communicate concerns about routes to supervisors.
2. Follow specific route requirements provided by the logistics provider and sender.
3. Ensure that any deviations before and during transit are communicated and approved.
4. Protect information related to security escorts.

10.1.8 Incident Plan and Reporting

10.1.8.1 Senders

1. Ensure that any regulatory requirements for incident reporting are complied with.
2. Confirm that the incident-reporting plan has been communicated to the logistics provider.

10.1.8.2 Logistics Providers

1. Understand regulatory requirements for incident reporting.
2. Forward incident reports to the sender, if requested.
3. Confirm that an incident-response plan is available and whether it has been communicated to the relevant parties.
4. Determine the root cause of an incident and investigate how it was handled so as to prevent reoccurrence.

10.1.8.3 Drivers

1. Familiarise yourself with the roles and responsibilities within the incident-response plan.
2. Understand what information should be recorded after an incident.

10.1.9 Terms and Conditions

10.1.9.1 Senders

1. Ensure that a contract is in place detailing all the relevant terms and conditions of the agreed-upon transport with the logistics provider, including any insurance provisions.
2. Confirm who is responsible for any costs incurred for environmental clean-ups in the event of an incident.
3. Understand if additional insurance is required due to the value or hazard of the goods.
4. Verify that the liability (in the event of an incident) is clearly understood by all parties.

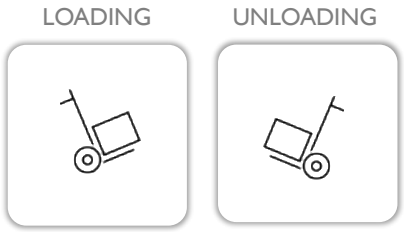
10.1.9.2 Logistics Providers

1. Ensure that the terms and conditions of the transport have been agreed upon with the sender.
2. Verify that the liability (in the event of an incident) is clearly understood by all parties.
3. Confirm that all parties are adequately insured and the cost of the provision of insurance is communicated.

10.1.9.3 Drivers

1. Verify the correct delivery address and enquire as to whether there are any specific limitations in terms of arrival times.
2. Confirm whom to call in the event of a delay in delivery or a safety or security incident.

10.2 Loading and Unloading



The processes of loading and unloading chemicals share similar risks and risk-management principles.[66,67,68,69,70] Loading and unloading may involve transferring hazardous chemicals from tank to tank, from forklift to truck, or from truck to truck. While transferring the chemicals may be a small part of the process, it can pose increased safety and security risks. Risks during these stages can be managed with proper preparation, although additional considerations may be needed for these types of trans-shipments. Recipients may benefit from the instructions provided in this section.

10.2.1 Plan/Pre-loading

10.2.1.1 Senders

1. Ensure that workers have appropriate competency, equipment, and understanding of processes for loading/unloading.
2. Develop a safety and security plan for loading and unloading.
3. Confirm that processes for loading and unloading are documented (e.g., that there are standard operating procedures).
4. Clarify roles and responsibilities, including those of the driver (e.g., whether the driver participates in the loading or unloading of the chemicals).
5. Verify that relevant processes and requirements have been communicated to the logistics providers and drivers.
6. Confirm whether risk assessments for loading and unloading have considered facility and environmental factors (e.g., time of day of the loading and unloading process, possible weather conditions, length of the various procedures involved, and suitability of conditions for optimum worker performance).
7. Ensure that any site-specific requirements have been communicated to the logistics provider.
8. Confirm whether the relevant documents of the logistics providers and/or the drivers (e.g., drivers' licences, permits, and documentation as to fitness for duty have been verified prior to release of shipment).
9. Ensure that any restrictions on where drivers can travel within the facility and where vehicles may be parked have been communicated.
10. Develop a response plan in the event that drivers are found in the wrong location.
11. Ensure that an emergency-response plan is in place. Confirm that:

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[66] CEFIC, *Best Practice Guidelines for Safe (Un)Loading of Road Freight Vehicles: Covering Technical, Behavioural and Organisational Aspects*, Issue 1, December 2013, Corrigendum, September 2021, https://cefic.org/app/uploads/2021/09/Best-practice-guidelines-for-safe-Un-Loading-of-road-freight-vehicles-Corrigendum-2021-GUIDELINES-ROAD.pdf.

