

## **PLASCORE DEFORMABLE BARRIER**



## **MOBILE DEFORMABLE BARRIER EEVC WG13**



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## **1.0 - INTRODUCTION**

### **1.1 Performance Requirements**

The ECE Regulation 95 (and the equivalent EU Directive) defines the deformable element of the mobile deformable barrier (MDB) in terms of the force-deflection characteristics when impacting a six element load cell wall together with some dimensional requirements. Due to inconsistencies in the dynamic performance of these barriers the European Enhanced Vehicle-Safety Committee's (EEVC) Working Group 13 (WG 13) proposed modifications to the existing MDB face.

The new design specification includes quasi-static force deformation corridors, adhesive bond strength requirements and specifications for the aluminum material used for blocks, front plate and back plate. Other minor changes have also been added.

The MDB is made up of a MDB face and a trolley. The MDB face is henceforth called as an Impactor in this literature.

The Impactor is comprised of six individual face sections / blocks. The crush properties of each section must fall within special load-deformation corridors. There are two corridors for each section, a quasi-static corridor and a dynamic corridor. The quasi-static corridor is used for certification purposes.

To verify conformity with the specification requirements, Plascore tests one face section from each batch produced. The results of this testing must fall within the specific quasi-static corridor for the batch to be accepted.

Dynamic testing of a fully assembled barrier is carried out at a certified testing facility. One of every 100 barrier impactors Plascore Inc manufactures, will undergo dynamic testing at a certified testing facility to confirm the quality.

### **1.2 Documentation**

The test facility must obtain a copy of the certification data and procedure used by the MDB face manufacturer to certify that the honeycomb barrier meets the Quasi-Static requirements.

**Plascore's Barrier meets all the performance requirements set forth above. Also Plascore does provide all the certification and the documentation mentioned. Examples of certifications, graphs and test reports are shown, later in the brochure.**

## **2.0 - CHARACTERISTICS OF THE IMPACTOR**

The impactor consists of six single blocks of aluminium honeycomb, which have been processed in order to give a progressively increasing level of force with increasing deflection. (See section 2.1). Front and rear aluminium plates are attached to the aluminium honeycomb blocks.

### **2.1 Honeycomb blocks**

#### **2.1.1 Geometrical characteristics**

- The impactor consists of 6 joined zones whose forms and positioning are shown in Figures 1 and 2. The zones are defined as  $500 \pm 5$  mm x  $250 \pm 3$  mm in Figures 1 and 2. The 500mm should be in the W direction and the 250mm in the L direction of the aluminium honeycomb construction. (See Figure 3)
- The impactor is divided into 2 rows. The lower row shall be  $250 \pm 3$  mm high, and  $500 \pm 2$  mm deep after pre-crush (see 2.1.2), and deeper than the upper row by  $60 \pm 2$  mm.
- The blocks will be centered on the six zones defined in Figure 1 and each block (including incomplete cells) shall cover completely the area defined for each zone).

#### **2.1.2 Pre-crush**

- The pre-crush shall be performed on the surface of the honeycomb to which the front sheets are attached.
- Blocks 1, 2 and 3 shall be crushed by  $10 \pm 2$  mm on the top surface prior to testing to give a depth of  $500 \pm 2$  mm. (Figure 2)
- Blocks 4, 5 and 6 shall be crushed by  $10 \pm 2$  mm on the top surface prior to testing to give a depth of  $440 \pm 2$  mm.

#### **2.1.3 Material characteristics**

- The cell dimensions shall be  $19 \pm 10\%$  for each block.(see Figure 4.)
- The cells shall be made of 3003 aluminium for the upper row.
- The cells shall be made of 5052 aluminium for the lower row.
- The aluminium honeycomb blocks shall be processed such that the force deflection curve when statically crushed (according to the procedure defined in Section 2.1.4.) is within the corridors defined for each of the six blocks in Appendix 1. The processed honeycomb material used in the honeycomb blocks to be used for constructing the barrier shall be cleaned in order to remove any

residue that may have been produced during the processing of the raw honeycomb material.

- The mass of the blocks in each batch shall not differ by more than [5]% of the mean block mass for that batch.

#### 2.1.4 Static tests

- A sample taken from each batch of processed honeycomb core shall be tested according to the Static Test procedure described in Section 4.
- The Force-Compression for each block tested shall lie within the force deflection corridors defined in Appendix 1. Static force-deflection corridors are defined for each block of the barrier.

#### 2.1.5 Dynamic Test

- The dynamic deformation characteristics are supplemented by the static deformation characteristics. Hence conformity with the static test, force deflection corridors will be sufficient and provided to the customer. Dynamic Test details have been provided in this literature for reference purpose only.  
Deviation from the limits of the force-deflection corridors characterizing the rigidity of the impactor - as defined Appendix 2- may be allowed provided that:
  - The deviation occurs after the beginning of the impact and before the deformation of the impactor is equal to 150 mm;
  - The deviation does not exceed 50% of the nearest instantaneous prescribed limit of the corridor;
  - Each deflection corresponding to each deviation does not exceed 35 mm of deflection, and the sum of these deflections does not exceed 70 mm (see Appendix 2)
  - The sum of energy derived from deviating outside the corridor does not exceed 5 % of the gross energy for that block.
- Blocks 1 and 3 are identical. Their rigidity is such that their force deflection curves fall between corridors of Figure 2a.
- Blocks 5 and 6 are identical. Their rigidity is such that their force deflection curves fall between corridors of Figure 2d.
- The rigidity of Block 2 is such that its force deflection curves fall between corridors of Figure 2b.
- The rigidity of Block 4 is such that its force deflection curves fall between corridors of Figure 2c.
- The force-deflection of the impactor as a whole shall fall between corridors of Figure 2e.

- The force-deflection curves shall be verified by a test detailed in Annex 5 of WG 13's Publication - Revised Specification for the EEVC Mobile Deformable Barrier Face.
- The dissipated energy<sup>1</sup> against Blocks 1 and 3 during the test shall be equal to  $9.5 \pm 2$ kJ for these Blocks.
- The dissipated energy against Blocks 5 and 6 during the test shall be equal to  $3.5 \pm 1$ kJ for these Blocks.
- The dissipated energy against Block 4 shall be equal to  $4 \pm 1$ kJ.
- The dissipated energy against Block 2 shall be equal to  $15 \pm 2$  kJ.
- The dissipated total energy during the impact shall be equal to  $45 \pm 5$  kJ.
- The maximum impactor deformation from the point of first contact, calculated from integration of the accelerometers according to 5.6.3, shall be equal to  $330 \pm 20$  mm.
- The final residual static impactor deformation measured after the dynamic test at level B (Figure 2) shall be equal to  $310 \pm 20$  mm.

*[NOTE: the values of energy absorption for only blocks 1&3 and 2 differ from that in the existing Regulation 95]*

## **2.2 Front Plates**

### **2.2.1 Geometrical characteristics**

- The dimensions of the front plates are  $1500 \pm 1$ mm wide and  $250 \pm 1$ mm high. The thickness is  $0.5 \pm 0.06$  mm ( $0.02'' \pm 0.002''$ )
- When assembled the overall dimensions of the impactor (defined in Figure 2) shall be  $1500 \pm 2.5$ mm wide and  $500 \pm 2.5$ mm high.
- The upper edge of the lower front plate and the lower edge of the upper front plate shall be aligned within 4mm ( $0.157''$ ).

