

## Mechanical Testing

- Tensile
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IN CONFIDENCE TO THE CLIENT

REPORT No: 20-0123

## AS 4084:2012 IMPACT TESTS ON PALLET RACKING UPRIGHT PROTECTORS

CLIENT: **RACK ARMOUR (AUSTRALIA) PTY LTD**  
ATTENTION: KAREN VARIAN  
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DATE OF TESTING: FEBRUARY 6<sup>TH</sup> – 7<sup>TH</sup> 2020

DATE OF REPORT: FEBRUARY 18<sup>TH</sup> 2020

### TEST SYNOPSIS:

A consignment of RACK ARMOUR (AUSTRALIA) pallet racking upright protectors was to be installed and tested at the MTS laboratory (see Fig.1). At the request of the client, the pallet racking upright protectors were to be tested in accordance with AS 4084:2012 STEEL STORAGE RACKING CLAUSE 2.4: ACCIDENTAL ACTIONS to validate the energy absorption characteristics of the upright protectors when subjected to an unintentional impact from material handling equipment (i.e. a forklift). As advised by the client, the design intent of the Rack Armour (Australia) upright protectors was to protect a pallet racking column upright from an inadvertant strike in a direction normal to a racking aisle.

Prior to testing, the test items were examined, and the following nominal details recorded:

#### **R2-14400Y Upright Protectors:**

*Dimensions:* Ø 123 mm × 400 mm (diameter × height)

*Material:* 8 mm thick polymer exterior (nom.)  
Ø 105 mm × 50 mm thick foam interior

*Markings:* www.rackarmour.com.au

#### **R2-144600Y Upright Protectors:**

*Dimensions:* Ø 123 mm × 600 mm (diameter × height)

*Material:* 8 mm thick polymer exterior (nom.)  
Ø 105 mm × 50 mm thick foam interior  
See Appendix A for additional images

*Markings:* www.rackarmour.com.au

#### **Column Upright Section:**

*Dimensions:* 90 × 75 × 1.5 mm



**FIG.1**  
**RACK ARMOUR AUSTRALIA**  
**PALLET RACKING**  
**UPRIGHT PROTECTORS**

### TEST PROCEDURE:

Testing was conducted to validate the energy absorption capability of the column upright protection system when subjected to a 400 Nm impact in accordance with AS 4084:2012 CLAUSE 2.4.1 (c) and (d).

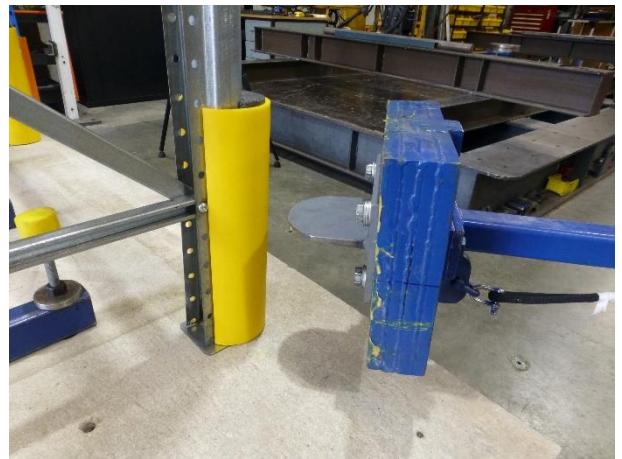
The test items and “reference” column upright section were installed on a concrete substrate.

The impact indenter, simulating the tip of a forklift tyre, was suspended from an adjustable hoist (see Fig. 2). The 62.4kg indenter was aligned in the client’s specified direction(s) of impact, positioned adjacent to the pre-determined test position(s) and raised to the computed release height ( $h_r$ ) in an arc using a rope and pulley. The indenter was then released and swung freely through a pendulum arc to strike the impact position.

After each impact, the test item was inspected for evidence of structural failure or permanent damage. The “reference” column upright was also inspected for evidence of contact and/or damage from the impact strike. This procedure was repeated in directions normal to the aisle and on a 45° angle to the aisle (see Fig. 3) at appropriate impact heights nominally between 0.1 and 0.4 m above the simulated floor for both the R2-14400Y and R2-144600Y products.