[67] CEFIC provides a document giving information about the unloading of solids and liquids in several languages, available from: *SULID (Site (Un)Loading Document) Guidance*, https://cefic.org/guidance/transport-and-logistics/sulid-site-unloading-document.

[68] Chemical Business Association, *Semi Bulk Discharge Procedure: Recommended Code of Practice*, Issue no. 5 (Draft), Revised August 2018, 5 and following, http://www.chemical.org.uk/wp-content/uploads/2018/12/Semi-Bulk-Discharge-Procedure-Recommended-Code-of-Procedure-August-2018.pdf.

[69] Chemical Industries Association, *Tanker Coupling Code of Conduct for Sodium Hypochlorite, Issue no. 2, (*June 2018), 13 and following, http://www.chemical.org.uk/wp-content/uploads/2020/01/Sodium-Hypochlorite-Tanker-Couplings-Code-Tripartite-v2-June-2018.pdf.

[70] Chemical Business Association, *Handling, Storage and Distribution of Packaged Hydrofluoric Acid*, Version 3.1 Draft (March 2021), 10 and following, https://www.chemical.org.uk/wp-content/uploads/2021/04/HF-guidance-version-3-1-March-2021.pdf.

a. a plan exists for an incident arising during loading and unloading;
b. the plan has been reviewed by relevant stakeholders; and
c. the plan has been communicated to the driver and other workers.

12. Ensure that any compatibility concerns in relation to mixed shipments (i.e., flammables and oxidisers or acids and bases) have been communicated to the logistics provider and to the driver.
13. Verify that systems are in place to ensure that drivers collect the correct loads and that these systems are working.
14. Verify that spill containment systems (e.g., pits, dikes, curbs) are in place and are functional.

10.2.1.2 Logistics Providers

1. Ensure that drivers have appropriate competency, equipment, and understanding of the processes involved in loading/unloading.
2. Check with the sender if a safety and security plan exists for loading and unloading, and that safety and security checklists have been provided to drivers.
3. Verify that safety and security plans have been harmonised with facility plans.
4. Ensure that an emergency-response plan:
    a. exists for an incident during loading and unloading;
    b. has been reviewed by relevant stakeholders; and
    c. has been communicated to the driver.
5. Confirm whether the sender has shared safety and security risk assessments of loading and unloading.
6. Check that any site-specific requirements have been communicated to the driver.
7. Verify that the drivers' documents and qualifications are checked prior to staffing on the job.
8. Confirm that drivers understand what PPE they must wear on site, and that it is provided and worn.
9. Ensure that any restrictions on where drivers can travel within the facility and where vehicles may be parked have been communicated.
10. Ensure that systems are in place to avoid incompatible chemical shipments.
11. Establish a system to ensure that drivers offload the correct load.

10.2.1.3 Drivers

1. Drivers should:
    a. confirm that their equipment is suitable and safe for use;
    b. have been trained on how to safely load and unload chemicals;
    c. know and understand site-specific requirements;
    d. have been instructed as to which areas they can and cannot access at the sender's facility;
    e. know where to stay during loading and unloading; and
    f. know how to verify that the correct material is being loaded and unloaded.
2. Request a checklist to assist with safety and security protocols during loading and unloading.
3. Confirm appropriate documentation (e.g., bill of loading, SDS) are readily available.
4. Ensure that plans are in place to accomplish the following:
    a. prevent the vehicle from moving (e.g., chock blocks during loading or unloading are in place);
    b. conduct a final inspection of a vehicle before leaving, confirming that hoses, platforms, lifelines, and wheel chocks have all been properly removed.

10.2.2 Equipment

10.2.2.1 Senders

1. Verify whether the following have been accomplished:
    a. loading equipment (e.g., forklifts, cranes) have been approved and provided; and
    b. training to drivers that come onto their sites has been provided.
2. Confirm whether there is a provision for man/machine separation.

10.2.2.2 Logistics Providers

1. Ensure that all containers are accurately and clearly marked and understand if there is any room for misinterpretation.[71]
2. Verify whether the right equipment is being used for the process.
3. Certify that their employees are competent for the task.
4. Check if there is a maintenance policy for the equipment.
5. Ensure that a system is in place to prevent incompatible chemicals from entering the same transportation vessel or storage tank.
6. Determine if a policy against using make-shift adapters by drivers is warranted.