### **2.2.2 Material characteristics**

- The front plates are manufactured from aluminium of series Al Mg 2.5 (5052) with elongation =12%, and a UTS = 228 N/mm<sup>2</sup>.(33 ksi)

## **2.3 Back Plate**

### **2.3.1 Geometrical characteristics**

- The geometrical characteristics shall be according to Figures 5 and 6.

### 2.3.2 Material characteristics

- The back plate shall consist of a 3 mm (0.118”) aluminium sheet. The back plate shall be manufactured from aluminium of series Al Mg 2.5 (5052) with a hardness of 60 HBS. This plate shall be perforated with holes for ventilation: the location, the diameter and pitch are shown in Figures 5 and 7.

### 2.4 Location of Honeycomb Blocks

The honeycomb blocks shall be centered on the perforated zone of the back plate (Figure 5).

### 2.5 Bonding

- For both the front and the back plates, a maximum of 0.5 kg per m<sup>2</sup> shall be applied evenly directly over the surface of the front plate, giving a maximum film thickness of 0.5 mm. The adhesive to be used throughout should be a two-part polyurethane {such as Ciba-Geigy XB5090/1 resin with XB5304 hardener} or equivalent.
- For the back plate the minimum bonding strength shall be 0.6 Mpa, (87 psi) ], tested according to the following:
  - Bonding strength tests:
    - Flatwise tensile testing is used to measure bond strength of adhesives according to ASTM C297-61.
    - The test piece shall be 100mm x 100mm, and 15 mm deep, bonded to a sample of the ventilated back plate material. The honeycomb used should be representative of that in the impactor, i.e. chemically etched to an equivalent degree as that near to the back plate in the barrier but without pre-crushing.

### 2.6 Traceability

Impactors shall carry a consecutive serial number, which is etched, from which the batches for the individual blocks and the date of manufacture can be established.

### 2.7 Impactor Attachment

The fitting on the trolley must be according to Figure 8. The fitting will use six M8 bolts, and nothing shall be larger than the dimensions of the barrier in front of the wheels of the trolley. Appropriate spacers must be used between the lower back plate flange and the trolley face to avoid bowing of the back plate when the attachment bolts are tightened. The attachment of the impactor to the trolley will be carried out by the contractor.

### **3.0 - VENTILATION SYSTEM**

The interface between the trolley and the ventilation system should be solid, rigid and flat. The ventilation device is part of the trolley and not of the impactor as supplied by Plascore Inc. Geometrical characteristics of the ventilation device shall be according to figure 9. The ventilation device mounting procedure below is for customers reference only:

- Mount the ventilation device to the front plate of the trolley;
- Ensure that a 0.5 mm thick gauge cannot be inserted between the ventilation device and the trolley face at any point. If there is a gap greater than 0.5mm, the ventilation frame will need to be replaced or adjusted to fit without a gap of >0.5mm.
- Dismount the ventilation device from the front of the trolley;
- Fix a 1.0 mm thick layer of cork to the front face of the trolley;
- Re-mount the ventilation device to the front of the trolley and tighten to exclude air gaps.

#### **4.0 - STATIC TESTS**

- One or more samples (according to the batch method) taken from each batch of processed honeycomb core shall be tested, according to the following test procedure:
  - The sample size of the aluminium honeycomb for static tests shall be the size of a normal block of the impactor, that is to say 250mm x 500mm x 440mm for top row and 250mm x 500mm x 500mm for the bottom row.
  - The samples should be compressed between two parallel loading plates which are at least [20]mm larger than the block cross section.
  - The compression speed shall be 100 millimeters per minute, with a tolerance of 5 %.
  - The data acquisition for static compression shall be sampled at a minimum rate of 5Hz.
  - The static test shall be continued until the block compression is at least 300mm. for blocks 4 to 6 and 350mm. for blocks 1 to 3.

## **5.0 - DYNAMIC TESTS**

Plascore Inc. provides the following discussion for reference only. The test facility does the actual dynamic testing. Plascore Inc will conduct a dynamic test every 100 impactors produced in-house, through a certified testing facility to confirm the quality of the impactor.

### **5.1 Installation**

#### **5.1.1 Testing ground**

- The test area shall be large enough to accommodate the run-up-track of the mobile deformable barrier, the rigid barrier and the technical equipment necessary for the test. The last part of the track, for at least 5 meters before the rigid barrier, shall be horizontal, flat and smooth.
- Fixed rigid barrier and dynamometric wall
- The rigid wall shall consist of a block of reinforced concrete not less than 3 meters wide and not less than 1.5 meters high. The thickness of the rigid wall shall be such that it weighs at least 70 tonnes.
- The front face shall be vertical, perpendicular to the axis of the run-up-track and equipped with six load cell plates, each capable of measuring the total load on the appropriate block of the mobile deformable barrier impactor at the moment of impact. The load cell impact plate area centers shall align with those of the six impact zones of the mobile deformable barrier face. Their edges shall clear adjacent areas by 20 mm such that, within the tolerance of impact alignment of the MDB, the impact zones will not contact the adjacent impact plate areas. Cell mounting and plate surfaces shall be in accordance with the requirements set out in the annex to ISO 6487/1987.
- Surface protection, comprising a plywood face (thickness :  $12 \pm 1$ mm), is added to each load cell plate such that it shall not degrade the transducer responses.
- The rigid wall shall be either anchored in the ground or placed on the ground with, if necessary, additional arresting devices to limit its deflection. A rigid wall (to which the load cells are attached) having different characteristics but giving results that are at least equally conclusive may be used.

### **5.2 Propulsion of the Mobile Deformable Barrier**

At the moment of impact the mobile deformable barrier shall no longer be subject to the action of any additional steering or propelling device. It shall reach the obstacle on a course perpendicular to the front surface of the dynamometric wall. Impact alignment shall be accurate to within 10 mm.

### **5.3 Measuring Instruments**

#### **5.3.1 Speed**

The impact speed shall be  $35 \pm 0.5$  km/h. the instrument used to record the speed on impact shall be accurate to within 0.1 percent.

#### **5.3.2 Loads**

Measuring instruments shall meet the specifications set forth in ISO 6487/1987

CFC for all blocks : 60 Hz

CAC for blocks 1 and 3 : 200 kN

CAC for blocks 4,5 and 6 : 100 kN

CAC for block 2 : 200 kN

#### **5.3.3 Acceleration**

- The acceleration in the longitudinal direction shall be measured at three separate positions on the trolley, one centrally and one at each side, at places not subject to bending.
- The central accelerometer shall be located within 500mm of the location of the center of gravity of the MDB and shall lie in a vertical longitudinal plane which is within  $\pm 10$ mm of the centre of gravity of the MDB.
- The side accelerometers shall be at the same height as each other  $\pm 10$ mm and at the same distance from the front surface of the MDB  $\pm 20$ mm
- The instrumentation shall comply with ISO 6487/1987 with the following specifications:  
CFC 1000 Hz (before integration)  
CAC 50 g.

### **5.4 General Specifications of Barrier**

The individual characteristics of each barrier shall comply with paragraph 1 and shall be recorded.

### **5.5 General Specifications of the Impactor**

- The suitability of an impactor as regards the dynamic test requirements shall be confirmed when the outputs from the six load cell plates each produce signals complying with the requirements indicated in this Appendix.
- Impactors shall carry consecutive serial numbers, which are etched or otherwise permanently attached, from which the batches for the individual blocks and the date of manufacture can be established.

