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TEST REPORT

Title	:	**Report of Development Testing of the JET Systems Ltd. Joint Expansion Tool**
Laboratory No.	:	**BT07719TGE**
Client	:	JET SYSTEMS LTD **JET Systems Ltd. No. 5, Gleneagles Drive, Southwood, Farnborough, GU14 0PH**
For the Attention of	:	**Anthony Lundie**
Client's Reference	:	**JET Development Testing**
Date Received	:	**31st October 2007**
Date Tested	:	**5th December 2007, 17th July 2008, 19th September 2008**
Authorised by	:	**Matthew Grainger**
Our Reference	:	**BT07719TGE report**
Date of Issue	:	**6th October 2008**

CONTENTS

REPORT OF DEVELOPMENT TESTING ON JET SYSTEMS LTD. JOINT EXPANSION TOOL

1.0 INTRODUCTION

Two sets of three samples of the JET Systems LTD. Joint expansion tools were delivered to CERAM to be subjected to a series of development testing to firstly determine a load/torque relationship and secondly to determine an ultimate load that the joint expansion tools can sustain within a brick wall.

2.0 SAMPLE DESCRIPTION

The Joint Expansion Tool (JET) consists of:

- 2no. 5mm thick 150mm x 65mm mild steel plate with 2no. 14mm diameter holes at 31mm centres located 10mm in from one end of the plate. On one of the plates an additional 14mm diameter hole is located at mid length of the plate, 24mm in from the same end of the two other 14mm diameter holes with a M12 nut welded onto the face of the plate around the hole.
- 3no. M12 47.5mm long bolts which were located at each hole within the steel plates
- 2no. M12 plain nuts which were used for the two bolts at the two holes 10mm in from the end of the plates

One set of joint expansion tools consisted of the JET tools described above, the other set of JET tools were exactly the same apart from that the steel plates were 6mm thick instead of 5mm thick.

A general view of the test samples can be seen in Figure 1

3.0 TEST ARRANGEMENT.

3.1 Load/Torque relationship

A 50mm thick 400mm x 400mm steel support plate was fixed to the laboratory strong floor using 4no. M36 125mm long bolts. A calibrated 25kN load was placed upon the support plate with the centre of the bottom flat surface of the JET tool placed upon that, then with a 25mm thick 200mm x 200mm steel plate placed upon the top flat surface of the JET tool, so that the operation part of the tool projected out. The steel plate was fixed to the support plate via 4no. M12 112mm long bolts, which effectively ‘clamped’ the load cell and the JET tool.

3.2 Ultimate Load Sustained within a Brick Wall

A Fletton brick wall made up of 15.5 bricks long and 19 courses high with mortar joints of nominally 10mm was built within the CERAM Laboratory and left to cure for no less than 28 days.

A steel test rig was placed directly above the wall and fixed to the laboratory test floor, 3no. hydraulic rams were fixed to the steel test rig and positioned above the wall, one ram at mid-span and the other two 900mm either side of the middle ram. Steel spreader 'feet' which consists of two steel spreader plates within a linkage system, were attached to the bottom of each hydraulic ram to account for any uneven vertical displacement of the wall during the test.

Two linear voltage displacement transducers (LVDT) were positioned 75mm either side of the steel spreader 'feet' of the middle hydraulic ram.

Four JET tools were used within the brick wall, the locations of these JET tools can be seen on figure 2.

4.0 METHOD OF TEST

4.1 Load/Torque Relationship

Torque was applied to the JET operation bolt by using a calibrated torque wrench and recorded at every 6Nm increments starting at 28Nm until failure occurred. At each torque increment the resulting load the JET tool provided was also recorded, thus providing a load/torque relationship.

Load was measured via a calibrated load cell

4.2 Ultimate Load Sustained Within a Brick Wall

Four perp mortar joints were removed at pre-determined locations by using a masonry hammer drill.

The four JET tools were inserted into the brick wall at the open perp mortar joint locations and tighten by using a manual ratchet spanner. The torque applied via the ratchet spanner was checked by using a calibrated torque wrench, all JET tools were tightened to 40Nm.