10.2.2.3 Drivers

1. Check that appropriate PPE and spill kits are available and ready.
2. Know how to inspect loading and unloading (e.g, forklifts, cranes) equipment to ensure it is in good working order.
3. Raise concerns if issues or suspicions are found.
4. Know how to operate all necessary equipment related to their job roles.

10.2.3 Responsibility

10.2.3.1 Senders

1. Should assume responsibility for, verify, and document who is responsible for loading and unloading chemicals.
2. Should verify whether the equipment is in good working order.
3. Understand and verify possible impacts on workers and the surrounding community if an incident were to occur. Senders should also ensure that potential impacts have been communicated with workers and/or relevant members of the community.

10.2.3.2 Logistics Providers

1. Verify who is responsible for loading chemicals.
2. Confirm that all operators are trained and adequately insured.
3. Check that equipment is in working order.
4. Understand possible impacts to workers and surrounding community if an incident occurs and ensure that potential impacts have been communicated to the drivers.

10.2.3.3 Drivers

1. Should check what damages they may be liable for if an incident occurs during loading or unloading.
2. Should understand the possible outcomes on themselves, on other workers, and the surrounding environment if a release or theft were to occur.

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[71] For an example of missteps and their repercussions in connection with the loading and unloading of chemicals, the reader is referred to the US Chemical Safety Board's video, *Mixed Connection, Toxic Result* (3 January 2018), https://www.csb.gov/videos/mixed-connection-toxic-result/.

3. Ensure that they are sufficiently rested so that they are alert and able to drive after loading or unloading, and that they are fit enough to comply with company standards or legal codes in the countries where they operate.

10.2.4 Insiders

10.2.4.1 Senders

1. Should consider how insiders may assist in the theft of chemicals.
2. Confirm that control measures (e.g., closed-circuit television (CCTV), transfer logs, chains of custody) are used and working.
3. Control tampering with shipments (e.g., the use of tamper evident seals).
4. Determine whether the site has Deter, Detect, Delay, and Respond security features and confirm whether transportation vehicles are included in this plan.[72]

10.2.4.2 Logistics Providers

1. Consider how insiders may assist in the theft of chemicals.
2. Verify CCTV, transfer logs, chains of custody are used and working.
3. Control tampering with shipments (e.g., tamper-evident seals).

10.2.4.3 Drivers

1. Should ascertain how to document chain of custody and operate security measures (e.g., tamper-evident indicators).

[72] Organisation for the Prohibition of Chemical Weapons (OPCW), *Indicative Guidelines 2021,* 13 and following, https://www.opcw.org/sites/default/files/documents/2021/06/OPCW%20Indicative%20Guidelines%20CSSM%2029062021%20Final_1.pdf.

10.3 Driving

DRIVING

Hazardous chemicals in motion present distinct safety and security risks. These risks can be reduced through the application of appropriate controls, which include, but are not limited to, qualified drivers, appropriate packaging, and approved routes. Drivers should be alert and follow safety and security plans.

10.3.1 Journey Plans

10.3.1.1 Senders

1. Ensure that logistic providers have a plan to address safety and security concerns.
2. Confirm that logistics providers are aware of regulatory requirements for safety-and- security plans.
3. Request communication from logistics providers in the case of an incident.
4. Notify, if required, relevant authorities of hazardous materials shipments.

10.3.1.2 Logistics Providers

1. Ensure that safety and security plans meet regulatory requirements.
2. Confirm that hired personnel are qualified and competent (e.g., fit for duty).
3. Ensure that personnel have been briefed on current safety and security concerns.
4. Provide a safety and/or security checklist to the drivers.
5. Given that conditions can change, develop emergency response procedures.
6. Establish protocols to maintain communication with drivers.
7. Provide reliable communication devices (e.g., radios, mobile phones).
8. Notify relevant authorities, if required, about the presence of hazardous materials shipments.
9. Request drivers to document and share road-safety hazards or suspicious security indicators, as appropriate.
10. Inform drivers of the range of weather conditions and appropriate actions if weather rapidly changes.

10.3.1.3 Drivers

1. Before departure, run through the checklist to ensure vehicle is fit for purpose and the load is ready to transport.
2. Ensure that you have been briefed on current safety and security concerns.
3. Know what suspicious indicators to look for that might indicate a security incident.
4. Ensure emergency action plans and equipment are readily accessible (i.e., TREM cards or ICSCs).
5. Confirm that shipping documentation is physically accessible.
6. Assure that you are fit to drive.
7. Know how to document and share road-safety hazards or suspicious security indicators/activities.