## 5.6 Data Processing Procedure

### 5.6.1 Raw data

At time  $T = T_0$ , all offsets should be removed from the data. The method by which offsets are removed shall be recorded in the test report.

### 5.6.2 Filtering

- The raw data will be filtered prior to processing/calculations.
- Accelerometer data for integration will be filtered to CFC 180, ISO 6487/1987.
- Accelerometer data for impulse calculations will be filtered to CFC 60, ISO 6487/1987.
- Load cell data will be filtered to CFC 60, ISO 6487/1987.

### 5.6.3 Calculation of MDB face deflection

- Accelerometer data from all three accelerometers individually (after filtering at CFC 180), will be integrated twice to obtain deflection of the barrier deformable element.
- The initial conditions for deflection are :
  - velocity = impact velocity (from speed measuring device).
  - deflection = 0
  - The deflection at the left hand side, mid-line and right hand side of the mobile deformable barrier will be plotted with respect to time.
  - The maximum deflection calculated from each of the three accelerometers should be within 10 mm. If it is not the case, then the outlier should be removed and difference between the deflections calculated from the remaining two accelerometers checked to ensure that it is within 10mm.
  - If the deflections as measured by the left hand side, right hand side and mid-line accelerometers are within 10 mm, then the mean acceleration of the three accelerometers should be used to calculate the deflection of the barrier face.
  - If the deflection from only two accelerometers meets the 10mm. requirement, then the mean acceleration from these two accelerometers should be used to calculate the deflection for the barrier face.
  - If the deflections calculated from all three accelerometers (left hand side, right hand side and mid-line) are NOT within the 10mm requirement, then the raw data should be reviewed to determine the causes of such large variation. In this case the individual test house will determine which accelerometer data should be used to determine mobile deformable barrier deflection or whether none of the accelerometer readings can be used, in which case, the certification test must be repeated. A full explanation should be given in the test report.
  - The mean deflection-time data will be combined with the load cell wall force-time data to generate the force-deflection result for each block.

#### 5.6.4 Calculation of Energy

The absorbed energy for each block and for the whole MDB face should be calculated up to the point of peak deflection of the barrier.

$$E_n = \int_{t_0}^{t_1} F_n \cdot ds_{mean}$$

where:  $t_0$  is the time of first contact

$t_1$  is the time where the trolley comes to rest, i.e. where  $u = 0$ .

$s$  is the deflection of the trolley deformable element calculated.

#### 5.6.5 Verification of Dynamic Force Data

- Compare the total impulse, **I**, calculated from the integration of the total force over the period of contact, with the momentum change over that period ( $M \cdot V$ ).
- Compare the total energy change to the change in kinetic energy of the MDB, given by

$$E_K = \frac{1}{2} M V_i^2$$

where  $V_i$  is the impact velocity and  $M$  the whole mass of the MDB

- If the momentum change ( $M \cdot V$ ). is not equal to the total impulse (**I**)  $\{\pm[5]\%$  or if the total energy absorbed ( $E_n$ ) is not equal to the kinetic energy,  $E_K$   $\{\pm 5\%$  then the test data must be examined to determine the cause of this error.

