Report Reference: **BTK14-12-01**

ENGINEERING TEST REPORT

DOTARS TEST FACILITY NUMBER T02348

LOAD RESTRAINT OF COTTON BALES – COLLIER AND MILLER CRUSH – SEMITRAILER

Report Prepared For:

Collier and Miller Pty Ltd
43 Jondaryan Avenue,
Griffith NSW 2680

Jan 20th, 2015
Modifications added Oct 19th, 2016

NOTE: FOR LATEST CERTIFICATION (Including A-trailer and 8 bale configuration b-trailer) REFER TO REPORT BTK16-10-10

Report Prepared By:

Robert Pyke - M App. Sci. CPEng (ret) 813626

Bisitecniks Pty. Ltd.

Report Approved By:

Keith Mackinlay - MIEAust, CPEng 320733

Bisitecniks Pty. Ltd.

Testing carried out at
Wagga Mobile Cranes, 7-9 Pearson St, Wagga Wagga NSW 2650
19th Nov, 2014

bisitecniks P/L
VEHICLE DESIGN - CERTIFICATION - ACCREDITATION
ABN 63 005 783 880

BALLARAT - HEAD OFFICE
2 Old Creswick Road
Wendouree Vic 3355
Phone: (03) 5339 6777
Fax: (03) 5339 6644
Email: adrcert@bisi.com.au

MELBOURNE
17 Kenthurst Court
Lilydale Vic 3140
Phone: (03) 9735 2988
Fax: (03) 9735 2716
Email: paulw@bisi.com.au

CONTENTS:

1. SUMMARY:

A full load of cylindrical cotton bales or modules was restrained by the Collier and Miller Pty Ltd "Cotton Crush" system and tested for load restraint by tilting in the lateral, forward and rearward directions. After the three appropriate tilt tests, the load remained secure within the load space, and on returning to level no visually noticeable disturbance of the load had occurred.

The Collier and Miller crush restrained the load against lateral and rearward forces of 0.5 times gravity and a forward force of 0.8 times gravity. The structure of the overhead restraining frame as confirmed by a finite element analysis (see separate report) provides a vertical restraint of 0.2g when the vehicle is fully loaded, satisfying the performance requirements of NTC Load Restraint Guide and VDI 2700.

As the two diagonal chains outside the headboard and tailboard were used in the tilt tests, these chains must form part of the load restraint when the system is used.

It is noted however, that after the test, self acting hydraulic locking valves were fitted to the rams, rendering the vertical check chains shown in some photographs unnecessary. It should be noted from the test photographs that the check chains were actually slack during the tilt tests so the load restraint was performed by the action of the hydraulic rams.

2. VEHICLE and LOAD DETAILS:

The load restraint system is designed for use with a drop deck trailer and a load of nine cotton bale modules – see photographs 1(a) and 1(b), diagrams one and two, and the table below.

Photograph 1(a) Rear detail of load of nine bales prior to tests.

Photograph 1(b) Front detail of load of nine bales prior to tests showing drop deck and supported second bale.