10.4 Stops/Breaks

Drivers may need to make planned (mandatory) or unplanned stops (e.g., stops necessitated by unforeseen events, such as road closures) along the route. When possible, drivers should park vehicles in locations appropriate for hazardous materials. Parked or stopped vehicles present different chemical safety-and security risks. Driver training on the risks, as well as instruction as to the selection of appropriate safety and security controls (e.g., locks, GPS devices), can prevent theft and/or the release of hazardous materials. Drivers should be trained, alert, and ready to execute any contingency plans.

10.4.1 Planning

10.4.1.1 Senders

1. Ensure that logistic providers are aware of the need for a safety and/or security plan at all stops.

10.4.1.2 Logistics Providers

1. Consider safety and security for stops planned along the route.
2. Ensure that safety and security plans meet regulatory requirements.
3. Consider whether each stop has been physically checked/inspected/surveyed and at the appropriate days/times.
4. Consider whether any sites have a history of accidents or security breaches.

10.4.1.3 Drivers

1. Familiarise themselves with the approved stops and where to park.
2. Secure the vehicle when vehicle is not in the line of vision.
3. Ensure that briefings have been given on current safety and security aspects of the stops.

10.4.2 Reducing Error and Improving Performance

10.4.2.1 Senders

1. Ensure that logistic providers are aware of critical human factors (e.g., ergonomics, air conditioning, and rest quality).

10.4.2.2 Logistics Providers

1. Ensure that there is a suitable/appropriate place for the driver to rest.
2. Consider whether human factors have been taken into account. For example, plan stops along routes taking into account reasonable driving durations; and select route segments that comply with regulations on driving shift times.

10.4.2.3 Drivers

1. Express with supervisors any personal safety or wellbeing concerns at stops.
2. Express any concerns related to securing the vehicle and the product at stops with supervisor.
3. Express any concerns manoeuvring the vehicle safely in busy areas.

10.4.3 Emergency Response

Training in emergency response is a key element to reducing the severity of a chemical incident. Training, including drills and exercises, will reduce/minimise impacts of most emergency situations. Any emergency response may involve drivers, local first responders, or specialised response personnel.

10.4.3.1 Senders

1. Must ensure that logistics providers are aware of regulatory requirements relevant to emergency-response capabilities and competencies.
2. Should mandate that logistics providers inform drivers of safety or security incidents so that continuous learning may take place.
3. Should be prepared to assist logistics providers in emergency situations.

10.4.3.2 Logistics Providers

1. Ensure that there is a plan in place should a vehicle need to be diverted or makes an unplanned stop.
2. Develop a notification process for identifying unplanned stops.
3. Train drivers on how to respond to potential safety or security incidents at a roadway stop.

10.4.3.3 Drivers

1. Should confirm that they know how to respond to relevant safety incidents (e.g., a tire puncture, an accident).
2. Ascertain that they can respond and behave appropriately during relevant security incidents (e.g., hijackings).
3. Confirm their knowledge of whom to contact in case of an emergency.
4. Ensure that they have the means of communication which will work at all locations along the route.[73]

[73] United States Department of Transportation, *Emergency Response Guidebook (ERG)* (2020.) This guidebook is intended to provide guidance for emergency responders in North America to respond to transportation accidents during the initial response phase, https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/2021-01/ERG2020-WEB.pdf.

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Appendix 1: International and Regional Transportation Regulations

Figure 9 provides examples of international transportation regulations and best practices relevant to inland waterways, rail, pipelines, and roads. Table 5 includes regulations and best practices from major chemical producing and trading regions and countries. The selected regulations were provided by reviewers and contributors to these guidelines and do not represent all countries or regions.