# DESIGN OF IMPACTOR

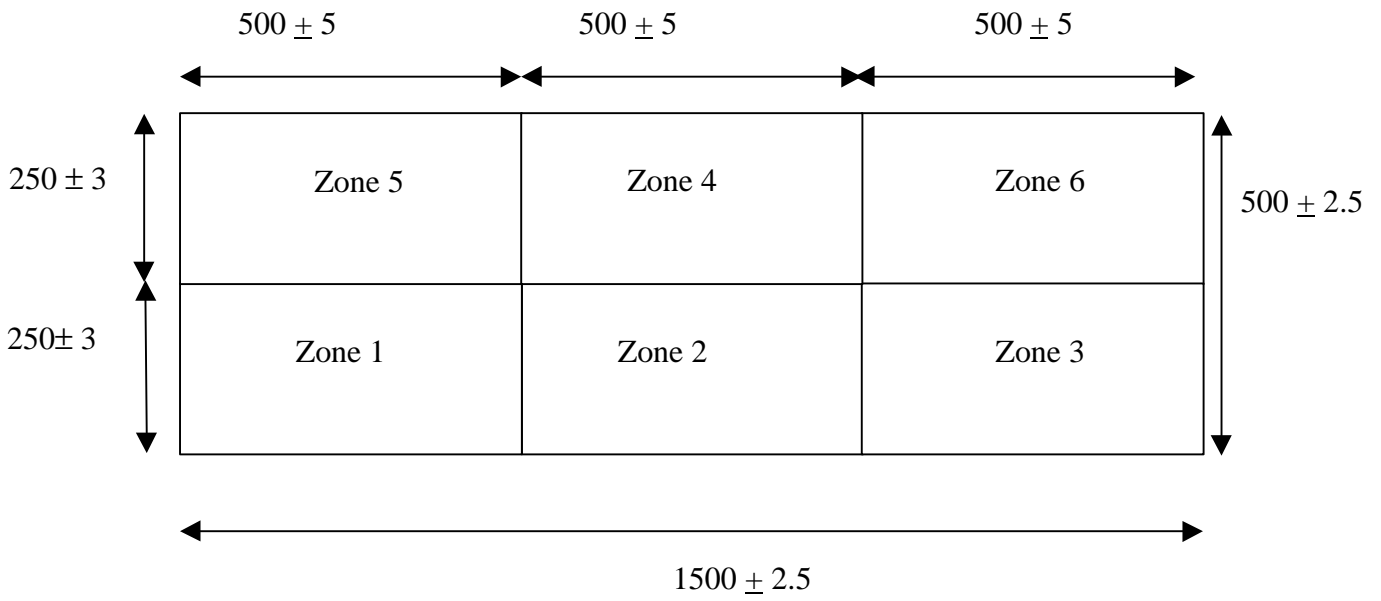


Figure 1

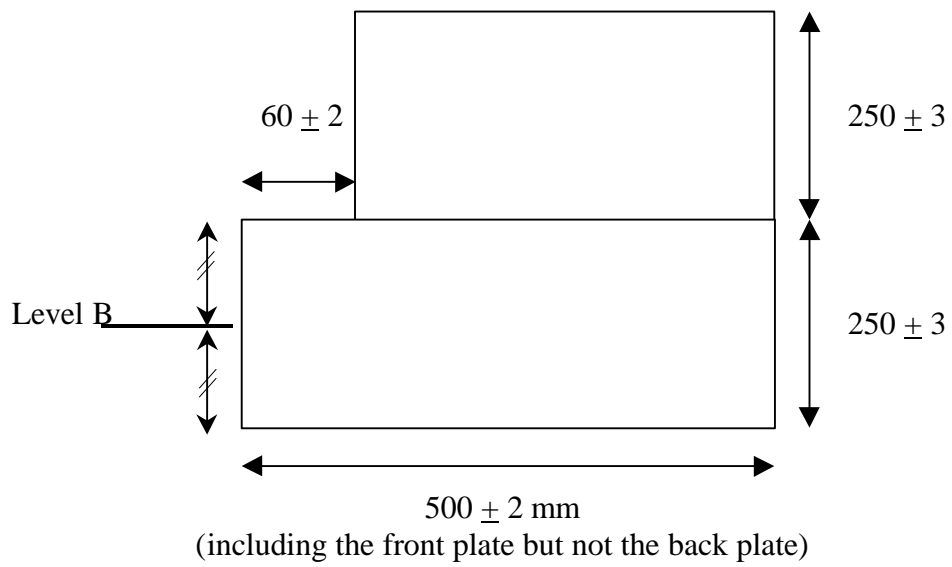
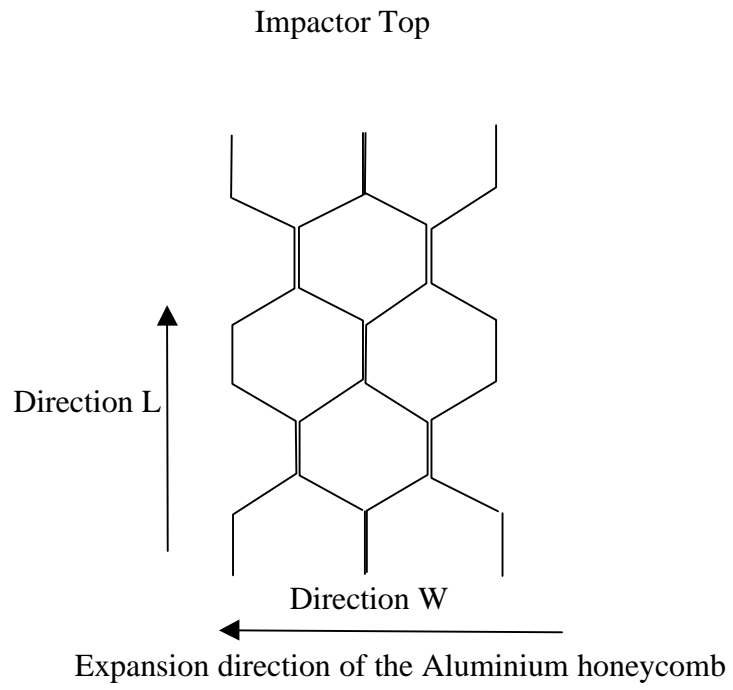
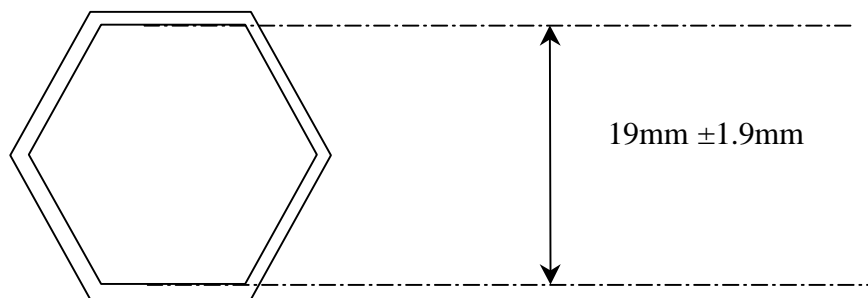


Figure 2



*Figure 3.* Aluminium Honeycomb Orientation



*Figure 4.* Dimension of Aluminium Honeycomb Cells

DESIGN OF THE BACK PLATE

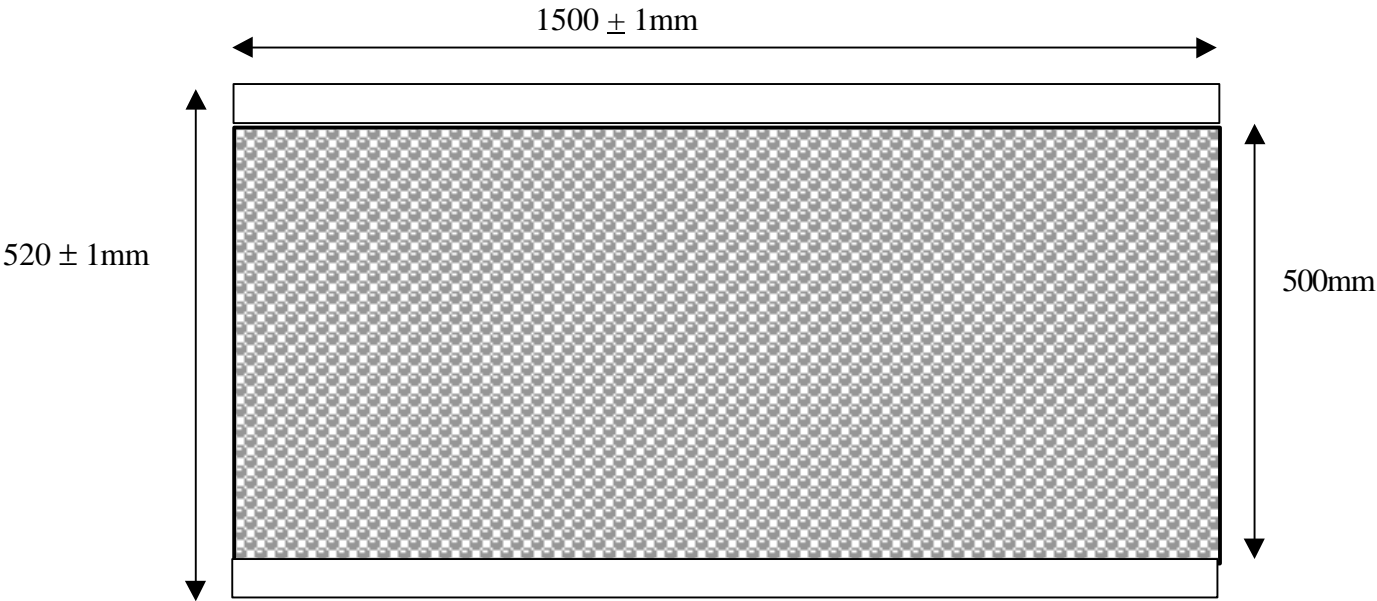
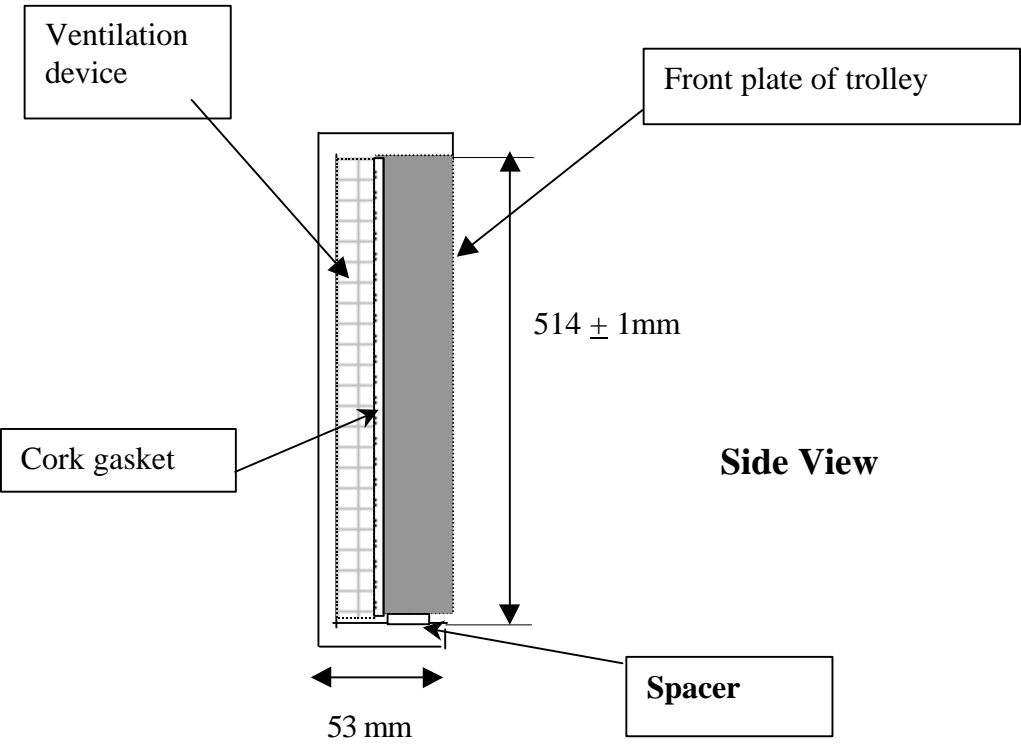


