Australian Dangerous Goods Code Comprehensive Review

Working group paper #8

National Transport Commission

Leading change

Tanks and bulk containers for dangerous goods transport

August 2023

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Report outline

Title	Tank and bulk container provisions for dangerous goods transport
Type of report	Discussion paper
Purpose	For public consultation
Abstract	In November 2020, transport and infrastructure ministers approved the NTC's recommendation to conduct a comprehensive review of the Australian Code for the Transport of Dangerous Goods by Road & Rail (the Code) This paper is the eighth of a series of topic specific discussion papers.
Submission details	The NTC will accept submissions until 22 September 2023 online at **www.ntc.gov.au** or by email to: **dkirk@ntc.gov.au**
Attribution	This work should be attributed as follows, Source: National Transport Commission, Tank and bulk container provisions for dangerous goods transport – discussion paper #8. If you have adapted, modified or transformed this work in anyway, please use the following, Source: based on National Transport Commission, Tank and bulk container provisions for dangerous goods transport – discussion paper #8.
Key words	Dangerous goods, ADG Code review, transport, ADR, tanks, bulk containers
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Have your say

What to submit

We are seeking stakeholder views on the consultation questions in the Executive summary and throughout the document. We are also interested in any additional information submitters could provide to support their views.

When to submit

We are seeking submissions on this issues paper by 22 September 2023.

How to submit

Any individual or organisation can make a submission to the NTC.

Making a submission

- Visit **www.ntc.gov.au** and select 'Engage NTC' on the homepage.

  Or

- Email your submission to **dkirk@ntc.gov.au**

Where possible, you should provide evidence, such as data and documents, to support the views in your submission.

Publishing your submission

Unless you clearly ask us not to, we publish all the submissions we receive online. We will not publish submissions that contain defamatory or offensive content.

A deidentified list of responses to specific questions, and how these have been considered in the final drafts will be made publicly available.

The *Freedom of Information Act 1982* (Cwlth) applies to the NTC.

Contents

Purpose of this paper

The National Transport Commission (NTC) is conducting a comprehensive review of the Australian Code for the Transport of Dangerous Goods by Road & Rail (the Code).

In conducting the review, the NTC will seek to achieve greater alignment with the internationally recognised land mode-specific requirements contained in the Agreement for the International Transport of Dangerous Goods by Road (ADR) and the Agreement for the International Transport of Dangerous Goods by Rail (RID).

The review is focused on outcomes that serve the best interest of all parties involved in the transport of dangerous goods. This includes those parties on which the requirements are imposed, those who regulate and administer the requirements, and those who must maintain them.

This paper is the eighth of a series of topic specific discussion papers. This paper should be read in conjunction with **Working Group Supplementary Paper #S1 – Tank provisions of the ADR - Terminology**.

The purpose of this paper is to examine the current requirements for tanks and bulk containers in the ADR and the current code, and how these requirements can be combined and carried forward into the future code.

Portable tanks and MEGCs that are designed to the requirements in the UN Model Regulations are out of scope for this paper.

This paper relates to:

the Code – Part No.	☐	Working group	☒	Discrete issue	☒
		Tanks, Vehicles and Emergencies		Tanks and bulk containers used for dangerous goods transport	

Executive summary

Context

A full review of the Australian Dangerous Goods Code (the Code) has not been conducted for over a decade.

The Code is applicable across Australia, and adherence to it by all relevant parties ensures specific risks posed through transport of dangerous goods by land are effectively managed.

In 2020, transport and infrastructure ministers agreed for the NTC to conduct a full review of the Code. The NTC's responsibility for the Code's content and stakeholder engagement over several years, highlighted that the road and rail specific requirements of the Code in particular, do not fully support the smooth and safe movement of dangerous goods across borders and transport modes.

The purpose of the review, therefore, is to ensure that the Code is reflective of the Australian transport environment, draws upon road and rail mode specific concepts used elsewhere in the world where appropriate, and considers inclusion of explosives as regulated dangerous goods under the Code's requirements.

Given the scale of the review, the content of the code has been broken into a series of topics. This paper focuses on tanks and bulk containers used for dangerous goods transport.

Themes

Chapter 1 – Project to Review the Australian Dangerous Goods Code

In November 2020, transport and infrastructure ministers approved the NTC's recommendation to conduct a comprehensive review of the Code.

The review seeks to better align Australia with international practices contained in the road and rail mode specific versions of the UN Model Regulations and will focus on improving transport of dangerous goods safety outcomes.

Chapter 2 – context

This chapter provides contextual overview for the topics included within this paper. This paper deals with the design, construction and use of tanks and bulk containers used to transport dangerous goods. The focus of the paper are tanks and bulk containers that do not conform to the UN provisions relating to portable tanks and multiple-element gas containers (MEGCs), which are out of scope for this paper.

This paper is closely related to the paper on the use of vehicles for dangerous goods transport (Working Group Paper #7).

Chapter 3 – Tank assignment and use in ADR

This chapter discusses how the ADR specifies and defines the use of tanks, and the various provisions that control their use for the transport of dangerous goods.

Chapter 4 – Tank assignment in the current code

This chapter explores the way the current code specifies dangerous goods transport in tank vehicles, and some of the issues that have been observed in the current system.

Chapter 5 – Possible changes for the future code

This chapter proposes potential changes to the code to ensure that existing tank design and construction standards are not diminished, while also benefiting from the additional work that has gone into developing the ADR. It also considers the use of ADR tanks as an alternative means of compliance, which was permitted prior to the current code.

Chapter 6 – Ullage for tank vehicles

This chapter details some of the inconsistencies in the current code for how ullage is treated and presents some options for resolving them.

Chapter 7 – Transport of solids in bulk containers

This chapter details some of the differences between the ADR and the current code for transport of solids in bulk containers, and how these may be incorporated into the future code.

Next steps

Consultation on this issues paper will close on 22 September 2023.

The responses to this paper will be used to develop a consultation draft of the tank provisions for the future code. This will likely be developed along with the vehicle requirements, after considering responses to the various papers on these issues.

List of questions

1 About this project

Key points

- In November 2020, transport and infrastructure ministers approved the NTC's recommendation to conduct a comprehensive review of the Australian Code for the Transport of Dangerous Goods by Road and Rail (the Code).
- Mode-specific requirements of the current code consist of a repository of often disjointed, contradictory requirements that fall apart when closely examined.
- The review seeks to better align Australia with international practices as set out in the ADR and RID.
- The review will focus on outcomes that serve the best interest of all parties involved in the transport of dangerous goods.
- Given the scale of the review, the content of the code has been broken into a series of topics, each allocated to a topic specific working group.

1.1 Project objectives

In November 2020, transport and infrastructure ministers approved the NTC's recommendation to conduct a comprehensive review of the Australian Code for the Transport of Dangerous Goods by Road and Rail (the Code). Ministers also supported the proposal to incorporate into the Code principles from both:

- the Agreement for the International Transport of Dangerous Goods by Road (ADR)
- the Agreement for the International Transport of Dangerous Goods by Rail (RID).

The ADR and RID are used extensively throughout Europe, Africa and Asia. As with the Australian code, both the ADR and RID are based on the United Nations Recommendations on the Transport of Dangerous Goods - Model Regulations (UN Model Regulations). In general, the requirements of the ADR and RID are the same. They only differ where requirements need to apply specifically to either road transport or rail transport.

Stakeholder feedback over the years and a literature review of relevant materials suggests that the mode-specific requirements of the current code consist of a repository of often disjointed, contradictory requirements that fall apart when closely examined. In many instances, there was no supporting evidence or data for their introduction and there is no evidence that they have contributed to safer outcomes. The lack of consistency and cohesiveness in these requirements coupled with a lack of a framework for maintaining the mode-specific requirements results in a continuing cycle of ad-hoc, random amendments without consideration of the consequential inconsistencies or contradictions.

Goal of the review

The goal of the review is to deliver a code that:

- addresses the specific risks of transport by land, while also recognising any risks unique to the Australian transport environment
- remains contemporary

- is aligned to international practices that support the smooth and safe movement of dangerous goods across borders and transport modes.

The review is focused on outcomes that serve the best interest of all parties involved in the transport of dangerous goods. This includes:

- parties that must meet the requirements
- parties that regulate and administer the requirements
- parties that must maintain the requirements.

The aim of the review is to deliver more than just a cohesive and contemporaneous code. We also aim to deliver a framework for making sure the Code remains up to date and aligned with international standards.

1.2 Background

In 2020, the NTC released an issues paper on the land transport of dangerous goods. The paper focused on the legislative framework that supports the dangerous goods code. However, the responses we received highlighted several problems with the code itself.

A major concern raised in submissions centred on the Australia-specific chapters of the current code. The biennial maintenance cycle of the Code, which keeps it aligned to the UN Model Regulations, is appreciated. However, many submissions noted the Australia-specific chapters have not been reviewed or revised. Many of these chapters were carried over from the sixth edition of the Code (ADG 6), either in full or in part, without examination. They have not been critically reviewed for over 15 years and are now outdated. In the case of some requirements, no evidence base, or justification can be found to support their original introduction.

Industry and regulators also noted the Australian Explosives Code is outdated and has no responsible agency. They expressed a strong preference for the dangerous goods code to be expanded to include Class 1 Explosives, and for the Australian Explosives Code to be made obsolete.