**FIG.2**  
**NORMAL TO AISLE DIRECTION**  
**TEST SETUP**



**FIG.3**  
**45° ANGLE TO AISLE DIRECTION**

**TEST DATA:**

All impact test data, including impact, release and drop height(s), energy calculation(s), test observations and comments are provided in Tables 1 – 3.

Equation 1 was used for computing impact energy in joules (J):

**EQN. 1**

$$W = mgh_d$$

Where:

$W$  = Work or Energy, Joules (J) (1 J = 1 Nm)

$m$  = Total mass of indenter, kilograms (kg)

$g$  = Gravitational acceleration constant, 9.81m/s<sup>2</sup>

$h_d$  = Test specific drop height, meters (m)

Impact Direction	Protector Type (mm)	Impact Height $h_i$ (mm)	Release Height $h_r$ (mm)	Drop Height $h_d$ (mm)	Calculated Energy $W$ (J)	Test Comments / Observations
Normal to Aisle Direction	400	350	1004	654	400	No damage observed to the steel column upon completion of one (1) impact strike. A 2mm deep permanent indentation to the polymer exterior was observed coincident to the impact location. Some permanent compression of the interior foam material was also observed.
	400	150	804	654	400	No damage observed to the steel column upon completion of one (1) impact strike. A 3mm deep permanent indentation to the polymer exterior was observed coincident to the impact location. Some permanent compression of the interior foam material was also observed.
	600	390	1044	654	400	No damage observed to the steel column upon completion of one (1) impact strike. A 3mm deep permanent indentation to the polymer exterior was observed coincident to the impact location. Some permanent compression of the interior foam material was also observed.
	600	150	804	654	400	No damage observed to the steel column upon completion of one (1) impact strike. A 6mm deep permanent indentation to the polymer exterior was observed coincident to the impact location. Some permanent compression of the interior foam material was also observed.

**TABLE 1**  
**NORMAL TO AISLE DIRECTION (FRONT-ON) IMPACT TEST DATA**

Impact Direction	Protector Type (mm)	Impact Height $h_i$ (mm)	Release Height $h_r$ (mm)	Drop Height $h_d$ (mm)	Calculated Energy $W$ (J)	Test Comments/Observations
45° Angle to Aisle Direction	400	250	904	654	400	No damage observed to the steel column upon completion of one (1) impact strike. A 4mm deep permanent indentation to the polymer exterior was observed coincident to the impact location. Some permanent compression of the interior foam material was also observed.
	600	250	904	654	400	No damage observed to the steel column upon completion of one (1) impact strike. A 5mm deep permanent indentation to the polymer exterior was observed coincident to the impact location. Some permanent compression of the interior foam material was also observed.

**TABLE 2**  
**45° IMPACT TEST DATA**

**TEST OBSERVATIONS:**

***Normal to Aisle ('Front On') Impact Direction:***

The upright protectors subjected to the specified impact energy were observed with post test permanent set deformation at the impact location (see Figs. 4 & 5), as specified in Table 1.

***45° Angle to Aisle Impact Direction:***

The upright protectors subjected to an angular impact were observed to undergo localised plastic deformation at the impact location. After the 45° angle impact, localised deformation of the polymer exterior was observed at the impactor interface, as detailed in Table 2.



**FIG.4**  
**400 PROTECTOR FRONT-ON**  
**IMPACT**



**FIG.5**  
**600 PROTECTOR FRONT-ON**  
**IMPACT**



**SUMMARY:**

When subjected to a 400 Nm magnitude impact, normal to the aisle direction (front on), the RACK ARMOUR (AUSTRALIA) PTY LTD R2-14400Y and R2-144600Y upright protectors absorbed the impact without obvious damage to the pallet racking column upright.

When subjected to a 400 Nm magnitude impact, 45° from normal to the aisle direction, the RACK ARMOUR (AUSTRALIA) PTY LTD R2-14400Y and R2-144600Y upright protectors absorbed the impact without obvious damage to the pallet racking column upright.