Nine bricks from the coursework beneath the bottom row of JET tools were removed by using a masonry hammer drill and a manual masonry saw, leaving an opening of nominally 2000mm x 70mm x 105mm.

The two linear voltage displacement transducers (LVDT) were then zeroed after the opening was made.

A vertical load onto the brick wall was applied via 3no. hydraulic rams until failure occurred within the brick wall. At a loading rate such that the brick wall would fail within 5-10 minutes

Load was measured via a calibrated load cell

Deflection was measured via calibrated transducers

Load and deflection was recorded on a calibrated data logger

5.0 RESULTS

5.1 Load/Torque Relationship

Load and torque results can be seen in the ‘results’ section. Comparison graphs between the 5mm plate JET tool and the 6mm plate JET tool can be seen in the ‘charts’ section

5.2 Ultimate Load Sustained Within a Brick Wall

The ultimate load the brick wall sustained with 3no 5mm plate JET tools incorporated within was 69.16kN (7057kg) which equals to a bearing stress 0.53kN/mm^2 beneath the loading plates. Load v deflection charts can be seen within the ‘charts’ section.

6.0 DISCUSSION

Assuming that the weight of brickwork being supported above the opening is that contained within a triangle with the opening as its base and the apex is at the head of the wall the weight to be supported is estimated as 1275N. This weight would give a bending moment in the brickwork of 425N-m. If the force in the course above the opening which has been introduced by the JET is sufficient to cause no tension to be developed at the soffit and taking a lever arm in the deep beam above the opening as 0.8 times its depth the force is estimated as 700N. Consequently if there is a safety factor against collapse of 3 the force required in the JET is 2.1kN. This assumes no real contribution from the JET at the upper level. From the calibration data for the 5mm JET tool a torque of 40Nm produces a force of 3.28kN which is more than enough even allowing for some fall off in force as the tool beds in. This torque is also readily achievable on site and hence was used in the test. It also provides a force well below that to crush the end faces of the brick. When the brick course was removed there was no distress whatsoever, no visible movement or cracking which suggests that the calculations above are reasonable.

The load applied to the jacks was 69.16kN of which probably about $^2/_3$ acts over the opening. This would apply a bending moment in excess of 7kNm at the soffit. At moments above about 4kNm the force in the JET would have been overcome and we might have expected a tension failure at the soffit.

In fact it took a greater load and moment to cause the collapse of the brickwork in the triangle above the opening. Clearly in this application the JET has demonstrated that it can with modest torque support the weight of the brickwork above a 2m opening safely. Also a significant amount of applied load is required to cause failure.

Authorised Signatory

M. Grainger

Matthew Grainger
Testing Co-ordinator, Structures Group

End of Written Report

RESULTS

TABLE 1: Load/Torque Relationship Results – 5mm Plate JET

Torque (Nm)	JET #1 Load (kN)	JET #2 Load (kN)	JET #3 Load (kN)	Mean Load (kN)
28	1.15	3.94	2.24	2.45
34	1.38	4.20	2.89	2.82
40	2.32	4.32	3.20	3.28
46	2.99	5.01	3.31	3.77
52	3.66	5.54	4.18	4.46
58	3.95	6.40	4.85	5.06
64	5.01	6.52	5.32	5.62
70	5.49	7.12	6.29	6.30
76	6.14	7.43	6.58	6.72
82	7.03	7.25	6.94	7.07
88	7.76	6.84	7.30	7.30
94	7.89	6.57	7.30	7.25
100	7.93	~	~	~