After analysing the submissions received, the NTC made recommendations to infrastructure and transport ministers. All recommendations were endorsed, including the following:

Recommendation 4:

Conduct a full review of the Australian Dangerous Goods Code to update outdated chapters, identify and correct translation errors, incorporate relevant ADR concepts and incorporate requirements for Class 1 and Division 6.2. Note: the technical requirements for Class 1 and Division 6.2 will be incorporated into the [ADG] Code but the legal requirements will not be incorporated into the regulations.

1.3 Approach

A set of Review Principles has been developed to guide the review and give it the best chance of delivering the right outcome. These principles were developed with regard to the following key considerations:

- impacts and benefits

- stakeholder engagement
- maintaining currency of the Code and associated model laws.

Given the scale of the review, the content of the code has been broken into a series of topics, each allocated to a topic specific working group.

This discussion paper deals specifically with design, construction and use of tanks (other than portable tanks) and bulk containers.

Previous consultation papers for this review include:

- Classification of dangerous goods – Working group paper #1, January 2023
- Dangerous Goods List – UN entries – Working group paper #2, February 2023
- Tank provisions in ADR – Terminology – Supplementary paper #S1, March 2023
- Approval of tanks, bulk containers and vehicles – Working group paper #3, March 2023
- Safety equipment for dangerous goods transport – Working group paper #4, May 2023
- Fire extinguishers for dangerous goods transport – Working group paper #5, May 2023
- Part 5 – Consignment procedures – Working group paper #6, June 2023
- Vehicles for dangerous goods transport – Working group paper #7, August 2023

2 Context of issues

Key points

- The design and construction of tanks used for transport are critical controls in dangerous goods transport.
- The current code has some deficiencies, including a focus on tanks used as part of tank vehicles, with limited information for other tank scenarios.
- ADR is more comprehensive, covering a wider range of issues that are missed in the current code.
- This paper examines options for combining the two systems in a way that is appropriate for the Australian transport context.
- This paper focuses on tanks and MEGCs other than UN-compliant portable tanks (such as isotanks) and UN-compliant MEGCs. The current code and ADR are already harmonised for these UN compliant situations.

The design and construction of tanks and bulk containers is a critical safety control for the transport of dangerous goods. Likewise, the assignment of permitted tank types for transporting particular types of dangerous goods.

Using a poorly designed or constructed tank or a tank that is not compatible or appropriate for the dangerous goods being transported can lead to catastrophic failure of the containment system.

The UN MR, and the ADR, have detailed requirements for design, construction and use of tanks and bulk containers. The Guiding Principles for the Development of the Model Regulations on the Transport of Dangerous Goods documents the principles used in assigning tank codes to specific UN numbers.

Australia relies heavily on the use of non-UN tanks. While the requirements in the code for UN tanks are well developed and documented, there are deficiencies in requirements for the design, construction and assignment of non-UN tanks. This paper focuses on non-UN tanks and containment systems.

Portable tanks in the ADR and the Code

The UN portable tank provisions, portable tank codes and portable tank special provisions are functionally the same between the ADR and the Code (both are in Chapter 4.2 of each document). These chapters both conform to the UN Model Regulations, minimising the potential for variation.

The UN portable tank instructions (T code) and special provisions (TP codes) assigned to a specific UN Number are shown in ADR columns (10) and (11) of the dangerous goods list, respectively. The codes are assigned in accordance with the Guiding Principles for the Development of the Model Regulations on the Transport of Dangerous Goods.

An initial comparison between the UN Model Regulations, the ADR and the Code found that most differences are stylistic or word choice, rather than material to the provisions themselves. For example, the UN Model Regulations and the ADR use the term *carriage* instead of *transport* and *shall* instead of *must.*

One significant difference is that the ADR has deleted portable tank special provision TP13. This special provision includes directions on carrying self-contained breathing apparatus when transporting substances that carry an inhalation toxicity hazard. The application of this special provision is discussed in working group paper #4 Safety equipment for dangerous goods transport.

Given that the provisions for and assignment of UN portable tanks is the same in the ADR and the code, this paper focuses on tanks that fall outside the UN portable tank framework. The ADR uses the term 'ADR tanks' for non-UN tanks. These tanks are specified in the ADR in two additional columns in the dangerous goods list. These are columns (12) and (13) in the ADR, applying the ADR tank code and ADR tank special provisions, respectively.

Tank assignment and use in the ADR – chapter 3

This chapter provides context for how tanks are specified for use in the ADR. This includes both ADR tank vehicles and intermodal tanks approved under the ADR (as compared to UN portable tanks). The chapter details the different features of the system of tank codes, how tank design and construction is defined, and the special provisions for tank transport in the ADR.

It also provides information relating to inspection and maintenance of tanks, and the way in which that information is laid out in the ADR. Finally, it notes that there are other requirements that apply when a vehicle and tank are mated together into a tank vehicle.

Tank assignment in the current code – chapter 4

This chapter explores how the current code specifies which materials are permitted to be carried in tanks, and the design and construction requirements for tanks under the current code. It notes the issues relating to the division between tanks and tank vehicles that arises in the current code, and what provisions apply to the use of tank vehicles.

Finally, it explores some of the areas where the current code has deficiencies.

Possible changes for the future code – chapter 5

This chapter uses the information from the previous chapters to discuss potential changes to the future code. The chapter aims to develop ways to improve the presentation of information in the current code, while still benefiting from the work that has been put into tank vehicle design and construction in Australia. It explores options for incorporating information from the ADR into the code.

The chapter also explores how tanks designed to ADR requirements may be permitted as an alternative means of compliance, and what controls may be needed for this. It also considers differences between inspection and maintenance requirements for the two systems, and how they can be aligned in an effective manner.

Finally, it notes that the ullage requirements for tanks are currently contained in Part 10 of the code, and proposes to move these to Part 4, as a requirement for the use of tanks. This aligns with the ADR and the requirements for packages and portable tanks.

Ullage rules for tank vehicles – chapter 6

This chapter details some of the differences between the ADR (and portable tanks in the code), and the ullage rules for tank vehicles in the current code. It provides a discussion of these issues, and options for resolving them.

Transport of solids in bulk containers – chapter 7

This chapter details some of the differences between the ADR and the current code for transport of solids in bulk containers. The differences are relatively small, and there are some questions to permit these issues to be properly addressed in the future code.

3 Tank assignment and use in ADR

Key points

- The ADR includes a comprehensive system of tanks, tank codes and special provisions for their use.
- The ADR also includes specific information on periodic inspection and testing of the tanks themselves.
- The ADR includes specific requirements when a tank is used as a part of a vehicle, these are primarily discussed in Working Group paper #7.

The supplementary paper (S1) on tank and vehicle terminology should be consulted for detailed information on the system for tanks and vehicles in the ADR. For this paper, the following means of containment are in scope:

- Fixed tanks (tank-vehicles) – Tanks forming a permanent part of a tank vehicle
- Demountable tanks – Tanks that can be detached from a vehicle, but only when empty
- Tank-containers – Intermodal tanks that are not UN portable tanks
- Tube-vehicles – Multiple-element gas containers permanently attached to a vehicle
- Non-UN MEGCs – Multiple-element gas containers that are not UN-approved MEGCs

As within the ADR (and the current code), it's presumed that UN-approved portable tanks and UN-approved MEGCs will continue to be treated separately with their own chapters in the future code. As a result, the following means of containment are out of scope for this paper:

- Portable tanks – Intermodal tanks meeting the UN portable tank provisions.
- UN MEGCs – Multiple-element gas containers meeting the UN MEGC provisions

As noted in the supplementary paper, the ADR tank provisions apply to tanks other than those used on tank vehicles and may also be applied to multi-modal tanks that don't necessarily comply with the UN portable tank provisions.

This section provides a general overview of tank assignment and use in the ADR. For the detailed provisions, refer to the ADR.

3.1 Tank codes

The ADR and RID use a comprehensive system of tank codes for all materials that are eligible for transport in tanks or MEGCs. This system is detailed in Chapter 4.3 and each entry in the dangerous goods list that may be transported in tanks is provided with one of these codes (the ADR includes these as columns (12) and (13) of the dangerous goods list). It also provides for a hierarchy of tanks that mean a tank with a stricter set of design requirements may be used for the transport of dangerous goods with a less restrictive set of requirements. Details on these tank codes is provided in Appendix A.

Under ADR and RID, it is currently possible for a tank to be assigned both an ADR tank code and a portable tank instruction. This can result in problems, as these two systems have different origins, and have not been harmonised. These issues are currently being

considered by the UN working parties that deal with ADR and RID, and it appears likely to be restricted in the future.[1]

In the ADR dangerous goods list there are:

- 100 entries with an ADR tank instruction, but no portable tank instruction
- 36 entries with a portable tank instruction, but no ADR tank instruction.

These entries are listed in Appendix B..

Tanks in the ADR can be divided into two main types:

- Those with a “G” in the second part of the tank code.
  - These tanks are not designed as pressure vessels and are generally used for gravity discharge tanks, chemicals with a lower vapour pressure or in very low forced-pressure discharge scenarios.
- Those with a number in the second part of the tank code.
  - These tanks are designed as pressure vessels and are used for higher vapour pressure or higher danger substances. The numerical value provides the test pressure for the design of the shell.
  - All gas tanks are designed as pressure vessels.

Note that most tanks in Australia for liquid service would be considered “G” type tanks, as they are not designed as pressure vessels. Generally, only gas tanks and some tanks for more specialised service are designed as pressure vessels.

Additional detail on tank codes is provided in Appendix A.

