

Memorandum

To	Adrian Thompson - CBRE
Date	21 November 2022
Copies	
Reference number	283754-05
From	Nigel Cann
File reference	MEM/05/01/NKC
Subject	TAM Building Dangerous Goods Design Considerations

1. Introduction

The Total Asset Management (TAM) building at Nepean Hospital is being rebuilt as part of the wider changes and upgrades at the hospital. An assessment has been made of the requirements for dangerous goods (DGs) storage in each of the compartments for the separate trades. The assessment assumes the following:

- The building will be a multi-compartment building with separated rooms for each trade like the existing set-up.
- That the layout and proposed fire services are as per drawing NHR-STH-DRW-ARC-TAM-20-101 Rev A
- That a quantity of each chemical slightly higher than the inventories present on my site visit on 6 April 2022 the expected maximum inventories in the new facility for each trade, unless it is prudent to restrict the quantities in a given situation to simplify the design, which will be noted as required.
- That the new design is to meet the requirements of the following relevant Australian Standards:
 - AS 1940 *The storage and handling of flammable and combustible liquids*
 - AS/NZS 1596 *The storage and handling of LP Gas*
 - AS 3780 *The storage and handling of corrosive substances*
 - AS/NZS 3833 *The storage and handling of mixed classes of dangerous goods, in packages and intermediate bulk containers*
 - AS 4332 *The storage and handling of gases in cylinders*
 - AS 4839 *The safe use of portable and mobile oxy-fuel gas systems for welding, cutting, heating and allied processes*
 - SafeWork NSW *Managing risks of hazardous chemicals in the workplace code of practice – August 2019*

Each compartment of the TAM building is assessed and divided into the following sections:

- **Inventory** – observed and maximum inventory assumed for design purposes;
- **Layout** – including floor area and room features; and
- **Dangerous Goods Australian Standard Assessment**

Design recommendations are included in each section as applicable.

In addition, the TAM building must be assessed in its entirety due to the potential for interactions between the different storages.

2. TAM Building Summary

The TAM building must be assessed in its entirety due to the potential for interactions between the different storages. As there are mixed classes of DGs stored at the facility, the primary relevant standards are AS/NZS 3833 and AS 4332. A screening assessment has also been performed in accordance with New South Wales Department of Planning and Environment *Applying SEPP 33* document to determine if the development is potentially hazardous and would therefore require a Preliminary Hazard Assessment (PHA) to be prepared.

2.1 Overall Inventory

The total inventory of dangerous goods in the TAM building is:

DG Class (Primary/ secondary)	Packing Group	Example chemicals	Inventory for Assessment by weight (t)	Applying SEPP 33 Threshold (t)	Threshold Exceeded? (Y/N)
2.1	NA	LPG	0.12	0.5	N
2.1	NA	Acetylene	0.036	0.100	N
2.1 Aerosols	III	Aerosol paint and lubricant cans	0.1	0.2	N
2.2/5.1	NA	Oxygen cylinders	.021	5	N
2.2	NA	Nitrogen and argon cylinders	0.056	None	N
3	II	Petrol, acetone and other solvents	0.905	5	N
3/6.1	II	Methanol	0.04	2.5	N
3	III	Enamel based and oil based paints	0.13	5	N
Combustible	NA	Diesel	0.5	None	N
8/6.1	II	Paint stripper	0.065	25	N
9	III	Acrylic paints with bio agents	0.02	None	N

2.2 Overall layout

The overall boundary considered is illustrated below and is assumed to come to a combined area of 1590 m².