Figure 5

Front View



Side View

Figure 6

Attachment of backplate to ventillation device and trolley face plate

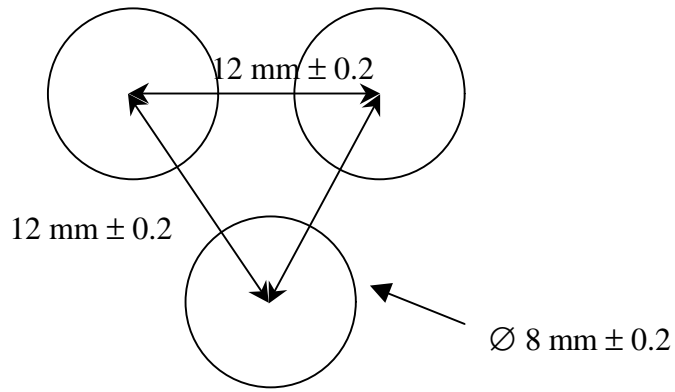
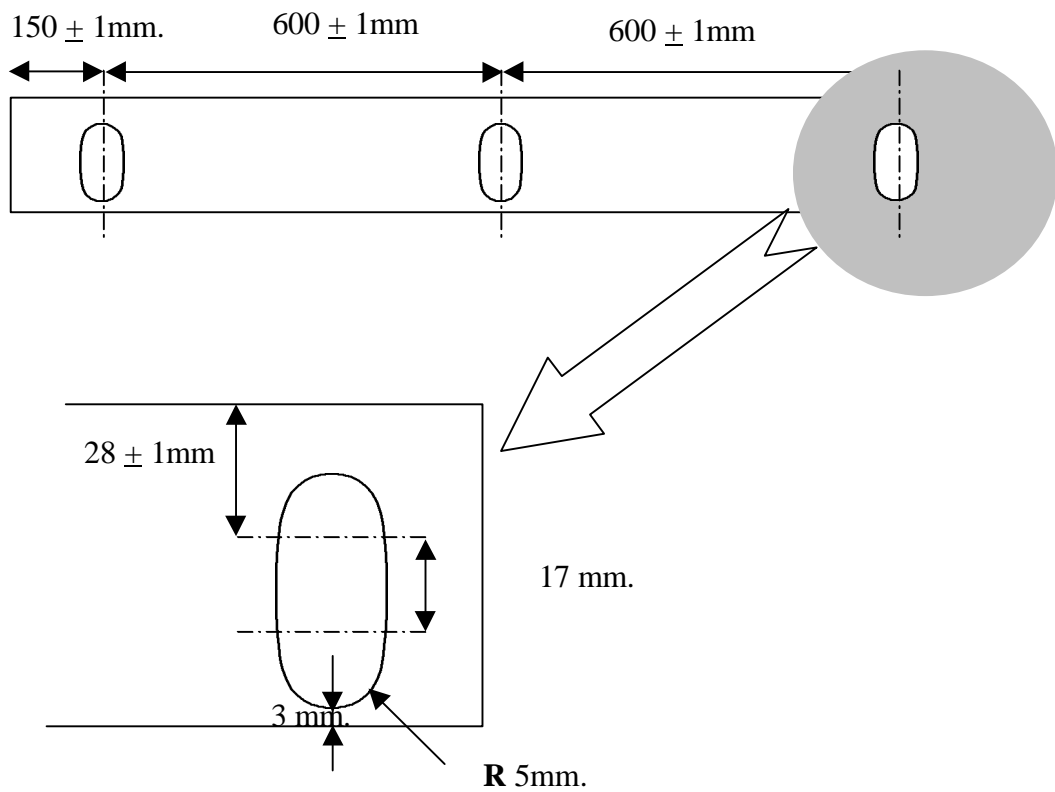


Figure 7 - Staggered pitch for the back plate ventilation holes



Top and Bottom Back Plate Flanges

*NOTE: The attachment holes in the bottom flange may be opened to slots, as shown below, for ease of attachment provided sufficient grip can be developed to avoid detachment during the whole impact test.*