3.2 Tank use provisions in ADR

Chapter 4.3 of the ADR contains detailed provisions relating to the selection and use of tanks for transport. These provisions are directed at the users of tanks for transport. This chapter includes a rationalised approach for the assignment of particular tank codes for substances in the ADR and permits a hierarchy of tanks to be developed. This provides significant flexibility to the users of tanks, allowing them to use tanks in multiple scenarios without needing separate approvals (with the exception of some specific materials).

This rationalised approach also means that competent authorities can readily determine the appropriate tank code for a new substance based on its hazard characteristics.

Chapter 4.4 includes additional information that apply to tanks constructed of fibre-reinforced plastics (FRP). Chapter 4.5 includes information for the operation of vacuum waste tanks for dangerous goods.

3.3 Tank construction provisions in ADR

Chapter 6.8 of the ADR contains the detailed provisions for the construction of tanks. These provisions are directed at designers and manufacturers of tanks for transport.

[1] Paper: **ECE/TRANS/WP.15/AC.1/2023/INF.33**. Working group report **ECE/TRANS/WP.15/AC.1/2023/INF.42**.

Chapter 6.9 contains additional provisions that apply to the construction of ADR-compliant tanks that are manufactured from FRP. Chapter 6.10 contains additional provisions for the construction of ADR-compliant vacuum tanks for waste service.

3.4 Special provisions applying to tank transport

Tank use codes

In addition to the general tank codes above, Chapter 4.3 of the ADR includes special provision for tank use. These codes are assigned to particular substances in the dangerous goods list. These codes have the form TUx.

The tank use codes modify how a tank is used when being transported for those particular substances. For example, TU1 provides the following requirements:

TU1 The tanks shall not be handed over for carriage until the substance has solidified completely and been covered by an inert gas. Uncleaned empty tanks which have contained these substances shall be filled with an inert gas.

This tank use code applies to a number of metals of division 4.3 that emit flammable gases when in contact with water.

These codes may also vary the application of some other provisions, such as ullage or filling rules where appropriate for a substance. They are intended to ensure that certain risks from transport of particular materials in tanks are mitigated.

Tank design and construction special provisions

Chapter 6.8 contains a number of special provisions that modify or apply additionally to the standard tank codes. As for tank use codes, these are assigned to dangerous goods in the dangerous goods list.

These are:

- Construction codes (TCx). These modify the way the tank is constructed, such as material or thickness.
- Items of equipment (TEx). These modify or require the use of equipment that is attached to the vehicle.
- Type approval (TAx). These modify the approval requirements for tanks for dangerous goods transport.
- Tests (TTx). These modify the tests that are required for tanks used for particular dangerous goods.
- Marking (TMx). These modify the marking requirements for tanks on the compliance plate when used for certain dangerous goods.

Other special provisions that impact tank transport

Chapter 3.3 of both the ADR and RID includes special provisions derived from the UN, and additional ADR and RID defined special provisions. Some of these special provisions make reference to tank transport, however they are not written in a way that defines how a tank may be used for transport.

3.5 Inspection and maintenance of tanks

The ADR refers to two standards for inspection and maintenance of tanks. EN 12972 for metallic tanks, and EN 14334 for LPG road tankers. These standards are mandatory for the inspection and testing of tanks. The ADR prescribes a six-yearly periodic inspection for tank vehicles, and a three-yearly intermediate inspection (five and 2.5 years respectively for tank-containers). These are similar to the detailed 2.5 yearly and five-yearly inspection and testing requirements in AS 2809.1 for tank vehicles.

These standards include detailed requirements for the inspection process and documentation requirements and detail the following requirements:

- examination of documents for the tank
- inspection of the shell interior
- inspection of the tank exterior
- leakproofness test
- inspection of service equipment
- inspection of frame or other structural equipment of portable tanks and tank containers
- hydraulic pressure test (six-yearly only)

3.6 Style of information in ADR

The ADR presents the information in a detailed manner, with most of the requirements relating to the construction of a tank being found in the main text of the ADR. Greater detail on compliance with these is found in the referenced standards and codes.

General requirements

These are statements that provide expectations for the design and construction of tanks. While they provide an indication of practice, they don't provide performance requirements. An example is found in the first part of 6.8.2.1.10. This section requires that for "welded shells only materials of faultless weldability whose adequate impact strength at an ambient temperature of –20 °C can be guaranteed, particularly in the weld seams and the zones adjacent thereto, shall be used."

This requirement does not define faultless weldability or how to guarantee adequate impact strength. However, it provides a clear expectation that the materials used in welded shells are capable of being welded in a manner that ensures safety.

Specific requirements

These statements provide detailed, measurable requirements that place hard limits on what is acceptable. These requirements tend to be much more detailed than the general requirements. An example can be found in the second part of section 6.8.2.1.10. It requires that "if fine-grained steel is used, the guaranteed value of the yield strength Re shall not exceed 460 N/mm² and the guaranteed value of the upper limit of tensile strength Rm shall not exceed 725 N/mm², in accordance with the specifications of the material."

This requirement provides a strict numerical limit for the yield and tensile strength of fine-grained steels. If the steel used does not meet these parameters, they are not permitted to be used.

References internal to ADR

These chapters of the ADR contain a large number of references internal to these chapters and to the rest of the ADR. This avoids duplicated information, though it can make interpreting the requirements difficult at times. However, as these construction provisions are mainly of interest to persons engaging in tank design and construction, this is not likely to have a significant impact on dangerous goods transporters generally.

References external to the ADR (including standards)

Most external references are to standards that provide additional detailed tank design, inspection and testing matters. The ADR references a large number of standards (generally EN or EN ISO standards) that support tank engineers to deal with matters that the ADR does not provide sufficient detail on.

The content of these standards is highly detailed and technical in nature and are managed separately to the ADR processes.

In the tables of standards that may be used, dates where the standards are valid are provided. This provides clear, unambiguous ranges for dates where a design standard is (and was previously) permitted.

3.7 Tank and tube vehicles in ADR

As noted in the supplementary paper (S1) on tank and vehicle terminology, the ADR also includes three tank types where the tank is a part of the vehicle. Fixed tanks and demountable tanks are used for liquids (including gases that are in a liquid state) and solids, while tube vehicles are used for compressed gases.

The provisions in Part 6 apply to the containment system itself, specifically restricting it to the shell of the tank, the elements of a tube-vehicle, and the service and structural equipment.

However, when used as a part of a vehicle, there are additional requirements applying to:

- The construction of the vehicle, and
- The completed vehicle once the tank and vehicle have been mated together.

These provisions are discussed in more detail in WG Paper #7 on vehicles for dangerous goods transport.

4 Tank assignment in the current Code

Key points

- The design and construction of tanks used for transport are critical controls in dangerous goods transport.
- The current code focuses on tanks used as a part of a tank vehicle and does not readily provide information for a wide range of transport scenarios.
- The limited information in the current code has resulted in many challenges that need to be managed by the competent authorities using other regulatory tools.
- The ullage requirements for tanks are provided in Part 10 of the current code and are different to those for portable tanks.

4.1 Substances that may be transported in tanks

The current code does not include specific tank instructions other than those for portable tanks. However, section 4.4.2.2 requires that only substances with a portable tank instruction may be transported in a tank vehicle or rail wagon.

This section also references that a competent authority may make a determination permitting particular dangerous goods to be transported in tanks if a portable tank instruction is not allocated.

> 4.4.2.2 Except in accordance with a Competent Authority determination under Regulation 1.5.1(2), dangerous goods must not be transported in a road tank vehicle or rail tank wagon if there is no Portable Tank Instruction allocated to the substance in Column (10) of the Dangerous Goods List in 3.2.3.

4.2 Tanks vs tank vehicles

Under the current code, substances that may be transported in tanks may be transported using a portable tank instruction, or in an approved tank vehicle.

As noted in the supplementary paper (S1) on tank and vehicle terminology, the most common example of a portable tank is an isotainer or isotank, but other designs may conform to this description. However, the current code presumes that any tank that does not form a part of a tank vehicle meets the definition of a portable tank, as no other tanks are provided for.

There have been issues determining compliance for tanks built under the 6th edition of the Code (or earlier), which did not include the UN portable tank provisions, but simply required compliance with one of a range of standards, such as AS 1210 (the pressure vessel standard).

4.3 Choice of tank vehicle

The current code references AS 2809 for tank vehicles, AS 1210 for pressure vessels, AS 2022 for anhydrous ammonia tanks. Additionally, the Competent Authorities Panel (CAP) adopted a number of requirements from the ADR to apply to vacuum waste tankers.

AS 2809 for road tank vehicles

AS 2809 is broken up into 6 parts:

AS 2809 part	What it applies to
Part 1	General requirements applicable to all tank vehicles.
Part 2	Tank vehicles for flammable liquids
Part 3	Tank vehicles for compressed liquefied gases
Part 4	Tank vehicles for corrosives, toxics, and ammonium nitrate
Part 5	Tank vehicles for bitumen-based products
Part 6	Tank vehicles for cryogenic liquids (refrigerated gases)

There are issues with the way AS 2809 is referenced in the current code. It does not mandate compliance with specific parts for specific dangerous goods, though this is achieved by inference from the scope of each part of the standard.

AS 2809 does not cover all materials for which a tank instruction may apply, most notably compressed (though non-liquefied) gases which would typically be transported in a tube vehicle. Sections have been prepared for the most common materials transported by tank vehicle in Australia, though new scenarios do arise from time to time. This requires competent authorities and tank manufacturers to develop bespoke compliance requirements for approval under the alternative compliance criteria provisions of Chapter 6.10 of the code.