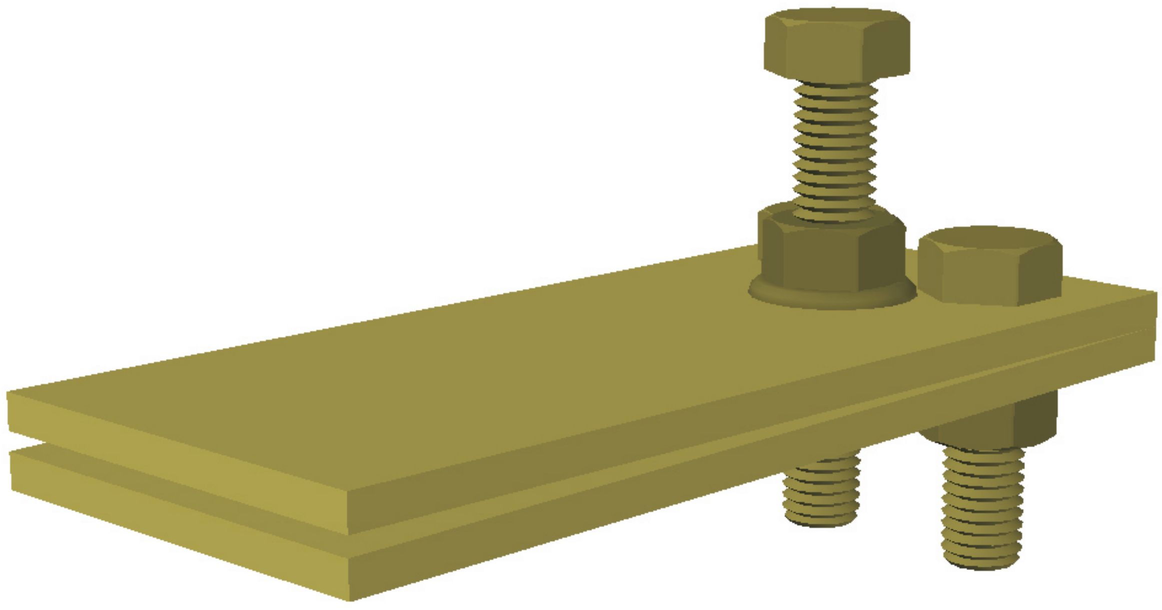
TABLE 2: Load/Torque Relationship Results – 6mm Plate JET

Torque (Nm)	JET #1 Load (kN)	JET #2 Load (kN)	JET #3 Load (kN)	Mean Load (kN)
28	3.45	4.77	4.25	4.16
34	3.69	5.19	5.29	4.72
40	4.33	5.78	5.50	5.20
46	4.52	6.67	5.91	5.70
52	4.58	6.76	6.37	5.90
58	5.17	7.71	6.66	6.51
64	6.60	9.42	7.24	7.75
70	7.20	10.75	7.60	8.52
76	7.91	11.57	7.96	9.15
82	8.42	12.86	8.12	9.80
88	9.27	13.58	8.39	10.41
94	9.85	14.29	8.76	10.97
100	10.02	14.51	9.43	11.32
106	11.04	16.26	10.15	12.48
112	11.38	16.59	10.68	12.88
118	12.55	16.88	11.02	13.48
124	13.23	16.91	11.62	13.92
130	13.57	16.94	11.85	14.12
136	14.26	16.79	13.47	14.84
142	14.11	16.89	13.52	14.84

TABLE 3: Ultimate Load Results

Ultimate Load (kN)	Failure Deflection (mm)
69.16	0.52

FIGURES



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DWG. N°.	SCALE:	DATE DRAWN:	DRAWN BY:
Figure 1	NOT TO SCALE	29/09/2008	A. BELLAMY