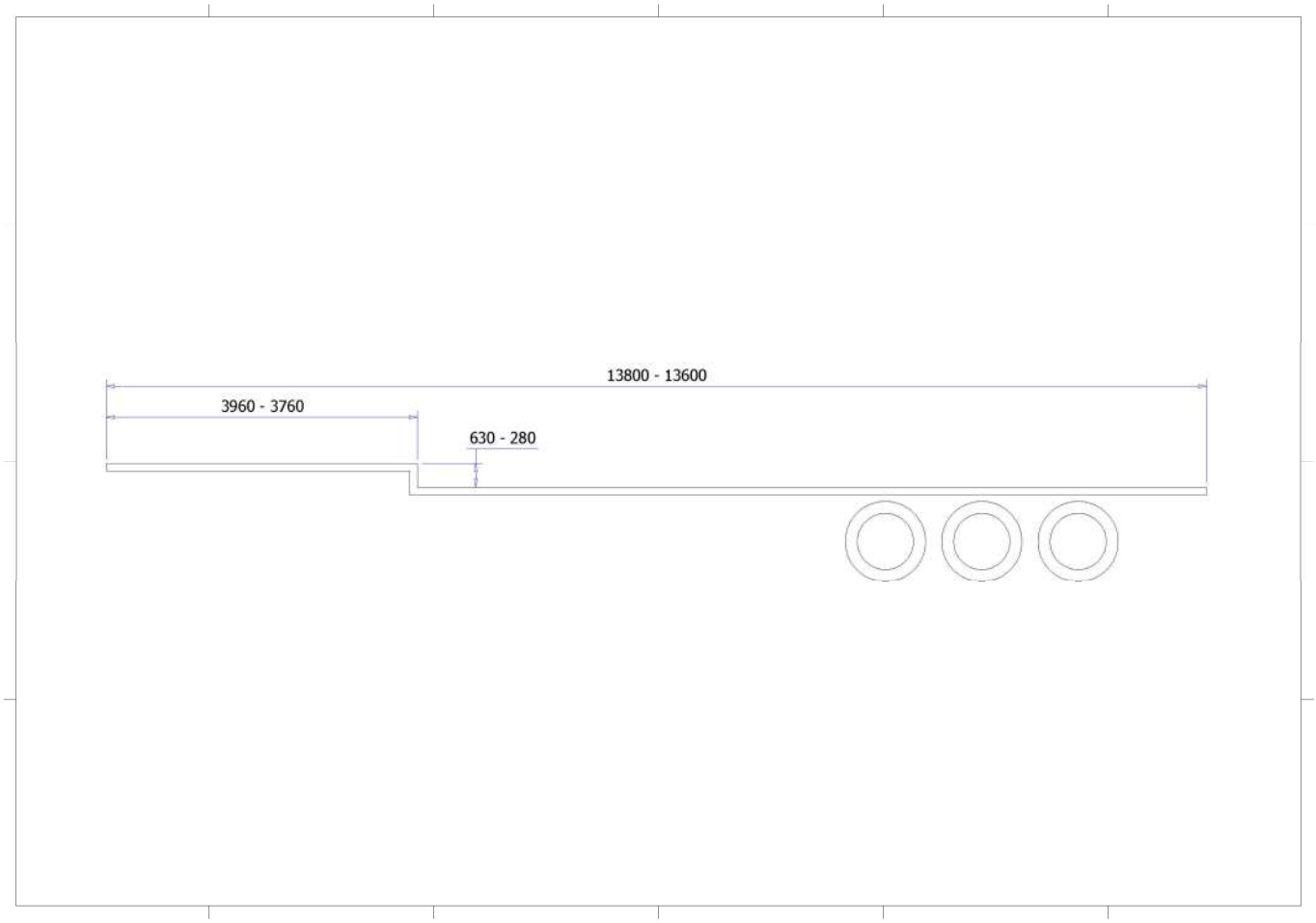


Diagram one – Range of allowable dimensions of drop deck trailers for use with Collier and Miller Pty Ltd "Cotton Crush" load restraint.