Additionally, the marking requirements for the tank compliance plate requires that the assessed standards are noted on the plate, but a designer and/or a competent authority may restrict what substances are permitted to be carried. Without this information on the compliance plate, the risk of an inappropriate substance being filled into a tank is increased. This is particularly an issue for toxic and corrosive substances, where the tank's construction may not be suitable for certain materials. A known example is that sodium hydroxide solution cannot be transported in aluminium tanks, but this is not required to be marked on the tank.

AS 1210 for road tank vehicles

The current code notes that AS 1210 applies to tanks that are also pressure vessels. AS 1210 includes requirements for transportable pressure vessels, though these apply alongside the requirements for road tank vehicles.

No specific information is included in the code to guide tank construction using AS 1210, however the code does require compliance with AS 1210. Additionally, AS 2809 requires compliance with AS 1210 for tanks that are pressure vessels.

AS/NZS 2022 for road tank vehicles

Similar to AS 1210, AS/NZS 2022 includes a section for tanks that will be used for anhydrous ammonia transport. The code requires compliance with AS/NZS 2022 for tanks that will be used for anhydrous ammonia transport.

4.4 Tank use provisions in the current code

The current code only contains limited information on the use of tanks that are not portable tanks. Chapter 4.4 includes information on the transport of dangerous goods in tanks that form a part of a tank vehicle, though these requirements are relatively general in nature, and mostly require compliance with both the requirements of Chapter 6.10 and AS 2809.

Some issues relating to transfer operations are included in Chapter 10.2 of the current code, but these are primarily focused on the activities relating to transfers rather than the use of the tank or vehicle itself.

4.5 Areas where the current code is deficient

The current code focuses on the requirements for tank vehicles, which results in transport scenarios where limited (or no) information is provided. Some of these issues have been discussed by CAP, and when an issue has been identified, it has to be managed by CAP as part of its determination or exemption processes.

While for one-off scenarios this is manageable, it reduces the usefulness of the code. It also impacts transparency, as a user of the code may not be aware that a problem they have has already been solved.

Differentiating between tank use scenarios

The current code primarily focuses on tanks that are used as a part of a tank vehicle. This is understandable however it means that there are tank transport scenarios that are not well-addressed. For example, the current code does not readily provide for multi-modal tanks that do not necessarily fit into the definition of a UN-compliant portable tank. By comparison, the ADR divides these into:

- Demountable tanks, which are not a permanent part of the vehicle, but are only designed to be lifted on or off the vehicle when empty (not a multi-modal tank).
- Tank-containers, which are not a permanent part of the vehicles, but are designed to be lifted on or off a vehicle while containing dangerous goods (a multi-modal tank).

More information on this division is included in the supplementary paper (S1) on tank and vehicle terminology.

Rail tank wagons

No standards are provided for rail tank wagons. The code notes that rail tank wagons need to be acceptable to the authority responsible for rail safety and competent authorities. It also provides a footnote stating: “until a recognised Australian standard or national code of

practice covering the design of rail tank wagons has been published, it is recommended that tank designs comply with standards applicable in North America or Europe."

Vacuum tanks

No additional information is provided on assessing vacuum tanks for dangerous goods. In approximately 2015 CAP agreed that certain sections of the ADR and API Recommended Practice 2219 would be applied to tank design assessments for vacuum tanks, but this has not been formally incorporated into the current code.

Fibre-reinforced plastic tanks

The current code provides no additional provisions or guidance on the use of fibre-reinforced plastics (FRP) in tank construction. From edition 7.8 the FRP chapter for portable tanks in the UN has been adopted, but no equivalent is provided for tanks that are not UN portable tanks.

This means that tank designers and competent authorities are provided limited guidance on the appropriate standards for FRP tank design. With an increasing demand for FRP tanks, this creates a significant workload for industry and competent authorities.

Multiple-element gas containers (MEGCs)

The current code does not address MEGCs that are designed and constructed outside the UN MEGC requirements. In most cases the requirements from the UN are likely suitable, but there may be more niche applications where this is not the case.

Tube-vehicles

Tube-vehicles (where an MEGC forms a permanent part of a vehicle) are completely absent from the current code. However, with the expected rise in demand for compressed hydrogen transport, there is already a significant demand for compliance requirements for these vehicles (and hence the containment systems they use).

Marking of tanks

The current code includes requirements for marking and labelling of tanks approved under the tank vehicle provisions in chapter 6.10. It directs the tank manufacturer to fit a plate containing all the information in the section. However, this information is insufficient in some cases for tank users to determine if a tank is appropriate for transport of a particular material.

Initial inspection and testing

The current code does not mandate an initial inspection by an independent expert, though there are a number of tests (such as an initial hydrostatic test) that need to be carried out as required by AS 2809 or other standards that are referred to.

In-service inspection and testing

This section directs that road tank vehicles must be maintained in accordance with the requirements of AS 2809, and that rail tank wagons are maintained in accordance with the relevant design standard that was used.

The current code does not provide information on who is to carry out this inspection, and the details of what must be inspected is not available to anyone who hasn't purchased a copy of

the standard (though the NSW EPA has published a tank vehicle inspection manual containing some of this information).

Information contained in approvals

The current system is heavily reliant on a number of details being included in the approval documentation, and this content varies across Australia, though CAP has worked to standardise this over time.

However, unlike the ADR, the amount of detail provided in tank design applications is relatively brief, and this has been identified as causing challenges for identifying when a tank or tank vehicle has been modified without additional approval.

Additionally, CAP has become aware of ongoing issues relating to determining whether a vehicle has been modified and whether necessary approvals have been obtained for this.

When standards are valid for design and construction

CAP agreed that standards should generally become obsolete for design and construction 12 months after publication. In edition 7.8 of the current code, this was included as a general requirement. However, this information is less easy to find than the list of dates in the ADR and it does not provide the NTC and competent authorities with a readily available way to modify this where it is appropriate.

Ullage and filling of tank vehicles

The current code includes ullage and filling provisions for tank vehicles in Chapter 10.3, while the equivalent rules for portable tanks are found in Part 4 of the code. There are some quirks and inconsistencies in these provisions:

- Large compartment tanks (in tank vehicles) are defined as being greater than 8,600 L, whereas this value is 7,500 L for portable tanks.
- Large compartment tanks (in tank vehicles) are not permitted for transport with a degree of filling between 15 % and 80 %, whereas for portable tanks this applies between 20 % and 80 %.
- The ullage rules are defined without a filling and reference temperature, which is provided for portable tanks.
  - Defining the ullage based on fill temperature and reference temperate ensures that appropriate ullage remains available if the liquid contents of the tank reach 50°C.
  - Without this information, it is possible for a tank to be filled and then be heated resulting in liquid expansion exceeding the tank's capacity. This is an unsafe situation where loss of containment of the dangerous goods is possible.

Question 1: Are there other tank or bulk solids transport scenarios that you are aware of, where the current code creates issues that can be addressed using information from the ADR (or another source)? Please provide details.

5 Possible changes for the future code

Key points

- The future code will incorporate information from the ADR, while needing to accommodate the existing Australian transport context.
- The design and construction provisions from the ADR may be useful in future as an alternative means of compliance, especially where the current code or standards are silent.
- The inclusion of information from the ADR will need to be carefully considered to ensure safety, while ensuring that changes do not cause an undue burden on industry.

Note: these options are presented for discussion and are not final. The responses to the questions in this paper will be used to develop provisions for consultation. Some of these options require a significant amount of work, and it may be necessary to undertake some of this work after the future code has already been implemented.

5.1 Tank use provisions

Chapter 4.3 of the ADR contains detailed provisions relating to the use of tanks and tank vehicles. It is expected that these provisions will be incorporated into the future code, which will provide additional certainty for tank owners and operators on the requirements for the use of tanks and tank vehicles. Chapter 4.3 also includes detailed information on assigning tank codes and the hierarchy of tanks.

Due to the close relationship between the information in Chapter 4.3 and Chapter 6.8 of ADR, the information in Chapter 4.3 that is included will be contingent on responses to questions below. For example, if ADR tank codes were not adopted into the future code, then this information would not be required in Chapter 4.3.

Question 2: Are there tank use provisions in Chapter 4.3 of the ADR that if adopted would significantly impact your transport operations? Please provide details.

Question 3: Are there FRP tank use provisions in Chapter 4.4 of the ADR that if adopted would significantly impact your transport operations? Please provide details.

Question 4: Are there vacuum tank use provisions in Chapter 4.5 of the ADR that if adopted would significantly impact your transport operations? Please provide details.

5.2 Tank design and construction provisions

In addition to these potential options, section 5.4 below includes options for permitting ADR tanks as an alternative means of compliance. All these options should be compatible with that approach.

Option 1: Fully incorporate ADR Chapters 6.8 - 6.10, while referencing Australian Standards

The relevant chapters from the ADR could be incorporated directly into the future code, with modifications to refer to AS 2809 or other relevant standards.

Many tanks designed for dangerous goods use under the ADR are designed as pressure vessels, so it may be possible to undertake this by referencing AS 1210 for the actual tank design requirements. This would inevitably leave gaps for gravity discharge tanks, which are outside the scope of AS 1210.

Potential issues with this approach would be the problems associated with conflicting information, much of which may not become apparent until someone attempts to design a tank under such a system. There are areas where the Australian Standard and the requirements of the ADR may come into conflict, these would need to be found and dealt with appropriately.