TITLE:
View of joint expansion tool

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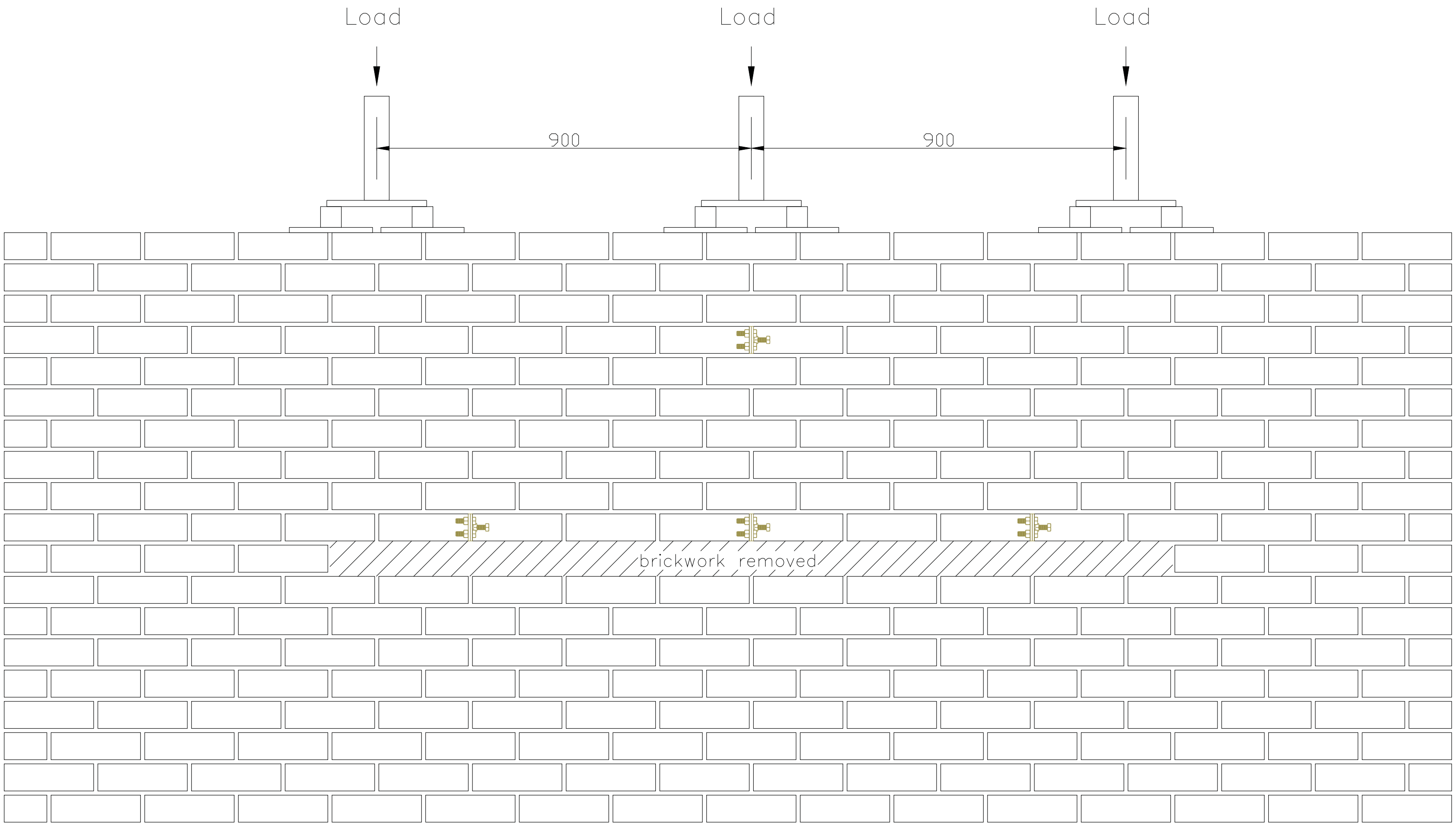

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DWG. N°.	SCALE:	DATE DRAWN:	DRAWN BY:
Figure 2	NOT TO SCALE	29/09/2008	A. BELLAMY