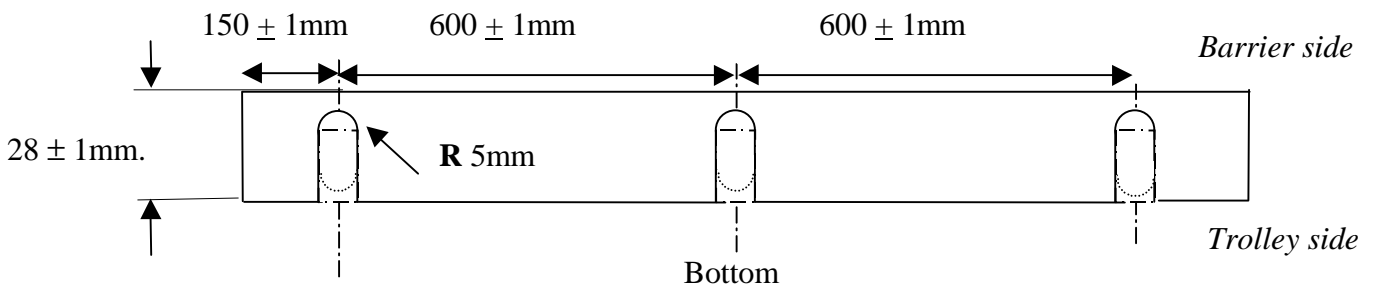
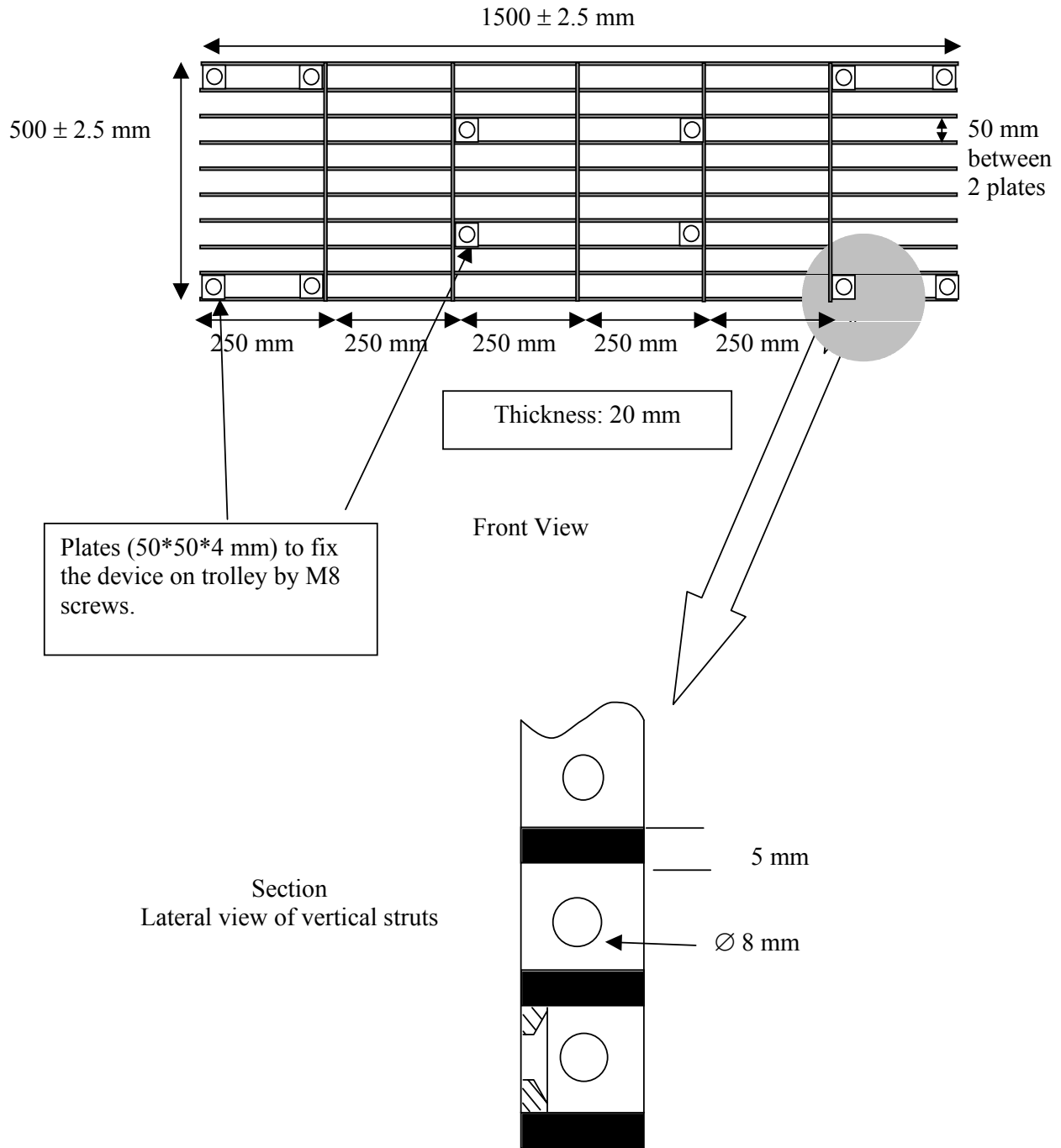


Figure 8

VENTILATION FRAME

The ventilation device is a structure made of a plate that is 5 mm thick and 20 mm wide. Only the vertical plates are perforated with nine 8 mm holes in order to let air circulate horizontally.