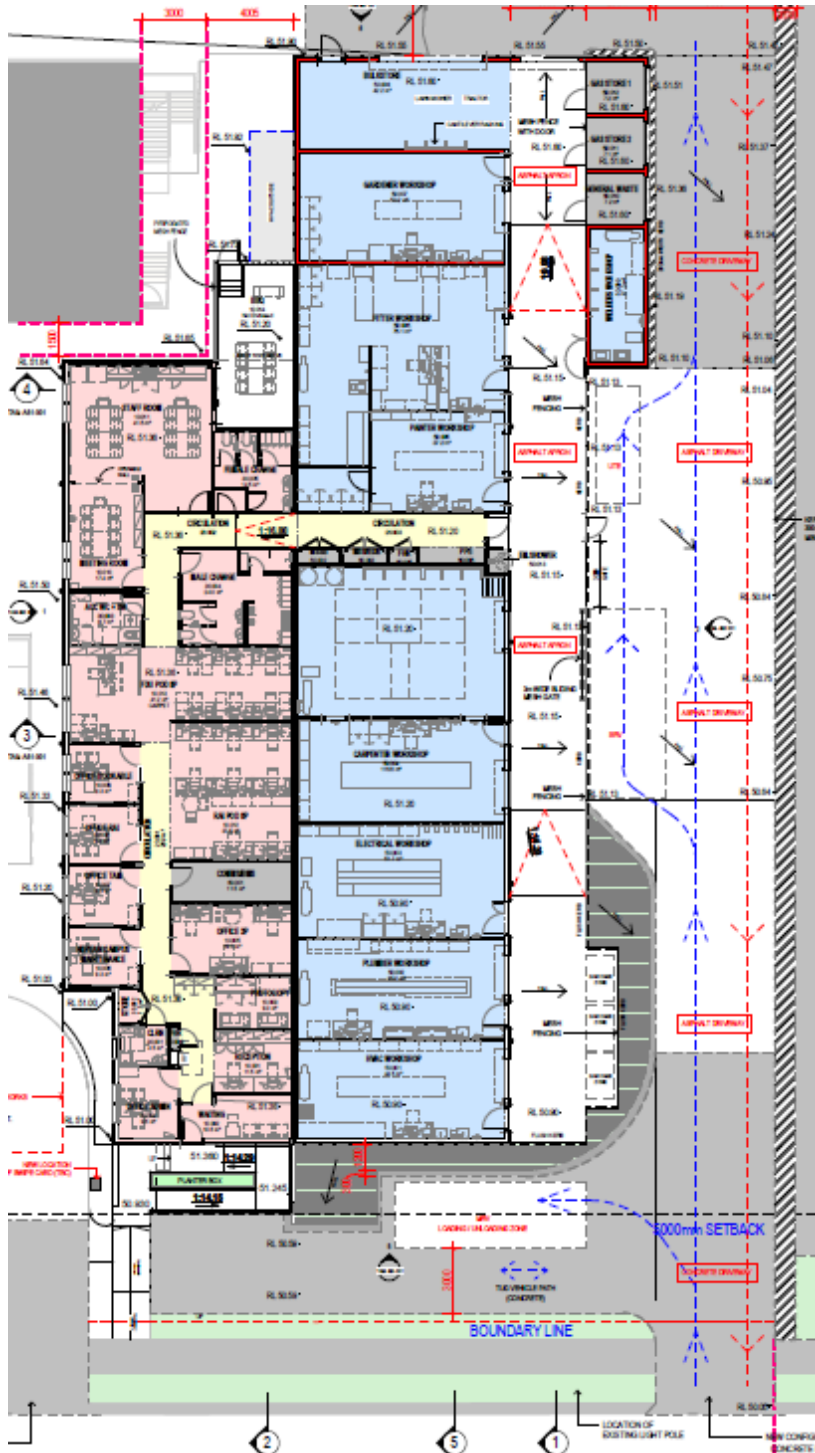


Figure 1: TAM building boundary (from drawing NHR-STH-DRW-ARC-TAM-A20-101 Rev A)

2.3 Dangerous Goods Australian Standard Assessment

The combined storage quantity of the different workshops exceeds the maximum quantities of dangerous goods to be considered a minor store under section 2 of AS/NZS 3833. Therefore, the assessments consider the requirements under section 5 and 9 of AS/NZS 3833. The following general remarks apply:

- 1) Rooms where liquid dangerous goods are kept shall have the floors bunded or sloped to a retaining sump such that the goods cannot escape the room. Sumps should be sized to take the largest container which was typically observed to be 60 L. Refer to section 5.4.3 of AS/NZS 3833.
- 2) The rooms generally lack the ability to provide natural ventilation. All rooms where dangerous goods are stored shall meet the minimum mechanical ventilation requirements of section 5.4.5.3 and in particular the requirements of subclause (c) unless stated as otherwise for the specific rooms. Specifically, the system requirement is to exhaust 0.3 m³ per square metre of floor area per minute or 5 m³/min, whichever is greater, and that entry air velocity shall exceed 300 m/min.
- 3) There is limited space available for gas bottle storage. There is a need for separation of gas bottles containing flammable gases (LPG, acetylene) and those containing oxidising substances (oxygen and nitrous oxide) by at least 3 m. This space can be utilised by non-combustible materials or gas bottles containing inert or non-reacting gasses of class 2.2 such as carbon dioxide, neon, argon, nitrogen or refrigerant gases.

2.4 SEPP33

The New South Wales Department of Planning and Environment State Environment Planning Policy 33 (SEPP 33) deals with potentially hazardous industry. Those facilities that store significant quantities of DGs above set thresholds must complete a PHA as part of the planning approval process.

The TAM building has been assessed against the thresholds in *Applying SEPP 33* and none of the thresholds are exceeded. Refer to section 2.1 Therefore, the development is not potentially hazardous and a PHA is not required.

3. Gardeners Workshop

3.1 Inventory

The following inventory and assumed maximum inventory is the basis of the assessment:

DG Class	Packing Group	Example chemicals	Observed Inventory	Maximum Inventory for Assessment
3	II	Petrol	750 L	750 L

Note 1: There is additional inventory in fuel tanks associated with equipment such as lawnmowers that is not considered storage for the purposes of this assessment.

Note 2: The storage is contained in 3 x 250 L flammable goods cabinets.

3.2 Proposed Layout

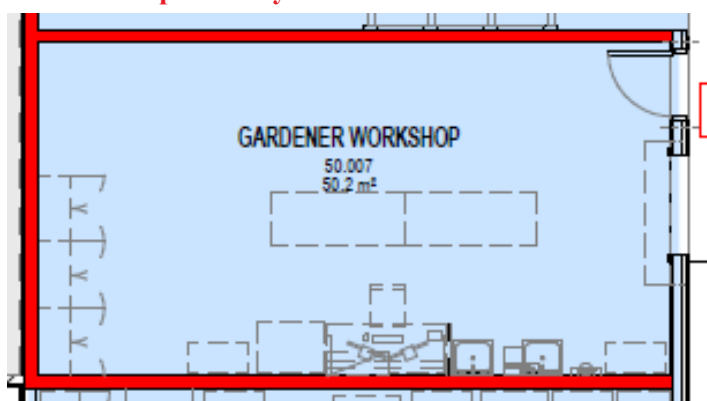


Figure 2: Gardeners Workshop (from drawing NHR-STH-DRW-ARC-TAM-A20-101 Rev A)

The Gardeners Workshop is a 50.2 m² room in the north of the compound, supplied with one powder fire extinguisher, and is 21 m from the nearest fire hydrant and 23.5 m from the nearest fire hose reel in the Plumbers Workshop.