Option 2: Incorporate the general tank design principles from ADR Chapters 6.8 - 6.10, with references to Australian standards

Adopting the general requirements into the future code would ensure that the principles on which tank design is based are included in the regulatory text of the code.

It would also be possible to incorporate some of the general principles from AS 2809 (or other Australian Standards) into the code to ensure that all users of the code are familiar with the basic principles of tank design, without including the technical details of tank design. This would mean that a user of the code could understand why a particular tank design requirement applies, while a tank designer would still need to use the Australian Standard to ensure compliance.

Taking this approach would mean that decisions on general expectations for tank design, construction, inspection and testing processes would be handled within the code maintenance processes. The details of tank design and construction would still be left to technical experts in the Standards Australia technical committee. By adopting the general requirements, it would be relatively straightforward for regulators and industry to incorporate changes from the ADR into the code in future, if deemed appropriate for Australia.

This option will require a significant analysis of the provisions to be undertaken. Decisions would then be required to determine what items should be removed, modified or retained. Nonetheless, future maintenance of the tank design and construction provisions would be significantly easier, and this would facilitate regulators and tank designers to utilise the ADR as an alternative means of compliance if that is considered appropriate.

Option 3: Rewrite the current Chapter 6.9 (edition 7.8) of the code

This would require work to identify what information in the ADR is critical, and what information would need to be brought into the code from AS 2809 or other sources.

Some modifications that would need to be made as a part of this process include:

- more detailed approval requirements
- more detailed inspection and maintenance requirements
- details on tanks constructed of fibre-reinforced plastics
- details on tanks constructed as vacuum tanks.

This option would require significant drafting work to ensure that the provisions are correctly drafted and would also mean that the benefits of ADR alignment would not be realised.

If this option were selected, it may be appropriate to pursue closer alignment to the ADR requirements (as outlined in options 1 or 2) after the review is completed.

Option 4: Continue with the status quo

This would result in the gaps in the existing system continuing, with no benefits derived from the more comprehensive ADR system of tanks, and the separation between tanks and vehicles.

Question 5: Which of these options do you consider the most practicable for the development of the future code? Please explain your reasoning.

5.3 Tanks, vehicles, and completed vehicle requirements

Responses to the paper on approvals of tanks and vehicles are being reviewed at the time of writing. There was general support for treating these separately, while ensuring that the completed vehicle (tank and vehicle together) complies with all the necessary requirements of the code and AS 2809 (as appropriate). However, it is expected that there will be clear requirements that apply to a tank vehicle once the tank and vehicle have been mated together, such as inspection, record keeping and/or approvals relating to these processes.

Further consultation on this paper and the related paper on vehicles for dangerous goods transport (Working Group Paper #7) will be undertaken. These findings will then be consolidated to develop detailed provisions for consultation as they relate to approvals.

5.4 Permitting ADR tanks as an alternative method of compliance

The 6th edition of the Code contained provisions relating to the use of tanks (and other types of packagings) approved to ADR, RID or the IMDG Code to be used in Australia, provided it was manufactured overseas. The 7th edition of the Code dropped these requirements, but similar provisions were incorporated into the model subordinate instrument. It is not clear the extent to which these have been used since the introduction of edition 7, or how this would apply to tanks, as opposed to other types of packagings.

One option for clarifying this situation is to explicitly permit the requirements of ADR or RID as an alternative means of compliance. This way, if a tank design is compliant with the ADR, and properly approved as such, it would be available for use in Australia. This would be particularly advantageous where there is a particular need that cannot be filled using the existing framework of tank design using AS 2809. The level of effort required to develop new sections to AS 2809 is often disproportionate to the benefits, meaning that they are often managed by exemption or determination. Permitting ADR tanks would resolve this issue, providing certainty for both regulators and the transport industry.

Further, the separate (though still related) treatment of tanks and vehicles (as proposed in working group paper #7 on vehicles) will support this outcome. While a tank may be properly approved under either AS 2809 or ADR, the completed vehicle itself would still need to be approved to meet Australian road and transport conditions, in accordance with AS 2809.1.

The much larger scale of chemical transport in ADR countries means that transport scenarios are considered that may only occasionally arise in Australia. With the ADR available as an option, these needs can be more readily met if needed.

An additional consideration is that many ADR tanks are designed as pressure vessels, with reference to EN 14025 *Tanks for the transport of dangerous goods – Metallic pressure tanks – Design and construction*. In part, EN 14025 applies the European pressure vessel standard (EN 13445) to transportable pressure vessels. In Australia, pressure vessels are generally required to meet the requirements of AS/NZS 1200 *Pressure equipment*. Appendix F of AS 1200 notes that EN 13445 has "been extensively used or critically examined and accepted in Australia". Including a statement similar to the following example taken from section 6.7.3.1.1 of the current code, may be useful to prevent inadvertent non-compliance with Australian pressure vessel requirements:

> "This Section must be applied in conjunction with the legislation applicable in the particular State or Territory to pressure vessels. Where there is conflict, the requirements of that legislation and any Codes and Standards mandated by that legislation take precedence over this Section."

Question 6: If ADR tanks are permitted as an alternative means of compliance, do you foresee this being useful for your operation? Please provide details.

Question 7: Is there a reason why ADR tanks should not be permitted as an alternative means of compliance? Please provide your reasoning.

Question 8: If the ADR is permitted as an alternative means of compliance, are there situations where you consider this should be restricted? Please provide your reasoning.

Question 9: With the ADR as an alternative means of compliance, should: (a) the relevant content from the ADR be incorporated into the future code, (b) should reference be made to the ADR and users directed to consult the ADR, or (c) something else? Please provide your reasoning.

Question 10: Do you have any examples where EN 14025 has been accepted as an alternative means of compliance for transportable pressure vessels in Australia?

5.5 Inclusion of information about tanks in the dangerous goods list

What substances are permitted for tank transport

The current code permits transport in tank vehicles if a portable tank instruction is provided. By contrast, the ADR only permits transport in ADR-compliant tanks if an ADR tank code is provided. There are some discrepancies between the assignment. Appendix B includes information on which dangerous goods entries contain these variations.

As with the ADR, it is expected that the future code will provide for tank transport to be permitted when an ADR tank code is available. An option would be to also permit entries with a portable tank special provision (as is currently the case).

Question 11: Are you aware of any dangerous goods currently being transported in tank vehicles that are listed in Appendix B? Please provide details.

Question 12: Should dangerous goods be permitted for transport in a tank vehicle where there is no portable tank instruction? If yes, what additional controls would be appropriate?

Question 13: Should dangerous goods be permitted for transport in a tank vehicle where there is no ADR tank instruction? If yes, what additional controls would be appropriate?

Inclusion of ADR tank codes in the dangerous goods list

The ADR tank codes (in column (12) of the ADR dangerous goods list) could be considered for included in the dangerous goods list. If ADR tanks are permitted as an alternative means of compliance, then including this information would be useful to designers, manufacturers and users of ADR tanks. This would also replace the current system where portable tank codes are used to define when a tank vehicle may be used.

Question 14: Is there a reason why the future code should not include ADR tank codes in the dangerous goods list? Please provide details.

Inclusion of ADR special provisions for tank use in the dangerous goods list (TU codes)

Even if the ADR tank codes in column (12) are not incorporated, the TU codes (found in Chapter 4.3 of ADR) could be considered for inclusion. These codes provide useful information about the conditions that are required during carriage for particular substances. These codes may also provide useful information for the users of tanks designed and constructed under AS 2809.

Question 15: Is there a reason why the future code should not include ADR special provisions for tank use in the dangerous goods list? Please provide details.

Question 16: Are you aware of a current transport scenario where applying the ADR tank use codes (TU) would have a significant impact on the transport? Please provide details.

Inclusion of ADR special provisions for tank design and construction in the dangerous goods list (TC, TE, TA, TT, and TM codes)

These codes relate to the actual construction, equipment, approval, testing and marking of tanks. They are not intended to be read outside of the context of tank design and construction, so would likely not be included if the ADR tank design and construction provisions are not incorporated into the code. The information contained may still be of interest to the designers and builders of tanks using AS 2809.

If ADR tanks are permitted as an alternative means of compliance, these tank design and construction special provisions will certainly be relevant, as they form a part of the ADR system of tank design and construction.

Question 17: Is there a reason why the future code should not include ADR special provisions for tank design and construction in the dangerous goods list?

Question 18: Are you aware of a current transport scenario where requiring compliance with the ADR tank use codes (TU) would have a significant impact? Please provide details.

5.6 Inspection and maintenance of tanks

As noted, the ADR contains much more extensive inspection and maintenance requirements for tanks. These are not likely to create significant challenges, as they align to similar requirements already in place for tank vehicles. An option would be to continue to align the inspection and maintenance to the 2.5 (intermediate) and five-yearly (periodic) inspections found in AS 2809.

A further option would be to adopt a reference to EN 12972 (as in the ADR) to provide additional details on the inspection requirements, though this may need further consultation and development.

Under the current code and AS 2809, there are inspection and maintenance requirements that are specified, generally at 3-month intervals. These are generally focused towards the vehicle as a transport unit, rather than the tank as a containment system, though there are checks to ensure that the tank remains suitable for use.

The ADR includes specific requirements for inspections prior to loading a tank (in section 7.5.1), and duties on the participants to carry these checks out (in the safety obligations of the participants, Chapter 1.4). It is expected that similar requirements will be carried into the future code. The paper on vehicles for dangerous goods transport proposes that these inspection and maintenance requirements would form a part of the vehicle requirements in the future code.