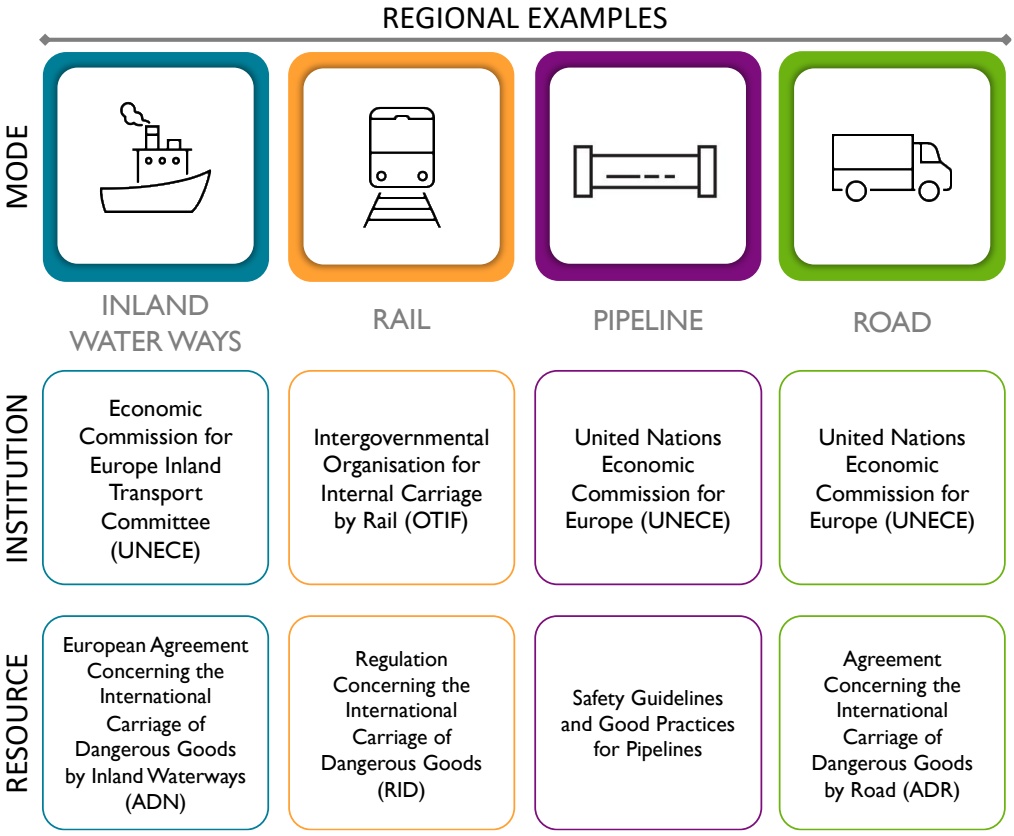

Figure 9. Examples of regional transportation regulations and guidelines

Table 5. Select international and regional transportation regulations and best practices.

Modality	Region	Organisation	Document
All	Global	United Nations Economic Commission for Europe (UNECE)	United Nations Model Regulations on the Transport of Dangerous Goods (UNRTDG)[74]

[74] UNECE, *UN Recommendations on the Transport of Dangerous Goods: Model Regulations*, https://unece.org/about-recommendations.

Modality	Region	Organisation	Document
Air	Global	International Civil Aviation Organization (ICAO)	Technical Instructions for the Safe Transport of Dangerous Goods by Air (ICAOTI)[75]
Sea	Global	International Maritime Organization (IMO)	International Maritime Dangerous Goods Code (IMDG)[76]
Inland Waterway	Europe	Economic Commission for Europe Inland Transport Committee (UNECE)	European Agreement Concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN)[77]
Rail	Europe, Asia, Africa	Intergovernmental Organisation for Internal Carriage by Rail (OTIF)	Regulation Concerning the International Carriage of Dangerous Goods (RID)[78]
Rail	Europe, Asia	Organisation for Co-operation between Railways (OJSD)	Convention on International Direct Railway Traffic[79]
Pipeline	UNECE Member States	United Nations Economic Commission for Europe (UNECE)	Safety Guidelines and Good Practices for Pipelines[80]
Road	Europe	United Nations Economic Commission for Europe (UNECE)	Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR)[81]
Road and Rail	South America (Argentina, Brazil,	MERCOSUR	Agreement for the Facilitation of the Transport of Dangerous Goods in MERCOSUR 1994[82]