3.3 Dangerous Goods Australian Standard Assessment

Provided that the storage is contained within storage cabinets meeting the requirements of clause 4.9 of AS 1940, there is no need to consider fire walls for the construction of this room.

It is preferable that the cabinets are located on the exterior wall away from any other rooms. If this cannot be achieved, then construction of the shared wall shall be of concrete or masonry to ceiling height and 3 m either side of the cabinets (cl 5.10.4(c)(ii)).

No other dangerous goods classes other than combustible liquids or flammable solids are to be kept in the same cabinets as the flammable liquids (cl 5.10.1).

The maximum storage capacity is to be 850 L in cabinets. Therefore, an additional 100 L capacity cabinet could be added to store other flammable DGs without changing this assessment.

For each storage cabinet a fire extinguisher with a rating of 2A 60B(E) is required (or a foam hose reel provided) (Table 9.3 of AS/NZS 3833 and clause 11.8.3 of AS 1940). Therefore, a minimum

of two further fire extinguishers are required as a minimum to be positioned between 3 and 10 m of the cabinets.

The Gardeners Workshop lacks the ability to provide natural ventilation. The minimum mechanical ventilation requirements of section 5.4.5.3 subclause (c) apply. Specifically, the system requirement is for to exhaust air quantity of $18 \text{ m}^3/\text{min}$ (0.3 m^3 per square metre of floor area per minute $\times 60 \text{ m}^2$) and have an entry air velocity shall exceeds 300 m/min .

4. Carpenters Workshop

4.1 Inventory

The following inventory and assumed maximum inventory is the basis of the assessment:

DG Class	Packing Group	Example chemicals	Observed Inventory	Maximum Inventory for Assessment
2.1 Aerosol	III	WD40 cans	1.2 L	10 L

4.2 Proposed Layout

The Carpenters Workshop is a 116.6 m² room in the immediately south of the Gardeners Workshop, supplied with one carbon dioxide fire extinguisher and is 26 m from the nearest fire hydrant and 10 m from the nearest fire hose reel in the Plumbers Workshop.

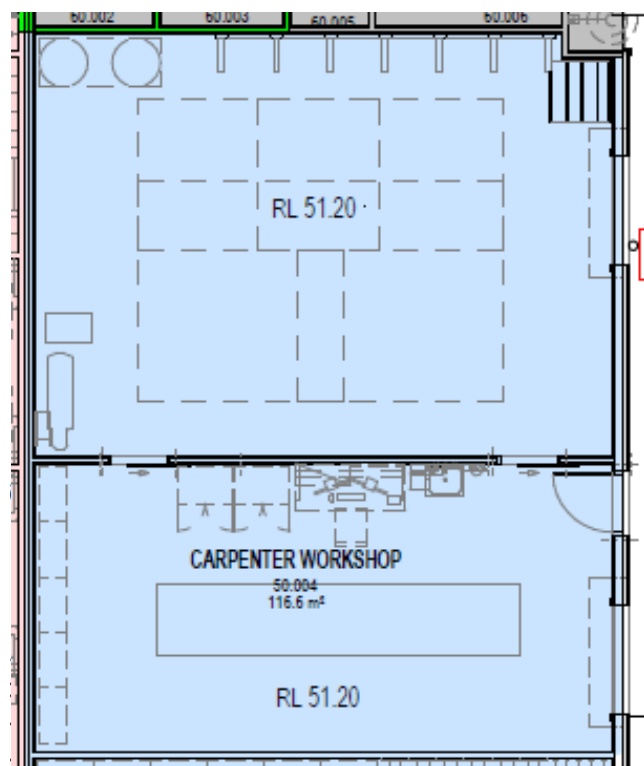


Figure 3: Carpenters Workshop (from drawing NHR-STH-DRW-ARC-TAM-A20-101 Rev A)

4.3 Dangerous Goods Australian Standard Assessment

There is insufficient dangerous goods inventory in the Carpenters Workshop for any specific design requirements from a DG perspective.

5. Painters Workshop

5.1 Inventory

The following inventory and assumed maximum inventory is the basis of the assessment:

DG Class	Packing Group	Example chemicals	Observed Inventory	Maximum Inventory for Assessment
2.1 Aerosols	III	Aerosol paint cans	72 L	100 L
3	II	Methylated spirits, thinners, turpentine, acetone, sealers	120 L	150 L
3	III	Decking oils, rust guard, and enamel paints	85	100 L
8	III	Paint Stripper	8 L	50 L
9	III	Endure	13 L	20 L

Note 1: Some of the storage is contained in one 250 L flammable goods cabinet. The rest is on shelves or stored on the floor

Note 2: There is significant storage of aerosol cans in the cabinet as well as additional storage of cardboard boxes of aerosol paint cans above the flammable goods cabinet. This is unacceptable.

Note 3: There is paint stripper (a class 8 corrosive) stored in the flammable cabinet. This is unacceptable as flammable liquids and corrosives are incompatible and must be stored separately.