Question 19: Is there a reason why the future code should not incorporate intermediate (2.5 years) and periodic (5 year) inspections for tanks? Please provide details.

6 Ullage for tank vehicles

Key points

- The future code will see the ullage rules moved to Part 4 of the code.
- There are some discrepancies in definitions and how these rules are applied to tank vehicles as compared to portable tanks.
- This section provides information on these discrepancies and presents some options for resolving these differences.

As noted, the ullage requirements for tank vehicles are contained in Part 10 of the current code, rather than Part 4. It is proposed that the ullage rules be moved from Part 10 as part of this review. The incorporation of requirements from Chapter 4.4 of the ADR will achieve this. This is a more appropriate location for this information, as it relates directly to the use and filling of packagings for transport.

Question 20: Is there a reason why the ullage rules for tank vehicles should not be moved to Part 4 of the future code? Please explain your reasoning.

However, in addition to the location of the ullage requirements, there are three notable discrepancies between the ADR and the code that will need to be considered.

6.1 Definition of a large compartment tank

The ADR uses a large compartment definition of 7,500 L (aligned to portable tanks), while the current code uses the AS 2809 definition of 8,600 L. Many tank vehicles in Australia are designed with a maximum compartment capacity of 8,600 L This would mean that changing the large compartment threshold in Australia (to 7,500 L) would have a significant impact on the transport industry. Two options are available for mitigating this impact:

Option 1: Permit tanks built to the existing threshold of 8,600 L to continue to use that threshold, and require tanks constructed in future to comply with a threshold value of 7,500 L.

Option 2: Continue the existing threshold of 8,600 L in the future code.

Question 21: Which of the two options for the large compartment threshold do you support? Please explain your reasoning.

6.2 Large compartment ullage rule

Both the ADR and the current code restrict the transport of liquids in tank vehicles with a large compartment, when the large compartment is partially full. However, while the ADR uses the same thresholds for portable tanks and tank vehicles, the code uses different thresholds for portable tanks and tank vehicles.

For both portable tanks and tank vehicles in the ADR and for portable tanks in the code, the degree of filling (in the large compartment) must be less than 20%, or more than 80%. By contrast, in the code, the degree of filling must be less than 15%, or more than 80%. This figure is also presented as an ullage figure of more than 20% or less than 85%. In an 8600 L tank, this would represent an additional 430 L (from 15% to 20%) before the ullage rule restricted transport. It is not readily apparent where this difference comes from.

This paper proposes that the future code present this using “degree of filling”, however it needs to be determined if the value should stay the same.

Option 1: Align the thresholds to the ADR and portable tank values of 20% and 80%.

Option 2: Continue to use the current code values of 15% and 80%.

Question 22: Which of the two options for the large compartment restrictions do you support? Please explain your reasoning.

6.3 Lack of a reference temperature for ullage

The current code sets the ullage value based on the thermal expansion of the liquid but does not define a reference temperature for this. This can result in an unsafe situation where heating of a tank may result in the ullage space being filled by an expanding liquid, potentially leading to loss of containment.

By comparison, the ADR provides for a maximum degree of filling to be observed depending on the type of dangerous goods being transported, and whether the tank is fitted with a breather device or is hermetically closed. While similar to the method already in use in Australia and ADR countries for portable tanks, it provides additional capacity for some liquids, at the cost of additional complexity. For comparison, AS 1940:2017 sets a maximum filling level of 95%.

The table below summarises the differences in how ullage is calculated between ADR tanks and portable tanks.

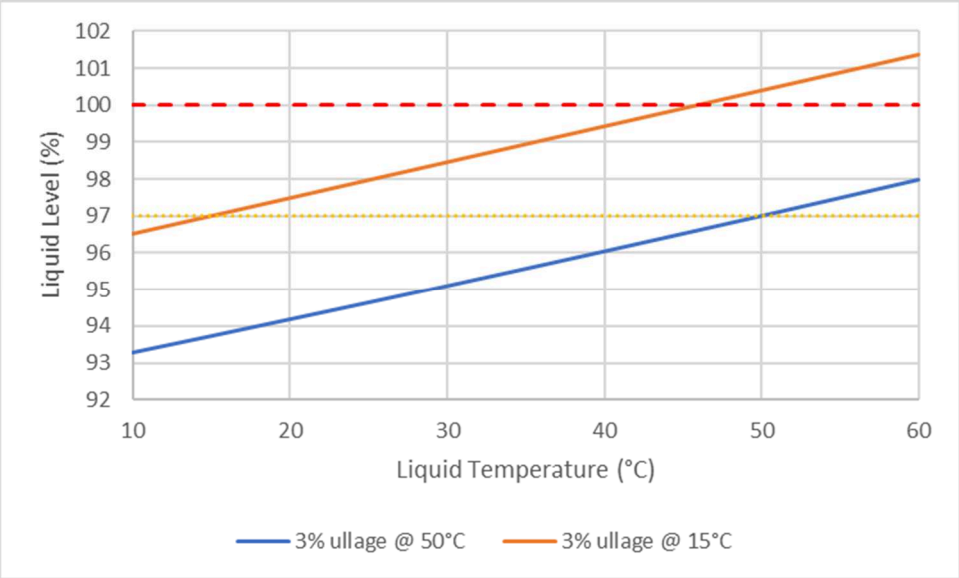
Formula for maximum degree of filling	ADR Tanks	Portable Tanks (both ADR and current code)
$\frac{100}{1 + \alpha(50 - t_F)}$ % of capacity	Classes 3, 4 & 9, without sub-hazards, in tanks with a breather device	N/A
$\frac{98}{1 + \alpha(50 - t_F)}$ % of capacity	Division 6.1, class 8, in tanks with a breather device	N/A
$\frac{97}{1 + \alpha(50 - t_F)}$ % of capacity	Classes 3, 4, Division 6.1 PG III, 8 PG III & 9 in hermetically sealed tanks	General requirement for liquids where no other situation applies

$\frac{95}{1 + \alpha(50 - t_F)}$% of capacity	Division 6.1 PG I & II, Class 8 PG I & II in hermetically sealed tanks	Class 6.1 and Class 8, in packing groups I and II, and all liquids with an absolute vapour pressure of more than 175 kPa (1.75 bar) at 65°C

Table Notes:

1. For both portable tanks and ADR tanks, some dangerous goods have additional restrictions based on special provisions, these take precedence.
2. the definition of when provisions apply has been simplified in this table to ease presentation.
3. α is the thermal expansion coefficient for the liquid from 15 to 50°C.
4. t_F is the temperature of the liquid when the tank liquid is filled.

To illustrate this issue, a petrol tank filled to 97% of maximum capacity at 15°C will exceed 100% capacity at approximately 45°C. However, this will also result in a small loss of capacity if tanks are mandated to have 3% ullage at 50°C. The figure below shows the liquid level in a tank filled with petrol to 3% ullage at 50°C, versus one filled to 3% ullage at 15°C. However, the likelihood of a filled tank being subjected to such heating may be low.



Note: this figure uses a thermal expansion coefficient of 0.001 K^{-1}.

Two options are presented to address this issue:

Option 1: Align the future code to the ADR ullage values, which are more complex but provide additional capacity in certain circumstances.

Option 2: Align the future code to the portable tank ullage values, which are simpler and may be more readily understood by users.

Question 23: Which of the two options for the ullage value options do you support? Please explain your reasoning.

Question 24: Are there alternative options for addressing this problem? Please provide details.

7 Transport of solids in bulk containers

Key points

- Bulk containers are treated very similarly in the ADR and the current code.
- The ADR includes some additional information that is not contained in the current code, this chapter explores these small differences, noting that the impacts are likely to be relatively small.

7.1 Bulk containers in ADR

Chapter 7.3 of the ADR includes the requirements relating to the use of bulk containers. Dangerous goods that are permitted to be transported in bulk containers in the ADR are assigned one of 3 codes (VC1, VC2 or VC3), corresponding to BK1, BK2 and BK3 containers respectively.

Most of these entries are modified with an AP Code, which modifies the requirements for the bulk containers that are used. These are in addition to the requirements included in Chapter 4.3. For example:

AP1	Vehicles and containers shall have a metal body and where fitted the sheet shall be non-combustible.

This chapter also includes all information relating to the filling and handling of bulk containers.

Chapter 6.11 of the ADR contains the construction requirements relating to the construction of bulk containers and are equivalent to the requirements of Chapter 6.8 of the current code.

7.2 Bulk containers in the current code

The current code only provides BK1, BK2 and BK3 codes for dangerous goods that are permitted to be transported in bulk containers. The information on bulk containers found in Chapter 7.3 of the ADR is not included.

Chapter 4.4 of the current code includes information on requirements for vehicles transporting bulk containers, but this section does not include requirements specific to the dangerous goods, as found in Chapter 7.3 of the ADR.

Chapter 6.8 of the current code provides for the construction requirements for bulk containers. Note that these correspond to the requirements in Chapter 6.11 of the ADR

7.3 Bulk containers in the future code

It is expected that the bulk container provisions from the ADR will be adopted into the future code.

As for transport in tanks, it is expected that a completed vehicle that includes a bulk container will need to meet the completed vehicle requirements outlined in the working group paper on vehicles for dangerous goods transport (paper #7).

Question 25: Are you aware of any transport that occurs in bulk containers that will be significantly impacted by incorporating the requirements from the ADR into the future code? Please provide details of these impacts.

8 Next steps

Detailed tank use and construction provisions, based on Chapter 4.3, 4.4 and 4.5 of the ADR will be developed, taking into consideration comments received in response to this paper. These will be modified as appropriate to reflect the Australian transport context.