TITLE:
Detail and Dimensions for test setup

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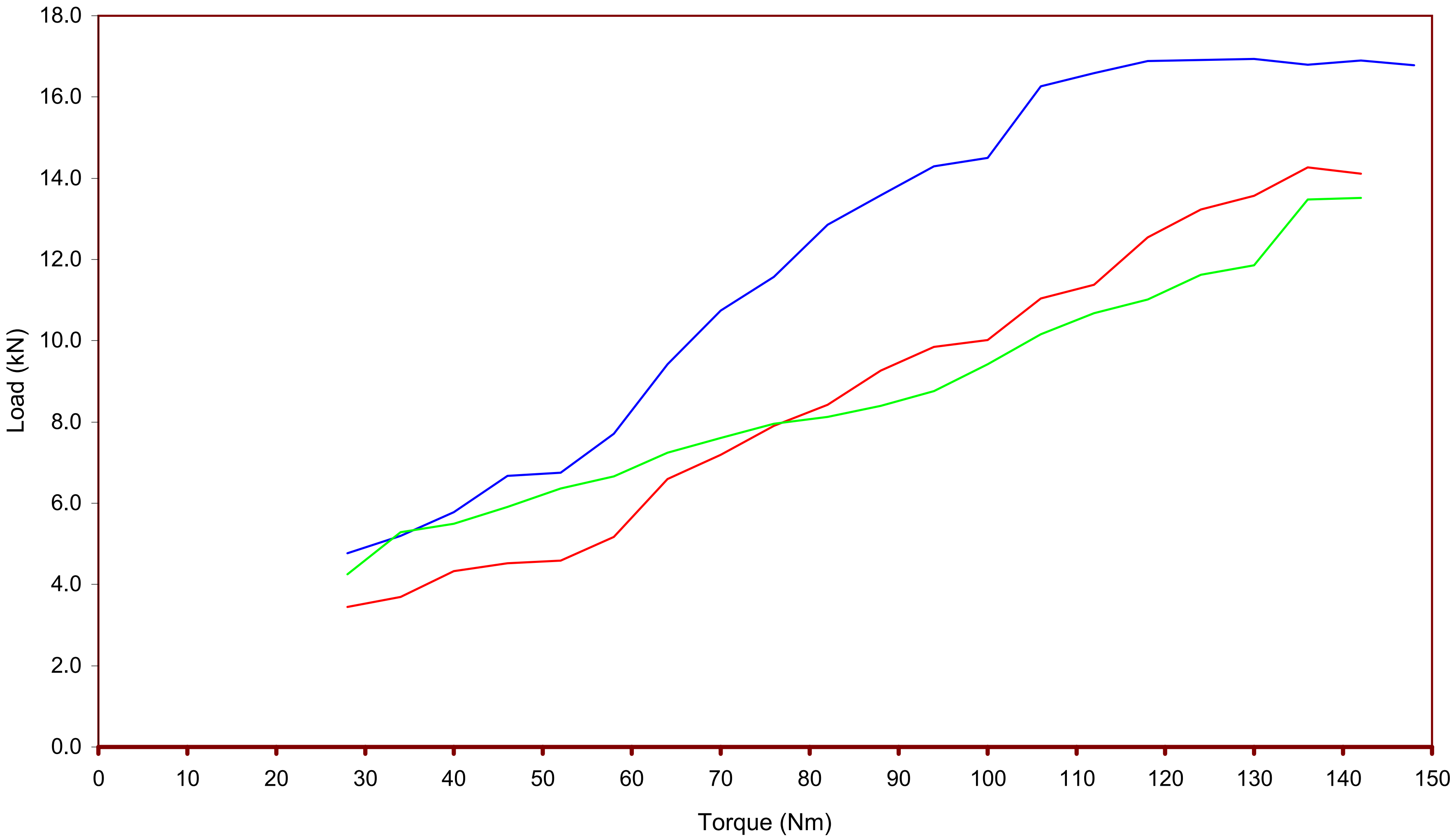
CHARTS