5.2 Proposed Layout

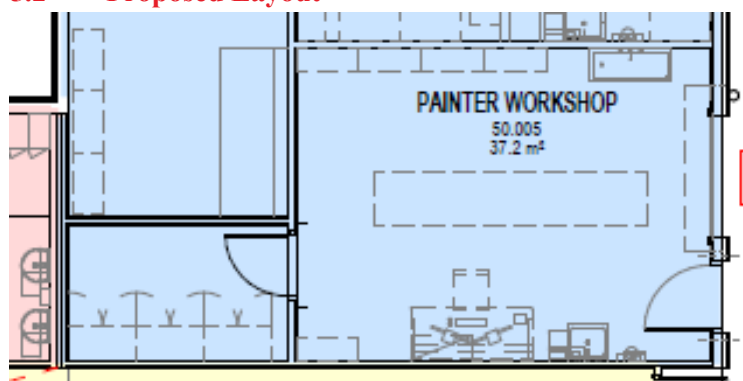


Figure 4: Painters Workshop (from drawing NHR-STH-DRW-ARC-TAM-A20-101 Rev A)

The Painters Workshop is a 37.2 m² room in the centre of the compound, supplied with one powder fire extinguisher and is 35 m from the nearest fire hydrant and 6 m from the nearest fire hose reel in the Plumbers Workshop.

5.3 Dangerous Goods Australian Standard Assessment

Provided that the storage of flammable liquids is contained within storage cabinets meeting the requirements of clause 4.9 of AS 1940 there is no need to consider fire walls for the construction of this room. If this cannot be achieved, then construction of the shared wall shall be of concrete or masonry to ceiling height and 3 m either side of the cabinets (cl 5.10.4(c)(ii)).

It is noted that there is class 3 paint and other materials which are currently stored outside of the cabinets. It is recommended that a separate aerosol cage of 100 L capacity is sourced for storing aerosol cans. This should free up space in a 250 L flammable cabinet to store all the flammable liquids.

An additional 100 L cabinet is recommended for the storage of corrosive liquids such as paint strippers as corrosives and flammable liquids are incompatible and can react dangerously.

No other DG classes other than combustible liquids or flammable solids are to be kept in the same cabinets as the flammable liquids (cl 5.10.1).

For each storage cabinet and aerosol cage, a fire extinguisher with a rating of 2A 60B(E) is required (or a foam hose reel provided) (Table 9.3 of AS/NZS 3833 and clause 11.8.3 of AS 1940).

Therefore, a minimum of two further fire extinguishers are required as a minimum to be positioned between 3 and 10 m of the cabinets.

The Painters Workshop has significant quantities of liquids (both DG and non-DG). It is recommended that the floor be bunded or sloped to a retaining sump such that the goods cannot escape the room. Sumps should be sized to take the largest container which was typically observed to be 20 L. Refer to section 5.4.3 of AS/NZS 3833.

The Painters Workshop lacks the ability to provide natural ventilation. The minimum mechanical ventilation requirements of section 5.4.5.3 subclause (c) apply. Specifically, the system requirement is for to exhaust air quantity of $10 \text{ m}^3/\text{min}$ (0.3 m^3 per square metre of floor area per minute $\times 33.6 \text{ m}^2$) and have an entry air velocity that shall exceed 300 m/min .

6. Plumbers Workshop

6.1 Inventory

The following inventory and assumed maximum inventory is the basis of the assessment:

DG Class	Packing Group	Example chemicals	Observed Inventory	Maximum Inventory for Assessment
2.1 Aerosols	III	Aerosol paint and lubricant cans	14 L	20 L
2.1	NA	Acetylene	1x D cylinder in welding set	1x D cylinder in welding set
2.2/5.1	NA	Oxygen	1x D cylinder in welding set	1x D cylinder in welding set
3	II	Turpentine	0.5 L	5 L

6.2 Proposed Layout

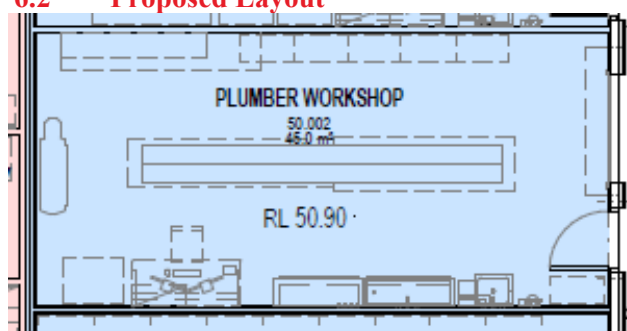


Figure 5: Plumbers Workshop (from drawing NHR-STH-DRW-ARC-TAM-A20-101 Rev A)

The Plumbers Workshop is a 45.0 m² room in the centre of the compound, supplied with one carbon dioxide fire extinguisher and one fire hose reel. It is 40 m from the nearest fire hydrant.

6.3 Dangerous Goods Australian Standard Assessment

There is insufficient dangerous goods inventory in the Plumbers Workshop for any specific design requirements from a DG perspective.

Note that having oxygen and acetylene gas bottles next to each other in a welding set is acceptable without additional precautions.

No storage of gas bottles is acceptable in the Plumbers Workshop.