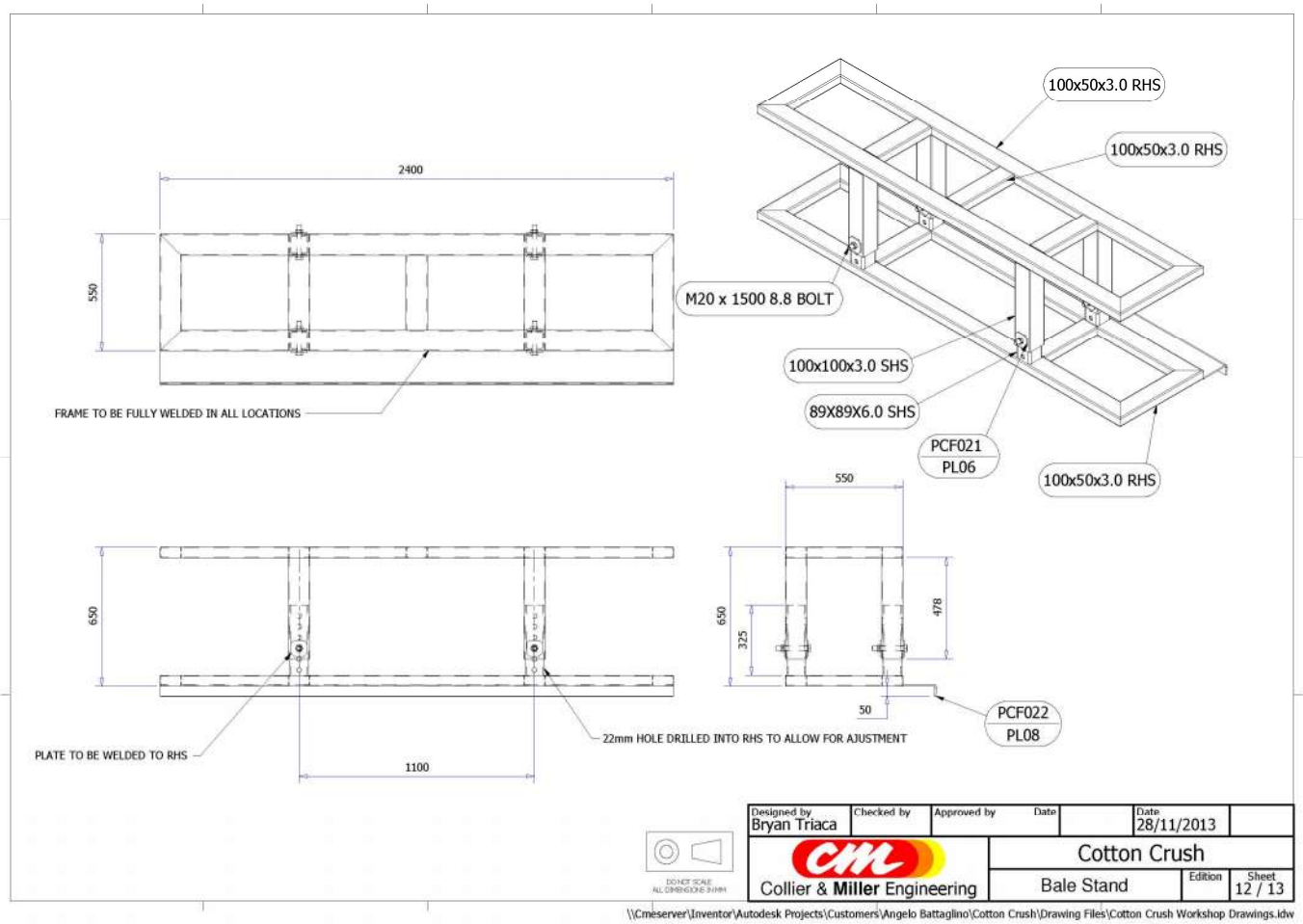


Diagram two – Design of bale stand for second bale. Note the lip at the rear of the stand to hook over the step in the deck so that the whole structure becomes effectively an intermediate bulkhead to restrain the load from forward motion at the third bale. The stand effectively increases the height of the deck step enabling trailers having the lower step dimension shown in diagram one to be used with the crush.

Details of example trailer used for test.

TRAILER MAKE	Maxitrans
MODEL	ST3-NSTCH
VIN	6F80000000B086498
REGISTRATION NO	Z55453
APPROVAL NO	25380AB
TARE	9260kg
LOADED WEIGHT	32180kg
LOAD DETAILS	Nine cotton bales, total mass 22920kg

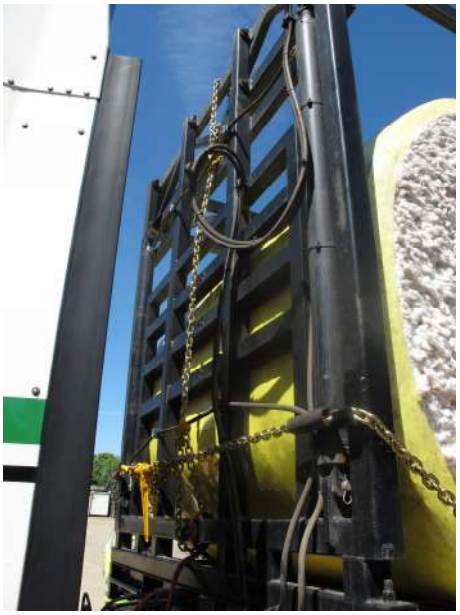
3. LOAD RESTRAINT DETAILS:

LOAD RESTRAINT MECHANISM	Superstructure with four vertical Norden NI rams with 3.5" bore and 2" rods (or equivalent), and two central horizontal Norden NA35A36 hydraulic rams (or equivalent) fitted with hydraulic lock valves. Hydraulic pressure set to 6.9MPa.
SUPPORT CHAINS	Chain restraints at approximately 45 degrees at head and tail boards.