Load v Torque Chart
for the 6mm Plate Joint Expansion Tool



Key test #1 test #2 test #3

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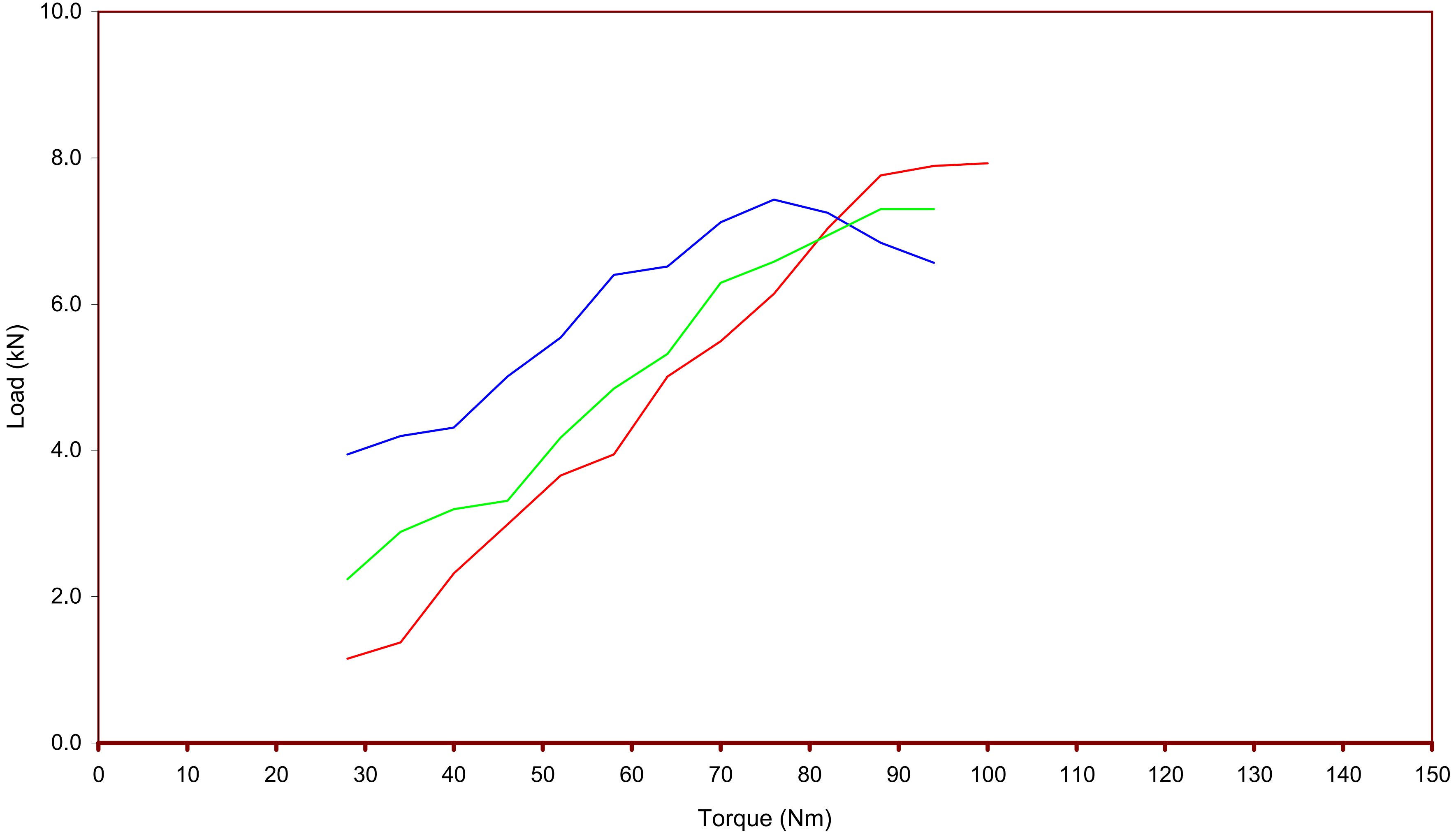
Load v Torque Chart
for the 5mm Plate Joint Expansion Tool