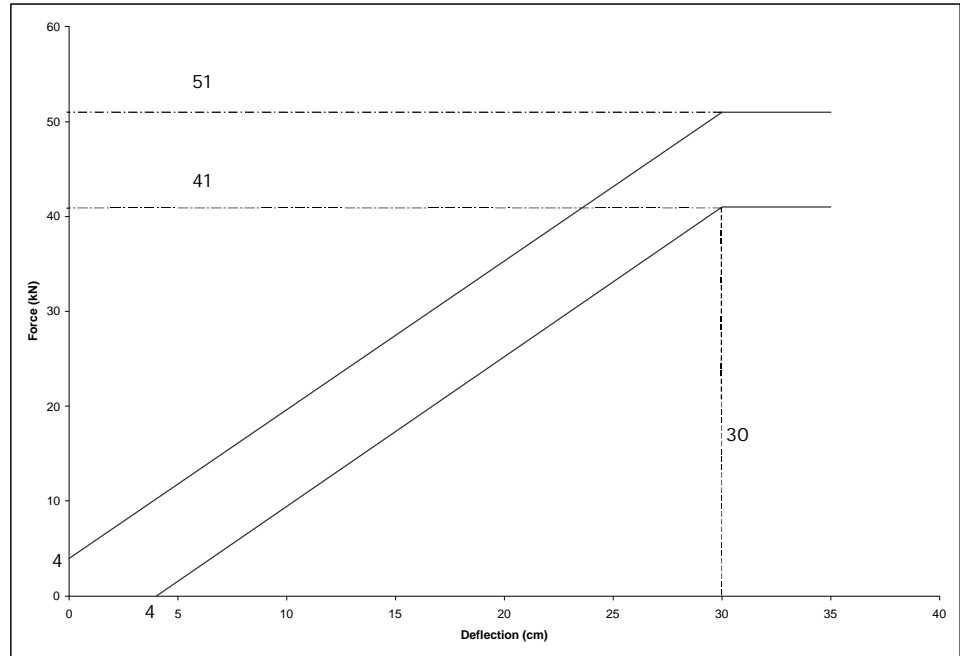


Side View  
 Figure 9

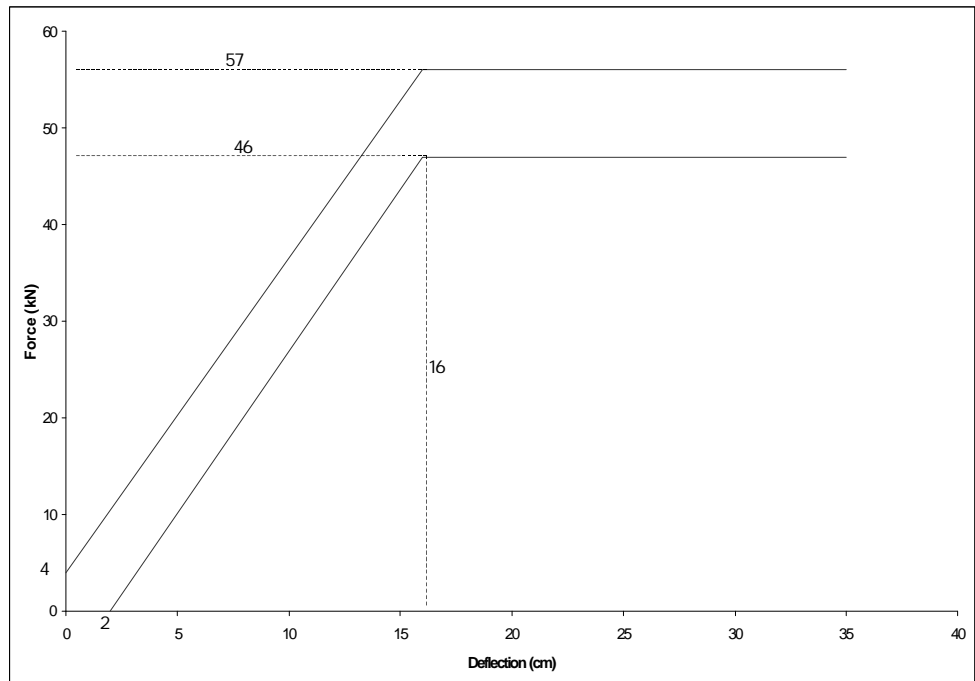
ANNEX 1, APPENDIX 1

FORCE-DEFLECTION CURVES FOR STATIC TESTS

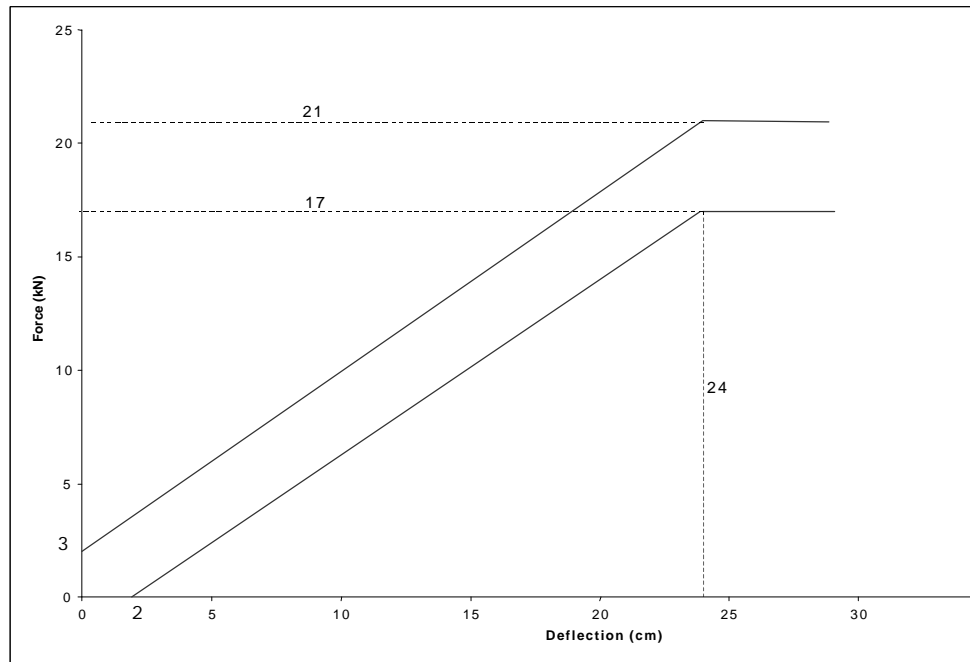
Blocks 1 & 3  
Figure 1a



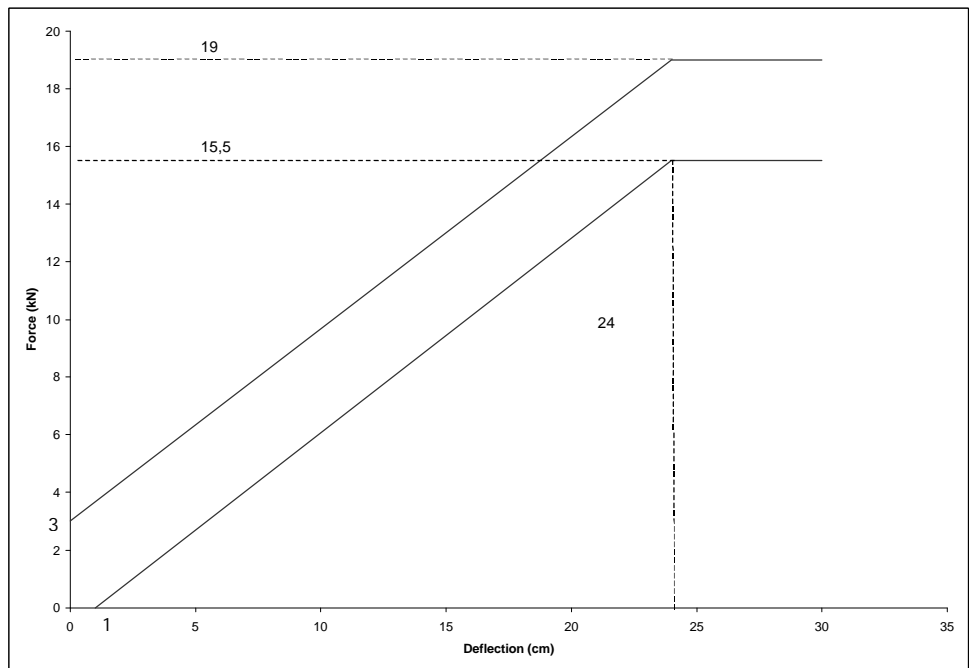
Block 2  
Figure 1b



Block 4  
Figure 1c



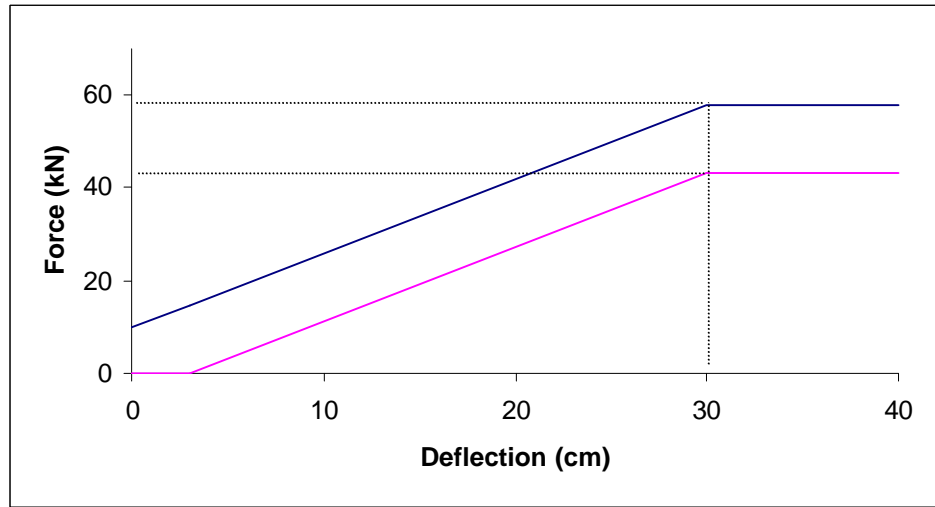
Blocks 5 & 6  
Figure 1d



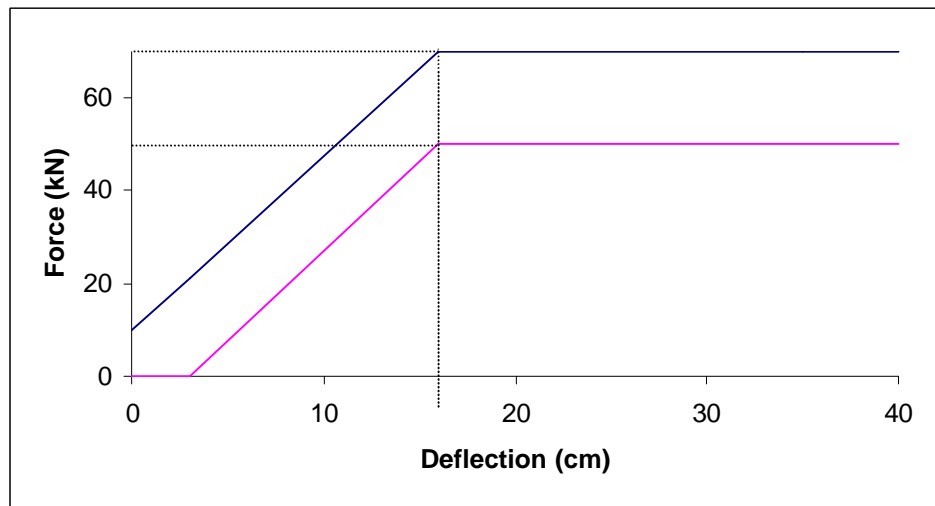
ANNEX 1 APPENDIX 2

FORCE-DEFLECTION CURVES FOR DYNAMIC TESTS

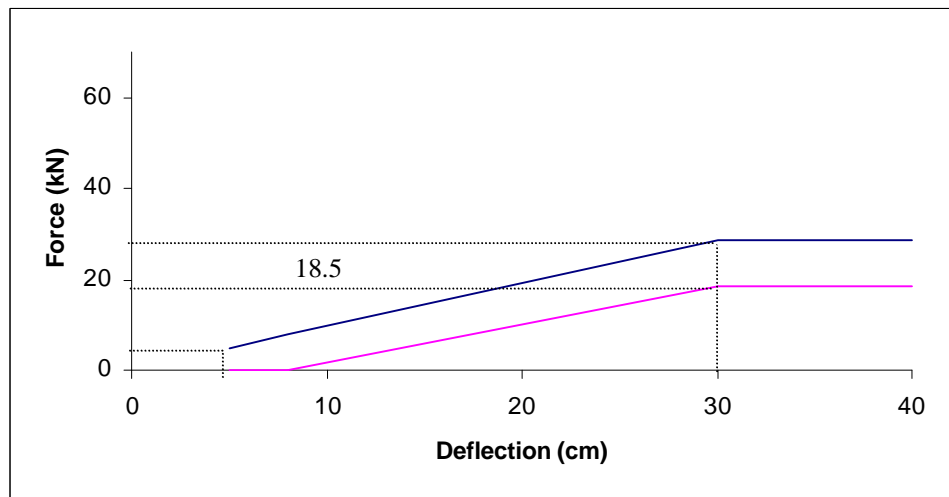
Blocks 1 & 3  
Figure 2a



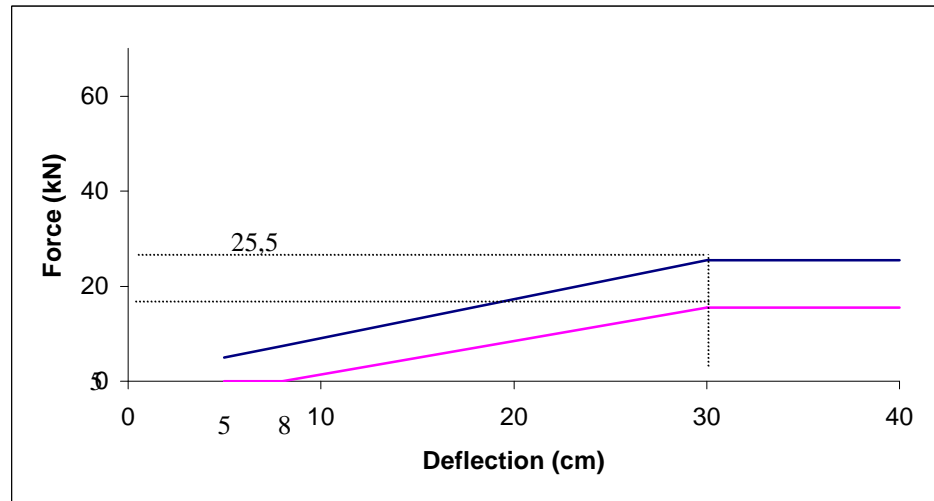
Block 2  
Figure 2b



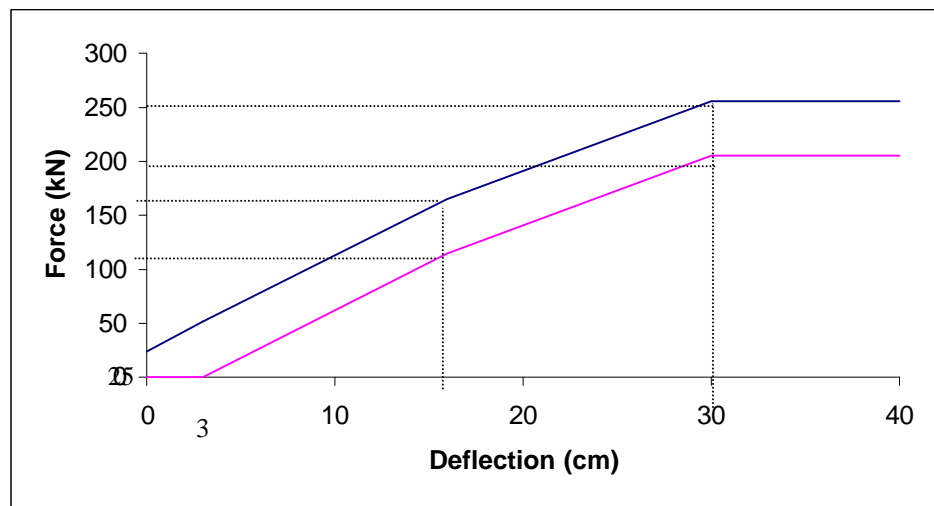
Block 4  
Figure 2c



**Blocks 5 & 6**  
**Figure 2d**



**Blocks total**  
**Figure 2e**



[NOTE: Dynamic corridors are not changed from the existing ECE Regulation 95]



## Plascore Sample Certification

### MOBILE DEFORMABLE BARRIER CERTIFICATION

Date: April 4 2002  
To:

### PURCHASE ORDER INFORMATION

Customer P.O. Number: 01/1381  
Sales Order Number: 9211

### MATERIAL INFORMATION

Barrier Serial Number: 9  
Face Sections 1, 2 & 3: 5052 Aluminum  
Cell Size: 19.05 mm  
Face Sections 4, 5 & 6: 3003 Aluminum  
Cell Size: 19.05 mm  
Front Plate: Material: 5052  
Hardness: 50-65 HBS  
Thickness: 0.5 mm  