Therefore, the RACK ARMOUR (AUSTRALIA) PTY LTD R2-14400Y and R2-144600Y column upright protectors, as tested and reported herein, are considered compliant to the requirements of AS 4084:2012 CLAUSE 2.4.1 (c) and (d).

**Notes:**

1. Melbourne Testing Services (MTS) Pty Ltd shall not be liable for loss, cost, damages or expenses incurred by the client or any other person or company, resulting from the use of any information or interpretation given in this report. In no case shall MTS be liable for consequential damages including, but not limited to, lost profit, damages for failure to meet deadlines and lost production arising from this report. This document shall not be reproduced except in full and relates only to the items tested.
2. It remains the responsibility of the client to ensure that the samples tested are representative of the entire product batch.
3. MTS shall take no responsibility for the procurement and authenticity of the test product as described herein.
4. This report is specific to the test items in their state at the time of testing. It should not be taken as a statement that all products in all states of repair, would also perform in the same manner.
5. MTS shall take no responsibility for the interpretation or misinterpretation of the procedures or calculation methods as provided herein or for the appropriateness or validity of the test procedures for the test items described and reported herein..
6. MTS shall take no responsibility for the installation procedures used for the test items as described herein.
7. MTS shall take no responsibility for the suitability and selection of test impact directions or indenter geometry. It remains the responsibility of the client to ensure the test conditions are representative of true in-service actions.



**CAREY ARTHURSON**  
**AUTHORISED SIGNATORY**







**YASANTHA PERERA**  
**TEST ENGINEER**

## APPENDIX B: INSTALLATION PROCEDURE



Rack Armour Australia Pty Ltd ABN 16 110 172 775

### Rack Armour Installation Tool Procedure

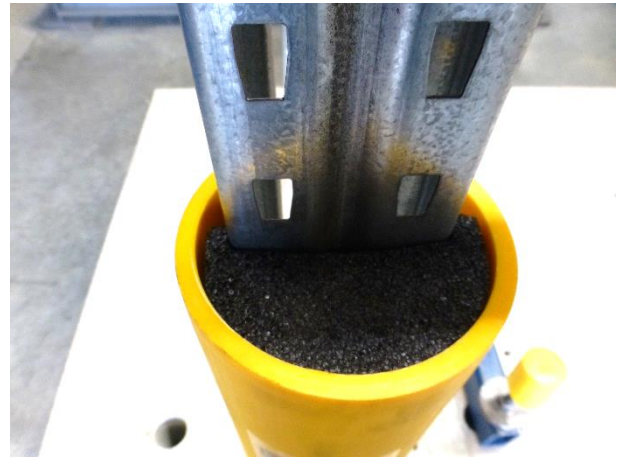
STEPS	DESCRIPTION	EXAMPLE
1	<ul style="list-style-type: none"> <li>- Fit backing plate onto the installation tool using the Allen key provided *</li> </ul>	
2	<ul style="list-style-type: none"> <li>- Fit Installation Tool onto upright</li> <li>- Lugs on the back of the installation tool need to sit into the slots on the upright</li> <li>- Ensure the installation tool is fitted above the height of the Rack Armour unit so the tool can be removed after install</li> </ul>	
3	<ul style="list-style-type: none"> <li>- Using two hands, slide Rack Armour unit down the installation tool from the top. RA will fit in the grooves on the side of the tool</li> <li>- Slide the Rack Armour unit down towards the ground using both hands</li> </ul>	
4	<ul style="list-style-type: none"> <li>- Ensuring the Rack Armour unit is secured correctly onto the upright, remove installation tool by pulling up to remove lugs from slots</li> </ul>	
<p>(*) 2 x backing plates provided Pitch: 150x57 Pitch: 152x47</p> <p>Refer manufactures video for installation process</p>		

Rack Armour – the simple and superior racking protection system  
[www.rackarmour.com.au](http://www.rackarmour.com.au)

**APPENDIX B:**



**FIG B1**  
**RACK ARMOUR CROSS SECTION**



**FIG B2**  
**RACK ARMOUR FITTED TO COLUMN**



**FIG B3**  
**RACK ARMOUR FITTED TO COLUMN**



**FIG B4**  
**TEST ASSEMBLY**