Key

test 1
test 2
test 3

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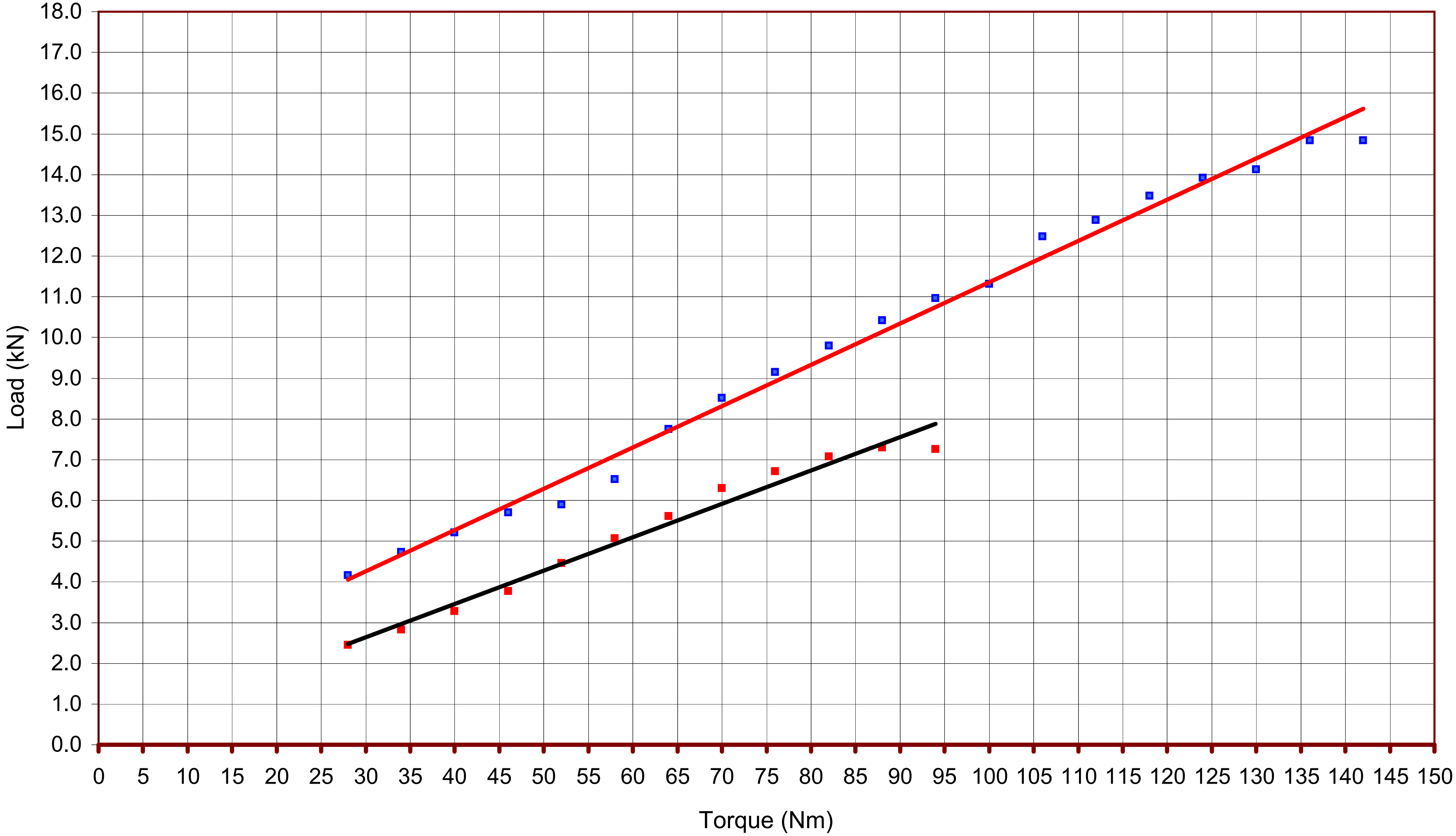
Load v Torque Chart
Comparison Chart Between the 6mm and 5mm Plate Joint Expansion Tools



Key 5mm 6mm Linear (5mm) Linear (6mm)