7. Welders Workshop (and Gas Store)

7.1 Inventory

The following inventory and assumed maximum inventory is the basis of the assessment:

DG Class	Packing Group	Example chemicals	Observed Inventory	Maximum Inventory for Assessment
2.1	NA	Acetylene	1x D cylinder in welding set	1x D cylinder in welding set
2.2/5.1	NA	Oxygen	1x D cylinder in welding set	1x D cylinder in welding set
2.2	NA	Argon	1x E cylinder connected to welder	1x E cylinder connected to welder
8	III	NOS Corrosive	5 L	5 L

7.2 Proposed Layout

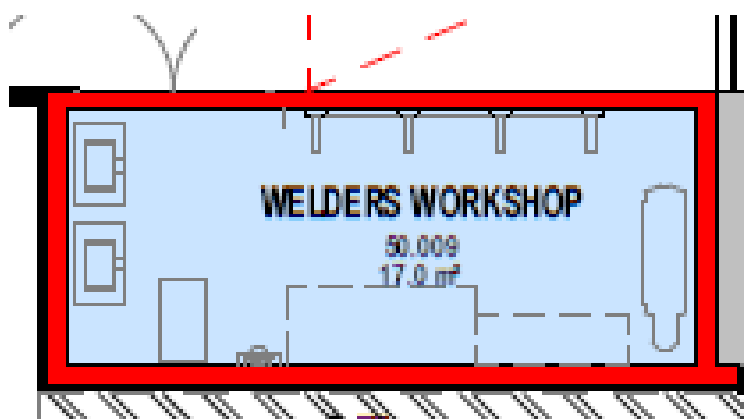


Figure 6: Plumbers Workshop (from drawing NHR-STH-DRW-ARC-TAM-A20-101 Rev A)

The Welders Workshop is a 17.0 m² room in the centre of the compound, supplied with one carbon dioxide fire extinguisher. It is 45 m from the nearest fire hydrant and 5 m from the nearest fire hose reel.

There is also a Welders Gas Store of 12.4 m² area located west of the Welders Workshop.

7.3 Dangerous Goods Australian Standard Assessment

Note that having oxygen and acetylene gas bottles next to each other in a welding set is acceptable without additional precautions. The use of an argon bottle attached to a welding machine is also acceptable.

According to clause 4.2.1 of AS 4332, the indoor storage of gas cylinders should be avoided wherever possible. However, if the external wall is made of wire mesh or fixed louvres or lattice with at least 50% openings, then this is considered fully open.

The fixed walls of the gas storage area that are part of the building need to have an FRL of 240/240/240 (cl. 4.2.1(d)). The roof shall have a FRL minimum of 120/120/120 (Fig. 4.1(b)(i)).

Any penetrations through the wall need to be gas tight (cl. 4.2.1(g)) and cannot compromise the wall FRL; therefore, having a door into the Welders Workshop would be non-compliant.

If the Welders gas store is to contain flammable gasses (acetylene) then the area will need to be assessed as to being a potential hazardous area and require appropriately rated lighting to be applied.

If the Welders gas store is at least twice as wide as it is deep, and open mesh has been used on the external wall, then this would be considered sufficient natural ventilation. Otherwise, mechanical ventilation will be required. The above design would not meet this requirement.

Further, gas cylinders of class 2.1 (acetylene or LPG) must be separated by 3 m from gasses of class 2.2/5.1 (oxygen) (cl 4.3.3). A wall can be constructed to achieve this separation. Gasses of class 2.2 (such as argon, helium or nitrogen) can be stored within this separation distance. See Figure 7.

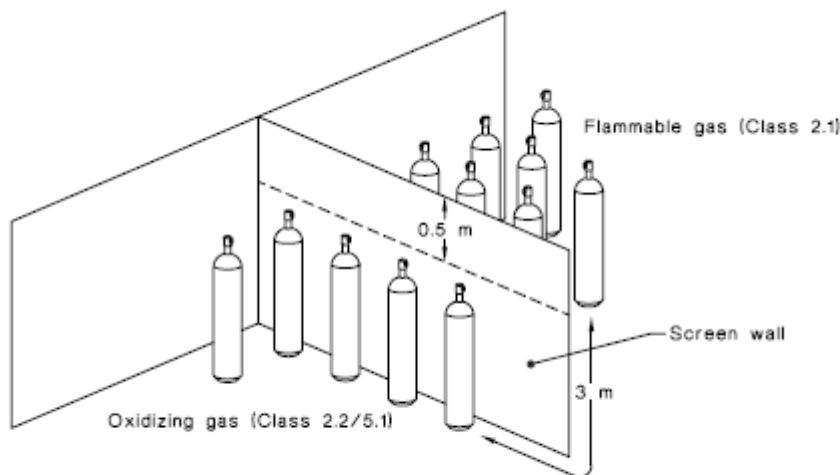


FIGURE 4.3 USE OF SCREEN WALL TO ACHIEVE SEGREGATION DISTANCE

Figure 7: Gas cylinder store separation wall requirements (from AS 4332)

Note that where the gas bottles are stored there is required to be a water connection and water hose available where the storage does not exceed 1000 L water storage capacity. The hose does not need to be a fire water hose – a garden hose connection will suffice (AS 4332 Table 7.2).

8. Fitters Workshop

8.1 Inventory

The following inventory and assumed maximum inventory is the basis of the assessment:

DG Class	Packing Group	Example chemicals	Observed Inventory	Maximum Inventory for Assessment
2.1 Aerosol	III	WD40 cans, aerosol paints	3.2 L	50 L
3	III	Rust guard enamel paint	2 L	10 L

8.2 Proposed Layout

The Fitters Workshop is a 74.1 m² room in the centre section of the TAMS building.