It is likely (though not certain) that responses to all tank and vehicle papers will be compiled and used to develop a comprehensive set of tank and vehicle provisions for consultation.

Appendix A Tank codes in ADR

ADR's tank codes are constructed in four parts (for example L4BN) and defines the tank's construction with the following parameters. Note the table below consolidates the tank codes for gases, liquids and solids, and is provided as a summary only. Not all code permutations are valid.

Code part	Description	Possible code entry and meaning
1	Type of tank, tube-vehicle or MEGC	L = tank for liquids S = tank for solids C = tank, tube-vehicle or MEGC for compressed gases P = tank, tube-vehicle or MEGC for liquefied gases or dissolved gases R = tank for refrigerated liquefied gases
2	Calculation pressure	G = gravity discharge tank – no pressure vessel calculation # = minimum calculation pressure in bar
3	Openings	A = tank with bottom-filling or discharge openings with 2 closures B = tank, tube-vehicle or MEGC for with bottom-filling or discharge openings with 3 closures, or for compressed gases C = tank with top-filling and discharge openings with only cleaning openings below the surface of the liquid D = tank, tube-vehicle or MEGC with top-filling and discharge openings with no openings below the surface of the liquid
4	Safety valves & devices	V = tank with a breather device, but no device protecting against the propagation of a flame; or non-explosion pressure shock resistant tank F = tank with a breather device, fitted with a device protecting against the propagation of a flame; or explosion pressure shock resistant tank N = tank without a breather device or safety valve and not hermetically closed H = hermetically closed tank (defined in ADR section 1.2.1)

Note: hermetically closed tanks are tanks that have no connection to the atmosphere in normal service. Where fitted with safety devices or valves, these generally require a burst disc to ensure that they only operate in emergency situations.

The use of a particular tank for a particular substance may be further modified by a tank use provision included in the dangerous goods list. Note that the actual codes and their use is beyond the scope of this paper.

The ADR provides a rationalised approach for when substances should be assigned to a particular tank code. This is based on the characteristics of the substance, including the class (or division), packing group and classification code.

Hierarchy of codes

The ADR also provides a clear hierarchy of tank codes for solids and liquids, where a tank with a particular code may also be used for a substance requiring a less restrictive code.

Certain codes have “(+)” appended to the code. Substances with these codes indicate it must be transported in tanks dedicated to the transport of the substance, unless specifically permitted by the tank approval. It does not prohibit the use of a code that is higher in the hierarchy.

Code part	**Least restrictive → most restrictive**
Part 1: Types of tanks	S → L
Part 2: Calculation pressure	G → 1.5 → 2.65 → 4 → 10 → 15 → 21 bar (or increasing calculation pressure for gases)
Part 3: Openings	A → B → C → D
Part 4: Safety valves/devices	V → F → N → H

ADR tank special provisions

The ADR provides special provisions for the design, construction and use of tanks. TU codes are found in Chapter 4.3 of ADR, while the other codes are found in Chapter 6.8.

Code type	**Effect of these codes**
TU	Special requirements that reflect issues relating to the transport of particular dangerous goods in tanks. They are generally matters that need to be considered by the operator and users of tanks.
TC	Special construction requirements when constructing a tank, such as material specification that applies to particular dangerous goods.
TE	Certain dangerous goods need to have items of equipment specific to the dangerous goods, for example to prevent risks from the service or structural equipment.
TA	Tanks used for some dangerous goods may need to be subject to particular approval requirements.
TT	Special testing requirements for tanks that are used to transport certain dangerous goods
TM	Marking requirements for tanks used for some dangerous goods.

Appendix B Variation between portable tank and ADR tank code assignment

Note: this appendix does not include dangerous goods with no tank instructions, or with both portable tank and ADR tank instructions.

Substances with a portable tank instruction, but no ADR tank instruction

UN No.	Name and description	Portable tanks instruction
ADR Column (1)	ADR Column (2)	ADR Column (10)
0332	EXPLOSIVE, BLASTING, TYPE E (AGENT, BLASTING, TYPE E)	T1
1040	ETHYLENE OXIDE	(M)
1363	COPRA	BK2
1373	FIBRES or FABRICS, ANIMAL or VEGETABLE or SYNTHETIC, N.O.S. with oil	T1
1374	FISH MEAL (FISH SCRAP), UNSTABILIZED	T3
1383	PYROPHORIC METAL, N.O.S. or PYROPHORIC ALLOY, N.O.S.	T21
1386	SEED CAKE with more than 1.5 % oil and not more than 11 % moisture	BK2
1442	AMMONIUM PERCHLORATE	T3
1741	BORON TRICHLORIDE	(M)
1854	BARIUM ALLOYS, PYROPHORIC	T21
2008	ZIRCONIUM POWDER, DRY	T21
2192	GERMANE	(M)
2217	SEED CAKE with not more than 1.5 % oil and not more than 11 % moisture	BK2
2534	METHYLCHLOROSILANE	(M)
2793	FERROUS METAL BORINGS, SHAVINGS, TURNINGS or CUTTINGS in a form liable to self-heating	BK2
2814	INFECTIOUS SUBSTANCE, AFFECTING HUMANS (animal material only)	BK1 BK2
2881	METAL CATALYST, DRY	T21
2900	INFECTIOUS SUBSTANCE, AFFECTING ANIMALS only (animal material only)	BK1 BK2
2930	TOXIC SOLID, FLAMMABLE, ORGANIC, N.O.S.	T6
3175	SOLIDS or mixtures of solids (such as preparations and wastes) CONTAINING FLAMMABLE LIQUID, N.O.S. having a flash-point up to 60 °C	T3 BK1 BK2
3200	PYROPHORIC SOLID, INORGANIC, N.O.S.	T21
3229	SELF-REACTIVE LIQUID TYPE F	T23
3230	SELF-REACTIVE SOLID TYPE F	T23
3239	SELF-REACTIVE LIQUID TYPE F, TEMPERATURE CONTROLLED	T23
3240	SELF-REACTIVE SOLID TYPE F, TEMPERATURE CONTROLLED	T23
3242	AZODICARBONAMIDE	T3
3254	TRIBUTYLPHOSPHANE	T21

Substances with an ADR tank instruction, but no portable tank instruction

UN No.	Name and description	ADR tank instruction
ADR Column (1)	ADR Column (2)	ADR Column (12)
1001	ACETYLENE, DISSOLVED	PxBN(M)
1076	PHOSGENE	P22DH(M)
1194	ETHYL NITRITE SOLUTION	L10CH
1259	NICKEL CARBONYL	L15CH
1308 (PG I)	ZIRCONIUM SUSPENDED IN A FLAMMABLE LIQUID	L4BN
1308 (PG II)	ZIRCONIUM SUSPENDED IN A FLAMMABLE LIQUID (vapour pressure at 50 °C more than 110 kPa)	L1.5BN
1308 (PG II)	ZIRCONIUM SUSPENDED IN A FLAMMABLE LIQUID (vapour pressure at 50 °C not more than 110 kPa)	LGBF
1308 (PG III)	ZIRCONIUM SUSPENDED IN A FLAMMABLE LIQUID	LGBF