The overhead frame has full width plates located where the bales in the upper row lie (see photograph two of lateral tilt) and is raised and lowered by a hydraulic ram at each corner of the trailer. Two more rams are located laterally at the centre of the frame and crush the load by acting on the blue webbing straps visible across the second bale in the bottom layer. The head and tailboards were braced with a chain passed over two brackets on the outside. The test trailer was loaded with nine bales consisting of four in the bottom row of the lower deck, one bale at the front of the upper deck and four bales in the upper row. Note that the second from front bale is supported by a stand rated at 3500kg.

Photograph two – lateral tilt test showing top of overhead restraint frame.

Photograph three – Detail of headboard showing vertical rams at corners and brace chain on support brackets. The vertical check chain in centre is redundant as the rams are fitted with self acting lock valves. Tailboard has similar arrangement.



Photograph four – Detail of webbing strap at centre of trailer exerting downward force translated from horizontal ram at centre of frame.

Photograph five – Detail of second bale support.

4. TEST METHOD:

The load restraint was tested by using a pair of cranes to tilt the trailer in the appropriate directions as summarised below.

Digital inclinometers were fastened to the trailer in two axes and checked for zero reading prior to tilting.

Photograph six – Test one, lateral tilt showing maximum angle reading of 31.3°

<u>Photograph seven</u> – Test two, forward tilt showing achieved angle of 55.5 degrees.

<u>Photograph eight</u> – Rearward tilt showing angle achieved of 31.2 degrees.

5. TEST RESULTS:

During all tilt tests, the load remained in position.

The structure of the crush with the full trailer width plates above the individual top layer bales is considered adequate to meet the requirement of an upward restraint equivalent to 0.2g. To be confirmed by FEA analysis. Note FEA confirmed in BTK16-05-11 and modifications to design as summarized in the introduction of this report.

1. Test - tilt direction	2. Maximum tilt angle measured (degrees)	3. g force (Calculated from column 2)	4. Restraint of load
Lateral	31.3	0.520	Yes
Forward	55.5	0.824	Yes
Rearward	31.2	0.518	Yes
Upward	Allowed for by downward force used in FEA simulation.		Yes

Photograph nine – Load after the three tilt tests. Also layout of tail board chains. Note vertical check chain is slack.

6. REFERENCES:

NTC Australia, “Load restraint Guide” Second edition 2004.

Grain Link Storage Pty Ltd, Griffith NSW Weighbridge Certificate T40212

Cotton Australia, “Cotton Australia Fact Sheet Transportation of Round Modules”, 2013

BTK16-05-11 “FEA Report – Cotton Crush Roof Structure”.

CERTIFICATE of COMPLIANCE:

This certificate is issued using the 0.8g forward, 0.5g lateral and rearward and 0.2g upward performance requirements "Load Restraint Guide", 2nd Edition, 2004 National Transport Commission, Australia, and VDI 2700 (Verein Deutscher Ingenieure – Association of German Engineers).

Vehicle Details:

Generic drop deck triaxle trailer (limiting dimensions shown in diagram one, page 3) with specialised cotton bale crush restraint:	Design by Collier and Miller Engineering

Load & Restraint Details:

Maximum loading and minimum loading.	The loading rate shall consist of nine standard cotton bales or modules. The system will not accommodate fewer bales.
Load binder chains	Head board and Tailboard to be supplemented by 45 degree chains located as shown below (centre).
Second bale	To be supported by stand rated at 3500kg, shown below. Note lip of stand must be engaged over raised deck rear edge to act as additional load restraint.

Vehicle under test:

The above load restraint system has been tested and assessed to meet the performance requirement for restraining the load as specified for a static forward force of 0.8g, a lateral force of 0.5g, a rearward force of 0.5g, and upward restraining force of 0.2g.

Certificate Approved By:

Keith Mackinlay - MIEAust, CPEng

Bisitecniks Pty. Ltd. Date: 9th December, 2014

Certificate number: BTK14-12-01

bisitecniks P/L
VEHICLE DESIGN - CERTIFICATION - ACCREDITATION
ABN 63 005 783 880