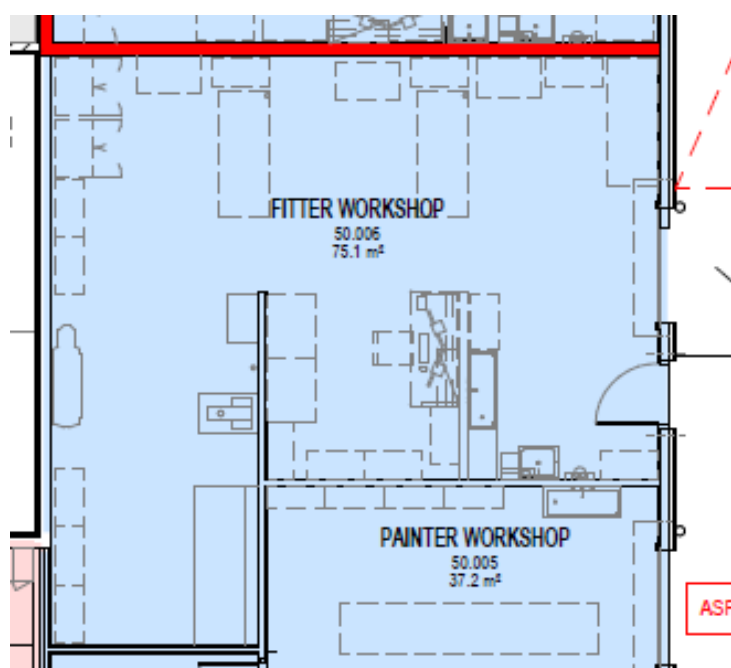


Figure 8: Fitters Workshop (from drawing NHR-STH-DRW-ARC-TAM-A20-101 Rev A)

8.3 Dangerous Goods Australian Standard Assessment

There is insufficient dangerous goods inventory in the Carpenters Workshop for any specific design requirements from a DG perspective.

9. HVAC Workshop

9.1 Inventory

The following inventory and assumed maximum inventory is the basis of the assessment:

DG Class	Packing Group	Example chemicals	Observed Inventory	Maximum Inventory for Assessment
2.1 Aerosol	III	WD40 cans, aerosol paints	3.2 L	10 L
2.2	NA	Refrigerant Gases	50 L	100 L
3	III	Turps and PVC solvent	10 L	10 L
8	III	Cleaning fluids	5 L	10 L

9.2 Proposed Layout

The HVAC Workshop is a 44.5 m² room in the southern section of the TAMS building.

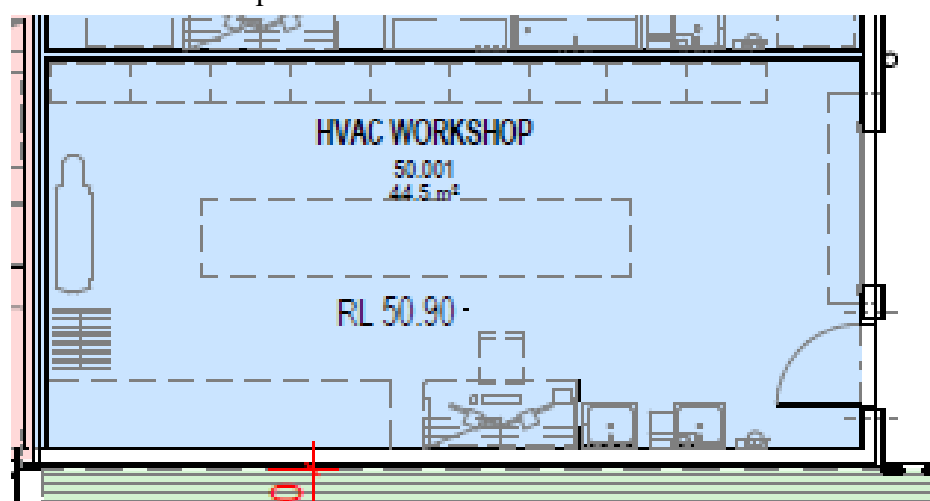


Figure 9: HVAC Workshop (from drawing NHR-STH-DRW-ARC-TAM-A20-101 Rev A)

9.3 Dangerous Goods Australian Standard Assessment

According to clause 4.2.1 of AS 4332, the indoor storage of gas cylinders (R410A, R134A) should be avoided wherever possible. Should a cylinder of gas be discharged it will produce a low oxygen atmosphere potentially reducing the oxygen content to less than 5% which is immediately life threatening.

It is recommended that the refrigerant gases be stored outside in a well-ventilated wire mesh cage or similar. If this is not possible then oxygen monitoring is recommended for the storage space for these gases, use of mechanical ventilation or storage in a ventilated cabinet.

Consideration should be given to a wire mesh cage for class 2.1 aerosol sprays.

The remaining dangerous goods are of low inventory such that there are no specific design requirements from a DG perspective, though incompatible substances must be kept separated.

Note that where the gas bottles are stored there is required to be a water connection and water hose available where the storage does not exceed 1000 L water storage capacity. The hose does not need to be a fire water hose – a garden hose connection will suffice (AS4332 Table 7.2).

10. Electrical Workshop

10.1 Inventory

The following inventory and assumed maximum inventory is the basis of the assessment:

DG Class	Packing Group	Example chemicals	Observed Inventory	Maximum Inventory for Assessment
2.1 Aerosol	III	WD40 cans, aerosol paints	3 L	10 L
3	III	Isopropyl alcohol and acetone	2 L	10 L

10.2 Proposed Layout

The HVAC Workshop is a 51.7 m² room in the southern section of the TAMS building.

