# Mixed Class Dangerous Goods Storage and Handling

**Frank Mendham MAIDGC**
**AECOM**
**15th September, 2009**

**Abstract**
The stated purpose of AS/NZS 3833:2007[1] is to provide minimum acceptable safety requirements for installations where more than one class of dangerous goods is stored and handled, whether in packages or intermediate bulk containers (IBCs) of up to 1.6 $m^3$ capacity.

AS/NZS 3833 addresses the storage and handling of mixed classes of dangerous goods of Classes and Divisions 1.4S (as consumer commodities), 2 (as consumer commodities or aerosols of UN 1950), 3, 4.1, 4.3, 5.1, 5.2, 6.1, 8 and 9, and combustible liquids when stored with the dangerous goods, in packages and IBCs as described above.

The application of AS/NZS 3833 is particularly suited to Regional Distribution Centres. This paper addresses opportunities and challenges that result from the application of AS/NZS 3833 to RDCs.

**Introduction**
The purpose of this paper is to inform the fellow membership of the 'Australasian Institute of Dangerous Goods Consultants' (AIDGC) and others, of options available for the design of Regional Distribution Centres (RDCs) using a 'Mixed Class Dangerous Goods' storage and handling approach applying AS/NZS 3833:2007 'The storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers'.

A study was carried out exploring the appropriateness of dangerous goods storage and handling schemes for existing and proposed Regional Distribution Centres (RDCs). This paper summarises AS/NZS 3833 in its effectiveness to meet this purpose. Examples are drawn from three (3) retail RDCs in Australia where AS/NZS 3833 has been applied. Two of these RDCs store consumable household commodities, whilst the third RDC stores automotive products in retail packages.

This study has shown that AS/NZS 3833 has not been widely applied to large RDCs, so the following questions were considered in this study:-

1. Is the level of risk acceptable for the storage in large quantities of dangerous goods of mixed classes contained in small volume consumable retail packages within the general storage area of a modern RDC?
2. Where a separate dangerous goods Package Store is considered necessary, but not required by law, does a design to AS/NZS 3833:2007 represent increased risk compared with a more traditional flammable liquids package store design to AS1940 'The storage and handling of flammable and combustible liquids'[2]?

**RDCs storing consumable household commodities**
Due to the proposed expansion of an existing RDC in WA, which was used for the storage of consumable household goods, the attached dangerous goods Package Store of the first example RDC was to be demolished and rebuilt in a new location on site to allow for the RDC expansion. The question of whether it was appropriate to rebuild the new dangerous goods Package Store to the same design as the existing Package Store, but in the new location, was addressed. The study assessed compliance of the existing dangerous goods Package Store design against the range of Standards applicable to the classes of dangerous goods stored. In addition, it addressed the compliance of the handling of dangerous goods in the Package Store and the compliance of the Package Store with respect to Building and Dangerous Goods legislation.

The study indicated that the traditional approach to dangerous goods storage design for RDCs and other large retail facilities, involved the application of multiple individual dangerous

goods Standards. The specific Standards used depended on the range of dangerous goods classes stored. The most common outcome of applying this approach was RDCs constructed with adjoining flammable liquids (Class 3) Package Stores designed to AS1940. It is understood that the motivation for this approach is the requirement in some States of Australia for Flammable and Combustible Liquids Licensing, which specifically reference AS1940.

Many existing installations use the attached Class 3 Package Stores to store Class 3 and Combustible liquids and dangerous goods of various other classes. This storage scheme is inconsistent with the intent of AS1940. Prescribed segregation requirements for the separation of incompatible dangerous goods are not readily achieved using an AS1940 designed flammable liquids Package Store.

The proposed use of the new Dangerous Goods Package Store was to store a wide range of dangerous goods in retail packages, so AS/NZS 3833:2007 was considered a more appropriate alternative to AS1940 as it is a relatively new Standard that considers 'consumer commodities' in various ways and under various storage scenarios. Significantly, it incorporates recent changes to AS 1940:2004.

AS/NZS 3833 applies a maximum storage quantity for dangerous goods stored in retail packages for Retail Stores. When the prescribed storage amount is exceeded, it mandates that a Package Store must be constructed; however this requirement is only applicable for Retail Stores and not RDCs. Under these circumstances a dangerous goods Package Store is not required for an RDC, in accordance with AS/NZS 3833.