UN No.	Name and description	ADR tank instruction
ADR Column (1)	ADR Column (2)	ADR Column (12)
1380	PENTABORANE	L21DH
1389	ALKALI METAL AMALGAM, LIQUID	L10BN(+)
1391	ALKALI METAL DISPERSION or ALKALINE EARTH METAL DISPERSION	L10BN(+)
1392	ALKALINE EARTH METAL AMALGAM, LIQUID	L10BN(+)
1407	CAESIUM	L10CH(+)
1420	POTASSIUM METAL ALLOYS, LIQUID	L10BN(+)
1421	ALKALI METAL ALLOY, LIQUID, N.O.S.	L10BN(+)
1423	RUBIDIUM	L10CH(+)
1471	LITHIUM HYPOCHLORITE, DRY or LITHIUM HYPOCHLORITE MIXTURE	SGAN
1510	TETRANITROMETHANE	L10CH
1583 (PG I)	CHLOROPICRIN MIXTURE, N.O.S.	L10CH
1583 (PG II)	CHLOROPICRIN MIXTURE, N.O.S.	L4BH
1583 (PG III)	CHLOROPICRIN MIXTURE, N.O.S.	L4BH
1602 (PG I)	DYE, LIQUID, TOXIC, N.O.S. or DYE INTERMEDIATE, LIQUID, TOXIC, N.O.S.	L10CH
1602 (PG II)	DYE, LIQUID, TOXIC, N.O.S. or DYE INTERMEDIATE, LIQUID, TOXIC, N.O.S.	L4BH
1602 (PG III)	DYE, LIQUID, TOXIC, N.O.S. or DYE INTERMEDIATE, LIQUID, TOXIC, N.O.S.	L4BH
1654	NICOTINE	L4BH
1656 (PG II)	NICOTINE HYDROCHLORIDE, LIQUID or SOLUTION	L4BH
1656 (PG III)	NICOTINE HYDROCHLORIDE, LIQUID or SOLUTION	L4BH
1693 (PG I)	TEAR GAS SUBSTANCE, LIQUID, N.O.S.	L10CH
1693 (PG II)	TEAR GAS SUBSTANCE, LIQUID, N.O.S.	L4BH
1699	DIPHENYLCHLORO-ARSINE, LIQUID	L10CH
1748 (PG II)	CALCIUM HYPOCHLORITE, DRY or CALCIUM HYPOCHLORITE MIXTURE, DRY with more than 39 % available chlorine (8.8 % available oxygen)	SGAN
1748 (PG III)	CALCIUM HYPOCHLORITE, DRY or CALCIUM HYPOCHLORITE MIXTURE, DRY with more than 39 % available chlorine (8.8 % available oxygen)	SGAV
1851 (PG II)	MEDICINE, LIQUID, TOXIC, N.O.S.	L4BH
1851 (PG III)	MEDICINE, LIQUID, TOXIC, N.O.S.	L4BH
1903 (PG I)	DISINFECTANT, LIQUID, CORROSIVE, N.O.S.	L10BH
1903 (PG II)	DISINFECTANT, LIQUID, CORROSIVE, N.O.S.	L4BN
1903 (PG III)	DISINFECTANT, LIQUID, CORROSIVE, N.O.S.	L4BN
1928	METHYL MAGNESIUM BROMIDE IN ETHYL ETHER	L10DH
2024 (PG I)	MERCURY COMPOUND, LIQUID, N.O.S.	L10CH
2024 (PG II)	MERCURY COMPOUND, LIQUID, N.O.S.	L4BH
2024 (PG III)	MERCURY COMPOUND, LIQUID, N.O.S.	L4BH
2208	CALCIUM HYPOCHLORITE MIXTURE, DRY with more than 10 % but not more than 39 % available chlorine	SGAN
2236	3-CHLORO-4-METHYLPHENYL ISOCYANATE, LIQUID	L4BH
2495	IODINE PENTAFLUORIDE	L10DH
2609	TRIALLYL BORATE	L4BH
2648	1,2-DIBROMOBUTAN-3-ONE	L4BH
2742	CHLOROFORMATES, TOXIC, CORROSIVE, FLAMMABLE, N.O.S.	L4BH
2809	MERCURY	L4BN
2880 (PG II)	CALCIUM HYPOCHLORITE, HYDRATED, or CALCIUM HYPOCHLORITE, HYDRATED MIXTURE, with not less than 5.5 % but not more than 16 % water	SGAN
2880 (PG III)	CALCIUM HYPOCHLORITE, HYDRATED, or CALCIUM HYPOCHLORITE, HYDRATED MIXTURE, with not less than 5.5 % but not more than 16 % water	SGAV
2904	CHLOROPHENOLATES, LIQUID or PHENOLATES, LIQUID	L4BN
2942	2-TRIFLUOROMETHYL-ANILINE	L4BH
3093 (PG I)	CORROSIVE LIQUID, OXIDIZING, N.O.S.	L10BH
3093 (PG II)	CORROSIVE LIQUID, OXIDIZING, N.O.S.	L4BN
3094 (PG I)	CORROSIVE LIQUID, WATER-REACTIVE, N.O.S.	L10BH
3094 (PG II)	CORROSIVE LIQUID, WATER-REACTIVE, N.O.S.	L4BN
3122 (PG I)	TOXIC LIQUID, OXIDIZING, N.O.S.	L10CH

UN No.	Name and description	ADR tank instruction
ADR Column (1)	ADR Column (2)	ADR Column (12)
3122 (PG II)	TOXIC LIQUID, OXIDIZING, N.O.S.	L4BH
3123 (PG I)	TOXIC LIQUID, WATER-REACTIVE, N.O.S.	L10CH
3123 (PG II)	TOXIC LIQUID, WATER-REACTIVE, N.O.S.	L4BH
3130 (PG I)	WATER-REACTIVE LIQUID, TOXIC, N.O.S.	L10DH
3130 (PG II)	WATER-REACTIVE LIQUID, TOXIC, N.O.S.	L4DH
3130 (PG III)	WATER-REACTIVE LIQUID, TOXIC, N.O.S.	L4DH
3140 (PG I)	ALKALOIDS, LIQUID, N.O.S. or ALKALOID SALTS, LIQUID, N.O.S.	L10CH
3140 (PG II)	ALKALOIDS, LIQUID, N.O.S. or ALKALOID SALTS, LIQUID, N.O.S.	L4BH
3140 (PG III)	ALKALOIDS, LIQUID, N.O.S. or ALKALOID SALTS, LIQUID, N.O.S.	L4BH
3141	ANTIMONY COMPOUND, INORGANIC, LIQUID, N.O.S.	L4BH
3142 (PG I)	DISINFECTANT, LIQUID, TOXIC, N.O.S.	L10CH
3142 (PG II)	DISINFECTANT, LIQUID, TOXIC, N.O.S.	L4BH
3142 (PG III)	DISINFECTANT, LIQUID, TOXIC, N.O.S.	L4BH
3144 (PG I)	NICOTINE COMPOUND, LIQUID, N.O.S. or NICOTINE PREPARATION, LIQUID, N.O.S.	L10CH
3144 (PG II)	NICOTINE COMPOUND, LIQUID, N.O.S. or NICOTINE PREPARATION, LIQUID, N.O.S.	L4BH
3144 (PG III)	NICOTINE COMPOUND, LIQUID, N.O.S. or NICOTINE PREPARATION, LIQUID, N.O.S.	L4BH
3151	POLYHALOGENATED BIPHENYLS, LIQUID or HALOGENATED MONOMETHYLDIPHENYLMETHANES, LIQUID or POLYHALOGENATED TERPHENYLS, LIQUID	L4BH
3172 (PG I)	TOXINS, EXTRACTED FROM LIVING SOURCES, LIQUID, N.O.S.	L10CH
3172 (PG II)	TOXINS, EXTRACTED FROM LIVING SOURCES, LIQUID, N.O.S.	L4BH
3172 (PG III)	TOXINS, EXTRACTED FROM LIVING SOURCES, LIQUID, N.O.S.	L4BH
3183 (PG II)	SELF-HEATING LIQUID, ORGANIC, N.O.S.	L4DH
3183 (PG III)	SELF-HEATING LIQUID, ORGANIC, N.O.S.	L4DH
3184 (PG II)	SELF-HEATING LIQUID, TOXIC, ORGANIC, N.O.S.	L4DH
3184 (PG III)	SELF-HEATING LIQUID, TOXIC, ORGANIC, N.O.S.	L4DH
3185 (PG II)	SELF-HEATING LIQUID, CORROSIVE, ORGANIC, N.O.S.	L4DH
3185 (PG III)	SELF-HEATING LIQUID, CORROSIVE, ORGANIC, N.O.S.	L4DH
3186 (PG II)	SELF-HEATING LIQUID, INORGANIC, N.O.S.	L4DH
3186 (PG III)	SELF-HEATING LIQUID, INORGANIC, N.O.S.	L4DH
3187 (PG II)	SELF-HEATING LIQUID, TOXIC, INORGANIC, N.O.S.	L4DH
3187 (PG III)	SELF-HEATING LIQUID, TOXIC, INORGANIC, N.O.S.	L4DH
3188 (PG II)	SELF-HEATING LIQUID, CORROSIVE, INORGANIC, N.O.S.	L4DH
3188 (PG III)	SELF-HEATING LIQUID, CORROSIVE, INORGANIC, N.O.S.	L4DH
3194	PYROPHORIC LIQUID, INORGANIC, N.O.S.	L21DH
3248 (PG II)	MEDICINE, LIQUID, FLAMMABLE, TOXIC, N.O.S.	L4BH
3248 (PG III)	MEDICINE, LIQUID, FLAMMABLE, TOXIC, N.O.S.	L4BH
3274	ALCOHOLATES SOLUTION, N.O.S., in alcohol	L4BH
3301 (PG I)	CORROSIVE LIQUID, SELF-HEATING, N.O.S.	L10BH
3301 (PG II)	CORROSIVE LIQUID, SELF-HEATING, N.O.S.	L4BN
3482	ALKALI METAL DISPERSION, FLAMMABLE or ALKALINE EARTH METAL DISPERSION, FLAMMABLE	L10BN (+)
3485	CALCIUM HYPOCHLORITE, DRY, CORROSIVE or CALCIUM HYPOCHLORITE MIXTURE, DRY, CORROSIVE with more than 39 % available chlorine (8.8 % available oxygen)	SGAN
3486	CALCIUM HYPOCHLORITE MIXTURE, DRY, CORROSIVE with more than 10 % but not more than 39 % available chlorine	SGAN
3487 (PG II)	CALCIUM HYPOCHLORITE, HYDRATED, CORROSIVE or CALCIUM HYPOCHLORITE, HYDRATED MIXTURE, CORROSIVE with not less than 5.5 % but not more than 16 % water	SGAN

UN No.	Name and description	ADR tank instruction
ADR Column (1)	**ADR Column (2)**	**ADR Column (12)**
3487 (PG III)	CALCIUM HYPOCHLORITE, HYDRATED, CORROSIVE or CALCIUM HYPOCHLORITE, HYDRATED MIXTURE, CORROSIVE with not less than 5.5 % but not more than 16 % water	SGAN

Glossary

See the supplementary paper (S1) on tank and vehicle terminology for detailed discussion of terms relating to tanks, bulk containers and vehicles.

Term	Definition
the Code	Refers to the Australian Code for the Transport of Dangerous Goods by Road & Rail – np specific edition
current code	Refers to edition of 7.8 of the code
future code	Refers to the revised code
ADR	Agreement concerning the International Carriage of Dangerous goods by Road
CAP	The Competent Authorities Panel
RID	Agreement concerning International Carriage of Dangerous Goods by Rail
UN MR	United Nations Model Regulations on the Transport of Dangerous Goods

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