[75] International Civil Aviation Organization (ICAO), *Technical Instructions for The Safe Transport of Dangerous Goods by Air [Doc 9284]*, 31 March 2023, https://www.icao.int/safety/DangerousGoods/Pages/Doc9284-Technical-Instructions.aspx .
[76] International Maritime Organization (IMO*), The International Maritime Dangerous Goods (IMDG) Code (IMDG)*, https://www.imo.org/en/OurWork/Safety/Pages/DangerousGoods-default.aspx.
[77] UNECE, *European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways*, *https://unece.org/about-adn*.
[78] Intergovernmental Organisation for International Carriage by Rail (OTIF), *Regulations concerning the International Carriage of Dangerous Goods by Rail (RID 2023)*, https://otif.org/en/?page_id=1105.
[79] OSJD, *Convention on International Direct Railway Traffic*, 1951, Chicago. https://en.osjd.org/en/9190.
[80] UNECE, *Safety Guidelines and Good Practices for Pipelines*, May 2015, https://unece.org/info/Environment-Policy/Industrial-accidents/pub/21639.
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[82] Agreement for the Facilitation of the Transport of Dangerous Goods in Mercosur. Details of the Regulations. No. 15/2019. Approved on December 4, 2019. Common Market Council (CMC), https://normas.mercosur.int/public/normativas/3832.

Modality	Region	Organisation	Document
	Paraguay, and Uruguay)		
Road	South East Asia (Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Vietnam)	Association of South East Asian Nations (ASEAN)	Protocol 9 for Dangerous Goods to implement ASEAN Framework Agreement On the Facilitation Of Goods In Transit (AFAFGIT)[83]
Multiple	United States	US Department of Transportation	Title 49 of the Code of Federal Regulations (CFR 49)[84]
Multiple	Canada	Transport Canada	Transport of Dangerous Goods Regulations[85]
Road	China	National Road Transport Standardization Technical Committee	Regulations Concerning Road Transportation of Dangerous Goods (JT/T617.1-2018)
Road and Rail	Australia	Australian National Transport Commission	Australian Dangerous Goods Code, Ed 7.8
Road and Rail	New Zealand	Waka Kotahi New Zealand Transport Agency	Land Transport Rule, Dangerous Goods 2005, Rule 45001/2005[86]

[83] Association of Southeast Asian Nations (ASEAN), *Protocol 9: Dangerous Goods*, 16 December 1998, https://agreement.asean.org/media/download/20140506105520.pdf.
[84] United States, *Title 49, Transportation, Code of Federal Regulations*, 2023, https://www.ecfr.gov/current/title-49.
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[86] Waka Kotahi, New Zealand Transport Agency, *Land Transport Rule: Dangerous Goods 2005*, https://www.nzta.govt.nz/resources/rules/dangerous-goods-2005-index/.

Appendix 2: International Chemical of Concern Lists

List	Description[87]
ADR Dangerous Goods List	The European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) is a treaty signed in 1957 under the auspices of the UNECE and frequently revised by the logistics sector. The Dangerous Goods list in ADR is applicable for all Member States of the ADR, including European Union under the European Union's Directive 2008/68/EC. This directive implements the European Agreements on the International Carriage of DG by Road (ADR) and Inland Waterways (ADN) and the Regulations on the International Carriage of DG by Rail (RID).
The Australia Group Export Control List: Chemical Weapons Precursors	The Australia Group (AG) published its Common Control Lists which includes a list of dual-use chemicals, equipment, technology, and software.
The Department of Homeland Security (DHS) of the United States Chemical Facility Anti-Terrorism Standards (CFATS) Chemical of Interest (COI)	The Chemical Facility Anti-Terrorism Standards (CFATS) Chemical of Interest (COI) List includes a description of security concerns for chemicals on the list (such as, toxic releases, flammable releases, explosives, theft), which can be used to produce mass-effect weapons; these pose threats of sabotage and/or contamination.
The Chemical Weapons Convention Annex on Chemicals	The Chemical Weapons Convention (CWC) is an international treaty aimed at eliminating chemical weapons worldwide. States Parties have undertaken, inter alia, never under any circumstances to develop, produce, otherwise acquire, stockpile, retain, or use chemical weapons, or transfer them directly or indirectly to anyone. The CWC acknowledges the use of toxic chemicals and their precursors for purposes not prohibited by the Convention, including for legitimate industrial, agricultural, research, medical, pharmaceutical, or other purposes. To ensure that activities are in accordance with the CWC, States Parties are subject to a declarations and verification regime for toxic chemicals and their precursors. There are three chemical schedules; each is separated into A and B categories, where A refers to toxic chemicals and B refers to precursor chemicals.
The European Union Regulation (EU) 2021/821 of the European Parliament and of the Council of 20 May	The EU published Regulation (EU) 2021/821, which includes a list of dual-use items.