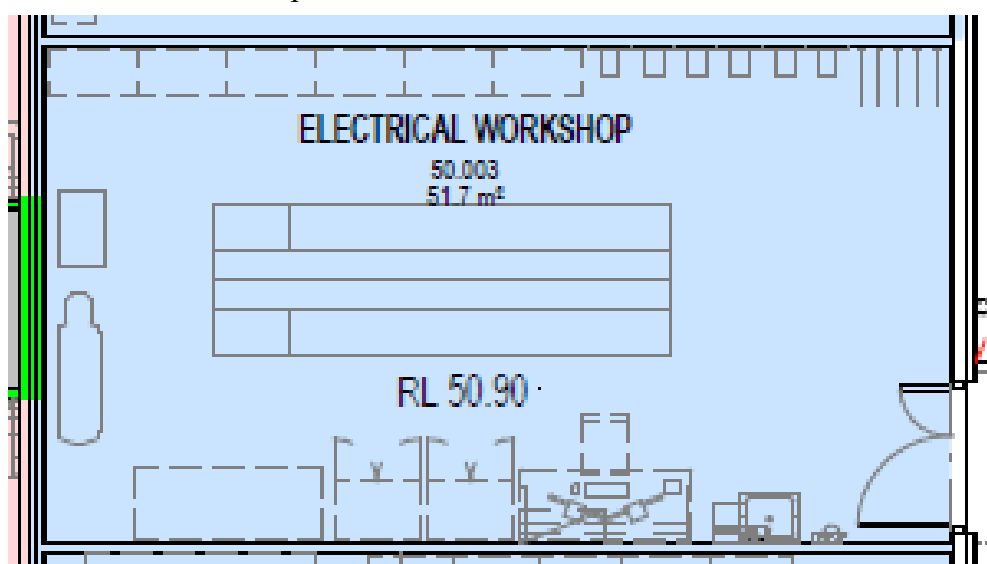


Figure 10: Electrical Workshop (from drawing NHR-STH-DRW-ARC-TAM-A20-101 Rev A)

10.3 Dangerous Goods Australian Standard Assessment

The dangerous goods are of low inventory such that there are no specific design requirements from a DG perspective, though incompatible substances must be kept separated.

11. Gas Bottle Store

11.1 Inventory

The existing gas bottle cage was examined. This may or may not be the same as the Welders gas bottles. Also included are two LPG barbecue gas bottle cages that were in the outside Gardeners Storage Area.

The following inventory and assumed maximum inventory is the basis of the assessment:

DG Class	Packing Group	Example chemicals	Observed Inventory	Maximum Inventory for Assessment
2.1	NA	LPG	2x G cylinder	2x G cylinder
2.2/5.1	NA	oxygen	5x D sized cylinders	5x D sized cylinders
2.2	NA	Nitrogen, Argon Carbon Dioxide and Neon	4x D cylinder Ar, 1x E cylinder Ne 5x E&C cylinders CO2	4x D cylinder Ar, 1x E cylinder Ne 5x E&C cylinders CO2

11.2 Proposed Layout

The gas cage area appears to be only able to handle the existing 2 x 4 x 9 kg LPG bottles for the barbecue.

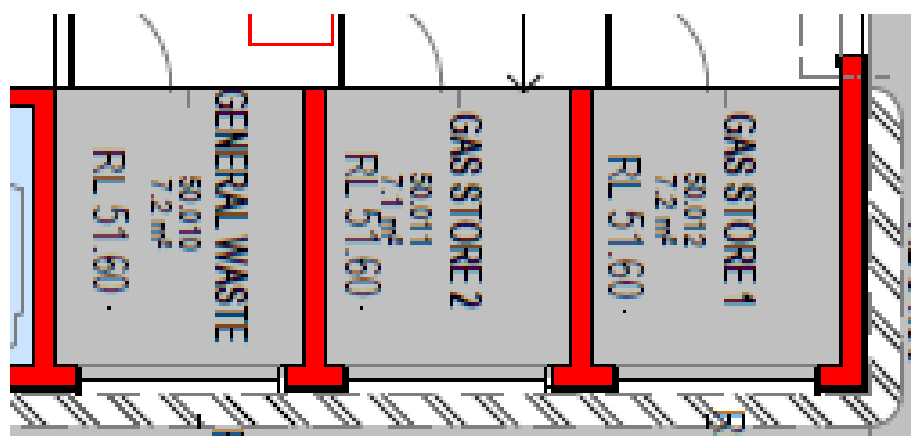


Figure 11: LPG Gas Cage (from drawing NHR-STH-DRW-ARC-TAM-20-101 Rev A)

11.3 Dangerous Goods Australian Standard Assessment

Given the inventory of gas cylinders above there appears to be no provision for the other gas bottles.

Note that having oxygen and acetylene gas bottles next to each other in a welding set is acceptable without additional precautions. The use of an argon bottle attached to a welding machine is also acceptable.

According to clause 4.2.1 of AS 4332, the indoor storage of gas cylinders should be avoided wherever possible. However, if the external wall is made of wire mesh or fixed louvres or lattice with at least 50% openings, then this is considered fully open.

The fixed walls of the gas storage area that are part of the building need to have an FRL of 240/240/240 (cl 4.2.1(d)). The roof shall have a FRL minimum of 120/120/120 (Fig. 4.1(b)(i)).

Any penetrations through the wall need to be gas tight (cl 4.2.1(g)) and cannot compromise the wall FRL; therefore, having a door into the Welders workshop would be non-compliant.

Further, gas cylinders of class 2.1(acetylene or LPG) must be separated by 3 m from gasses of class 2.2/5.1 (oxygen) (cl.4.3.3). A wall can be constructed to achieve this separation. Gasses of class 2.2 (such as argon, helium or nitrogen) can be used to also achieve separation. See Figure 7.