The key cost benefits of applying AS/NZS 3833 to the replacement of the existing Dangerous Goods Package Store were:-

a) AS/NZS 3833 conditionally does not require the construction of a dedicated mixed class Dangerous Goods Package Store to store dangerous goods, as the dangerous goods may be held within the Distribution Centre warehouse.
b) If a mixed class Dangerous Goods Package Store is required[1], AS/NZS 3833 is conditionally less onerous than the more traditional Package Store design using AS1940:2004.

The implementation of AS/NZS 3833 requires a written hazard analysis, which identifies the dangerous goods stored and undertakes a 'clause by clause' assessment of the relevant AS/NZS 3833 requirements. It was found that more detailed analytical and numerical modelling was required to address two significant aspects of the storage and handling approach.[2] The two hazards, the methods of analysis the outcomes include:-

i. Understanding the development and spread of potentially explosive or toxic vapour, gas or dust from individual dangerous goods class releases, which was assessed using a detailed analytical hazardous area analysis/classification combined with Computational Fluid Dynamics (CFD) modelling;

Outcome: The results of this analysis showed that releases of flammable liquids representing the most significant risk products, as identified in conjunction with the user group, had minimal impact on the development of hazardous zones within a mechanically ventilated RDC dangerous goods Package Store or even within the RDC main storage area. The resultant hazardous area classification was Zone 2 of Negligible Extent, allowing the use of 'standard' forklifts and electronic 'picking equipment'.

ii. Incompatible dangerous goods/packing groups coming into contact with each other, resulting in a toxic release, fire or explosion. This analysis involved both experimentation and analytical analysis.

[1] This RDC required a Dangerous Goods Package Store for insurance purposes.
[2] The hazards listed were residual, following an analysis that addressed most issues using a prescriptive compliance approach. Potential flammable atmosphere and spill control required to be assessed using more robust analytical and numerical methods.

Outcome: The results of this analysis indicated that the separation distances detailed in AS/NZS 3833 should be observed, however strategically located and separated open grille drains aligned with the front edge of racking, combined with floor surfaces sloping towards the drains would provide adequate separation of spilled incompatible compounds, eliminating the need for segregation bunding within the Package Store.

In the second RDC example involving household retail consumable storage, a dangerous goods storage strategy based on AS/NZS 3833 was implemented resulting in a cost effective and fully compliant RDC. This RDC also included a dangerous goods Package Store based on AS/NZS 3833 for insurance reasons only.

**RDC storing consumable automotive retail cleaning products**

The third example RDC was designed based on AS/NZS 3833 for the storage and handling of the large quantity of retail packages involving a range of dangerous goods classes. The design intent of this RDC was to use the RDC main area only for the storage and handling of all dangerous goods without the construction of a dedicated dangerous goods Package Store.

Products were delivered into the warehouse in large SKUs and broken down into smaller lots for distribution to retail outlets using a semi-automated process. This is a primary function of an RDC.

The AS/NZS 3833 hazard assessment was carried out and in this case, also identified the need to more deeply analyse the potential for flammable vapour to form as a result of small retail package releases and the fire risk potential of incompatible dangerous goods classes coming into contact with each other.

## Conclusion

Large RDCs have been traditionally designed on the concept of storing the dangerous goods retail packages outside the main RDC storage area in separate dangerous goods Package Stores. The accepted basis for Package Store design is AS1940, which is particularly suited to Class 3 and Combustible liquids storage, but less suited to storage of dangerous goods in mixed classes.

AS/NZS 3833 approaches mixed class dangerous goods storage and handling in a holistic way and excludes potentially high risk dangerous goods class combinations from its scope.

The risk of incompatible combinations within the range of dangerous goods classes included in the AS/NZS 3833 scope is managed using separation and segregation. The vast floor space and shelving arrangements within RDCs offers the ability to provide adequate separation of incompatible dangerous goods within the general RDC storage area, without the need for dedicated dangerous goods Package Stores.

This study recommends careful consideration of potentially flammable/explosive atmosphere be undertaken using rigorous analysis for all RDC designs where AS/NZS 3833 is proposed as the dangerous goods design basis, as it considers.

## References


1. AS/NZS 3833:2007 ‘The storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers’, 2006, SAI Global, Homebush NSW
2. AS1940:2004 ‘The storage and handling of flammable and combustible liquids’