[87] In most cases, the descriptions in this table are excerpts from the sources themselves.

List	Description[87]
2021 setting up a Union regime for the control of exports, brokering, technical assistance, transit and transfer of dual-use items (recast)	
Regulation (EU) 2019/1148 of the European Parliament and of the Council of 20 June 2019 on the marketing and use of explosives precursors	The EU published Regulation (EU) 2019/1148, which includes a list of explosive precursors.
International Narcotics Control Board (INCB) Red List	The Red List is the list of precursors and chemicals frequently used in the illicit manufacture of narcotic drugs and psychotropic substances under international control.
The Missile Technology Control Regime Annex (MTCR)	The Missile Technology Control Regime Annex consists of two categories of items, which include equipment, materials, "software" or "technology". Category I items, all of which are in Annex Items 1 and 2, are those items of greatest sensitivity. If a Category I item is included in a system, that system will also be considered as Category I, except when the incorporated item cannot be separated, removed, or duplicated. Category II items are those items in the Annex not designated as Category I.
National Academies of Sciences, Engineering, and Medicine (NAS) Reducing the Threat of Improvised Explosive Device Attacks by Restricting Access to Explosive Precursor Chemicals	The U.S. Department of Homeland Security (DHS) requested the National Academies of Sciences, Engineering, and Medicine to identify opportunities to reduce the threat of improvised explosive device (IED) attacks. The National Academies assembled a 13-member committee of experts on chemistry, energetic/explosive materials, supply-chain management, economics, defence, law, and other fields; and identified IED precursor chemicals and strategies for their control.
Nuclear Suppliers Group	The Nuclear Suppliers Group published guidelines for transfers of nuclear-related dual-use equipment, materials, software, and related technology (INFCIRC/254, Part 2) that includes chemicals that pose a security concern because they are high-explosive substances.
Organization for the Prohibition of Chemical Weapons: Handbook on Chemicals (HBC v.2022)	The "Handbook on Chemicals" (HBC) aims at assisting States Parties in the identification of individual chemicals covered by the three Schedules in the Annex on Chemicals of the CWC. The HBC is updated and revised on a regular basis to incorporate any new scheduled chemicals that States Parties declare, as well as any changes in the identifiers, such as the Chemical Abstracts Service

List	Description[87]
	Registry Numbers (CAS RN®) and Harmonized System Codes (HS codes) assigned to scheduled chemicals.
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	The objective of the Rotterdam Convention is to promote shared responsibility and cooperative efforts in the international trade of certain hazardous chemicals and pesticides. The Rotterdam Convention includes lists of chemicals in its annexes.
Stockholm Convention on Persistent Organic Pollutants	The Stockholm Convention aims to protect the environment and human health from persistent organic pollutants. The Stockholm Convention includes lists of chemicals that it aims to eliminate or restrict.
Wassenaar Arrangement	The "Wassenaar Arrangement on Export Controls for Conventional Arms and Dual-Use Goods and Technologies" was established in order to contribute to regional and international security and stability by promoting transparency and greater responsibility in transfers of conventional arms and dual-use goods and technologies, thus preventing destabilising accumulations. The aim is also to prevent the acquisition of these items by terrorists.
The World Health Organization (WHO) Recommended Classification of Pesticides by Hazard and Guidelines to Classification (2019)	The WHO Recommended "Classification of Pesticides by Hazard and Guidelines to Classification" (2019) includes lists of pesticides with technical-grade active ingredients that may pose acute safety risks. Additionally, the document includes lists of obsolete/discontinued pesticides and gaseous or volatile fumigants.

Appendix 3: List of Contributors

These guidelines have been developed as a result of two in-person OPCW workshops. Following the completion of the draft version during the workshop, a wider group of experts participating in an online review workshop reviewed and amended the draft version.

Drafting Committee

The drafting committee was formed following the first workshop and consisted of the members listed below, who were principally responsible for the text. This committee played a major role in providing technical expertise and knowledge. Among them, the Chair of the Committee/Principal Drafter, collated the technical input and harmonised the contents.

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