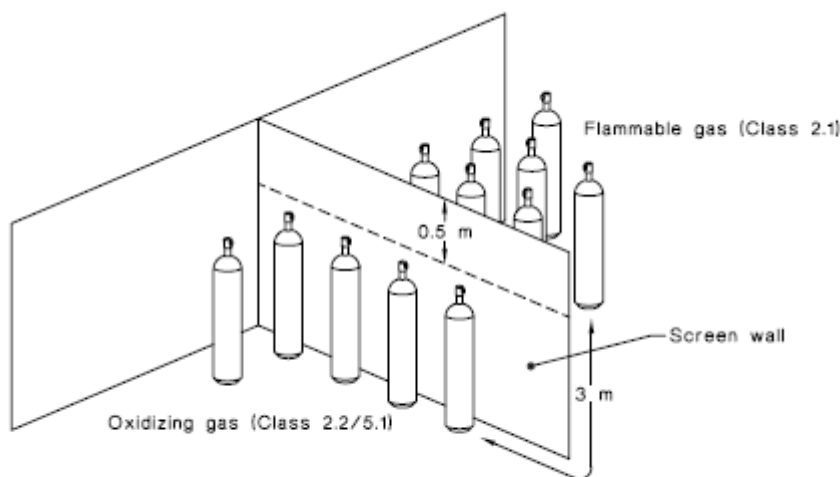


FIGURE 4.3 USE OF SCREEN WALL TO ACHIEVE SEGREGATION DISTANCE

Figure 12: Gas cylinder store separation wall requirements (from AS 4332)

Note that where the gas bottles are stored there is required to be a water connection and water hose available where the storage does not exceed 1000 L water storage capacity. The hose does not need to be a fire water hose – a garden hose connection will suffice (AS4332 Table 7.2).

12. Bulk Store

12.1 Inventory

The Bulk Store area contains supplies for use by the Gardeners including fertilisers, mulches and potting mixes. It is also assumed that this is the area in which the diesel fuel drums will be stored.

The following inventory and assumed maximum inventory is the basis of the assessment:

DG Class	Packing Group	Example chemicals	Observed Inventory	Maximum Inventory for Assessment
Combustible	NA	Diesel	2x 220 L drums	2x 220 L drums

12.2 Proposed Layout

The Bulk Store is on the western side of the compound, north of the office and barbecue areas and immediately south of the Gas Bottle storage area.

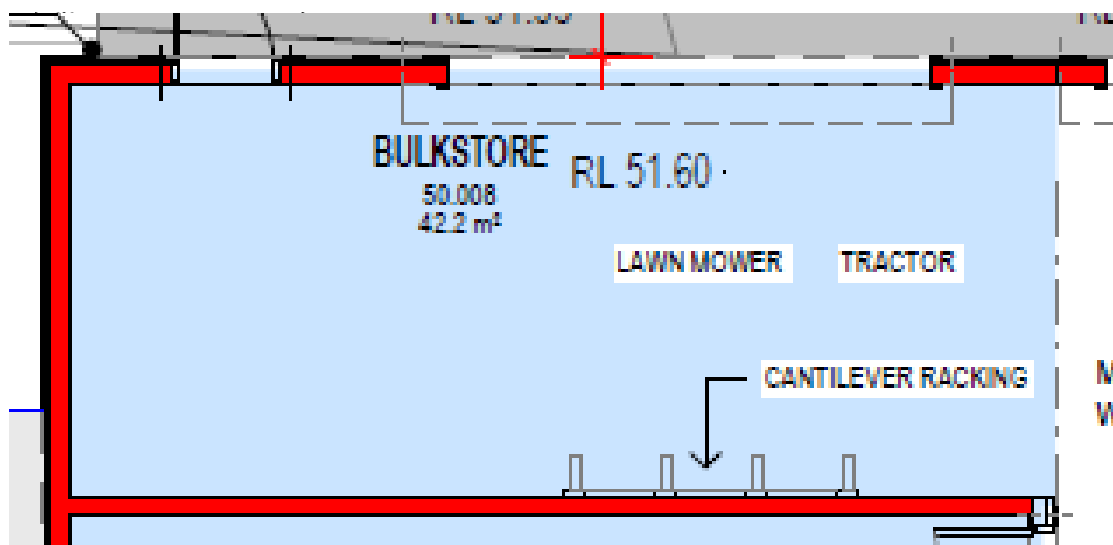


Figure 13: Bulk Store (from drawing NHR-STH-DRW-ARC-TAM-20-101 Rev A)

12.3 Dangerous Goods Australian Standard Assessment

Given the inventory of gas cylinders above there appears to be no provision for the other gas bottles.

Note that having oxygen and acetylene gas bottles next to each other in a welding set is acceptable without additional precautions. The use of an argon bottle attached to a welding machine is also acceptable.

The diesel needs to be stored outside up to a volume of 2500 L if stored at least 1 m from the building or with a fire wall of FRL 60/60/60 (AS 1940 Table 2.1). If stored in these conditions, the diesel is considered minor storage.

The diesel needs to be stored at least 3 m from the gas bottles (AS 4332 Table 4.1)

It is recommended that a powder-based fire extinguisher is available in the vicinity of the diesel storage with a rating of 2A 60B(E) (AS 1940 Table 11.3) though as a minor storage this is not strictly required.

Attachments

Drawing - NHR-STH-DRW-ARC-TAM-20-101 Rev A