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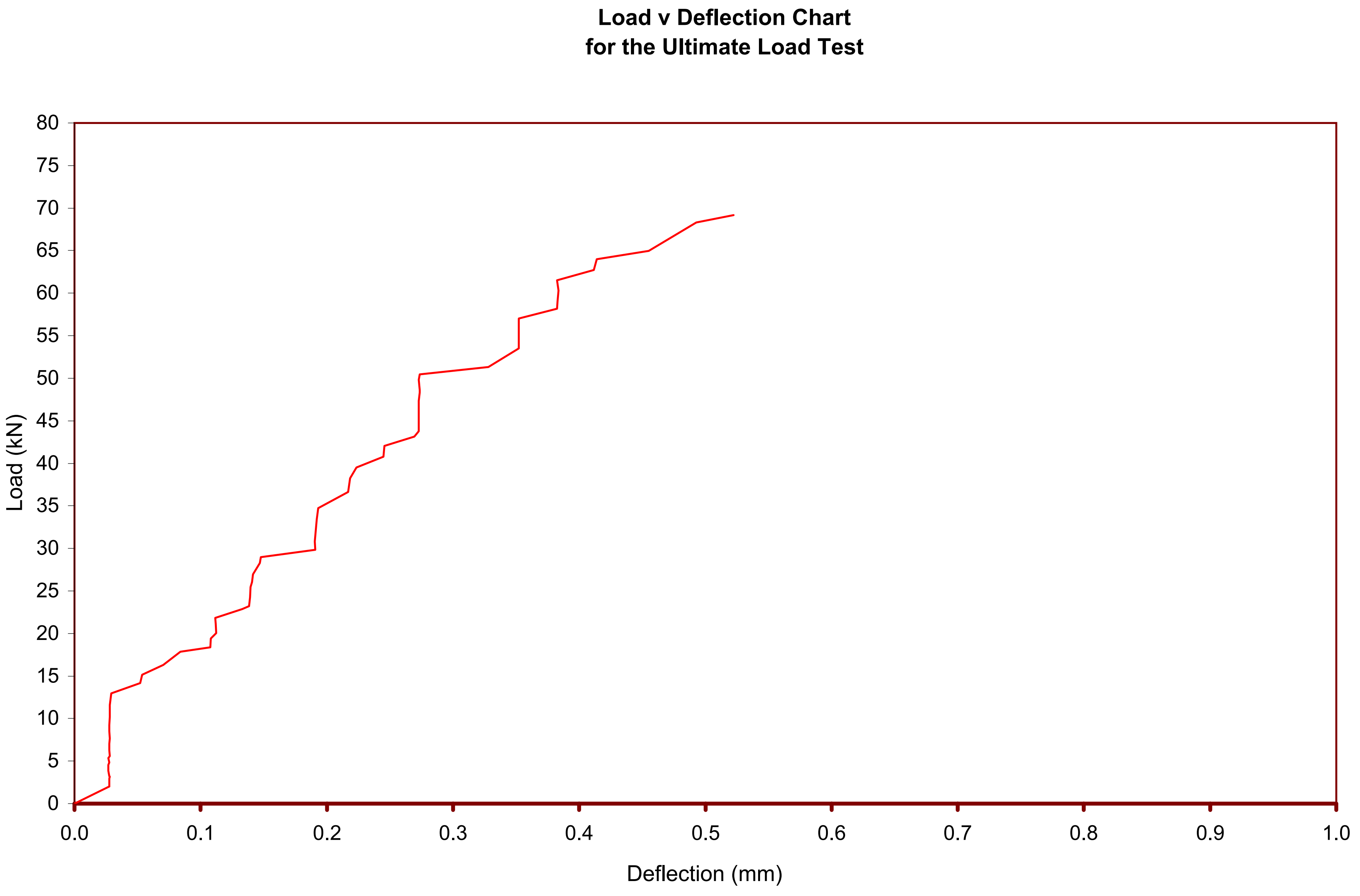

Key	load test	JET SYSTEMS LTD	Test Report Laboratory Number: BT07719TGE	Queens Road, Penkhull, Stoke-on-Trent, Staffs. ST4 7LQ Tel. (01782) 746476 Fax. (01782) 764458	CERAM BUILDING TECHNOLOGY

PLATES

PLATE 1: Showing General Test-Setup for the Ultimate Load

PLATE 2: Showing the Opening made Within the Brick Wall

PLATE 3: Showing Mode of Failure for the Ultimate Load