Back Plate: Material: 5052  
Thickness: 3 mm  
Hole Size: 8 mm  
Adhesive: 2 part Urethane

### TEST INFORMATION

	<u>Process Batch</u>	<u>Test File</u>
Face Section 1:	020211-3	IN223694
Face Section 2:	020215-2	IN223729
Face Section 3:	020211-3	IN223694
Face Section 4:	020228-1	IN223832
Face Section 5:	020219-2	IN223754
Face Section 6:	020219-2	IN223754

This is to certify that the aluminum honeycomb core supplied, under the unit numbers provided, meets the crush requirements of the Mobile Deformable Barrier Specification.

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Quality Control Representative

WG 13 BARRIER SECTION 1,2,3 CRUSH TESTING  
TESTING ON ETCHED HONEYCOMB CORE

Test type: Compression  
Operator name: ABHI  
Sample Identification: IN223694  
Interface Type: 4200

Instron Corporation  
Series IX Automated Materials Testing System 7.51.00  
Test Date: Monday, February 11, 2002

Humidity ( % ): 50  
Temperature: 73 F

Sample Rate (pts/secs): 5.0000  
Crosshead Speed: 100.0000 mm/min  
2nd Crosshead Speed: 0.0000 mm/min

Full Scale Load Range: 150.000 kN

SECTION # SECTION 1,3  
PROCESS FILE 020211-3

Specimen Geometry: Rectangular

Width: 250.0000 mm  
Thickness: 500.0000 mm  
Extensometer G.L.:500.0000 mm  
Specimen G. L.: 500.0000 mm

Sample comments:

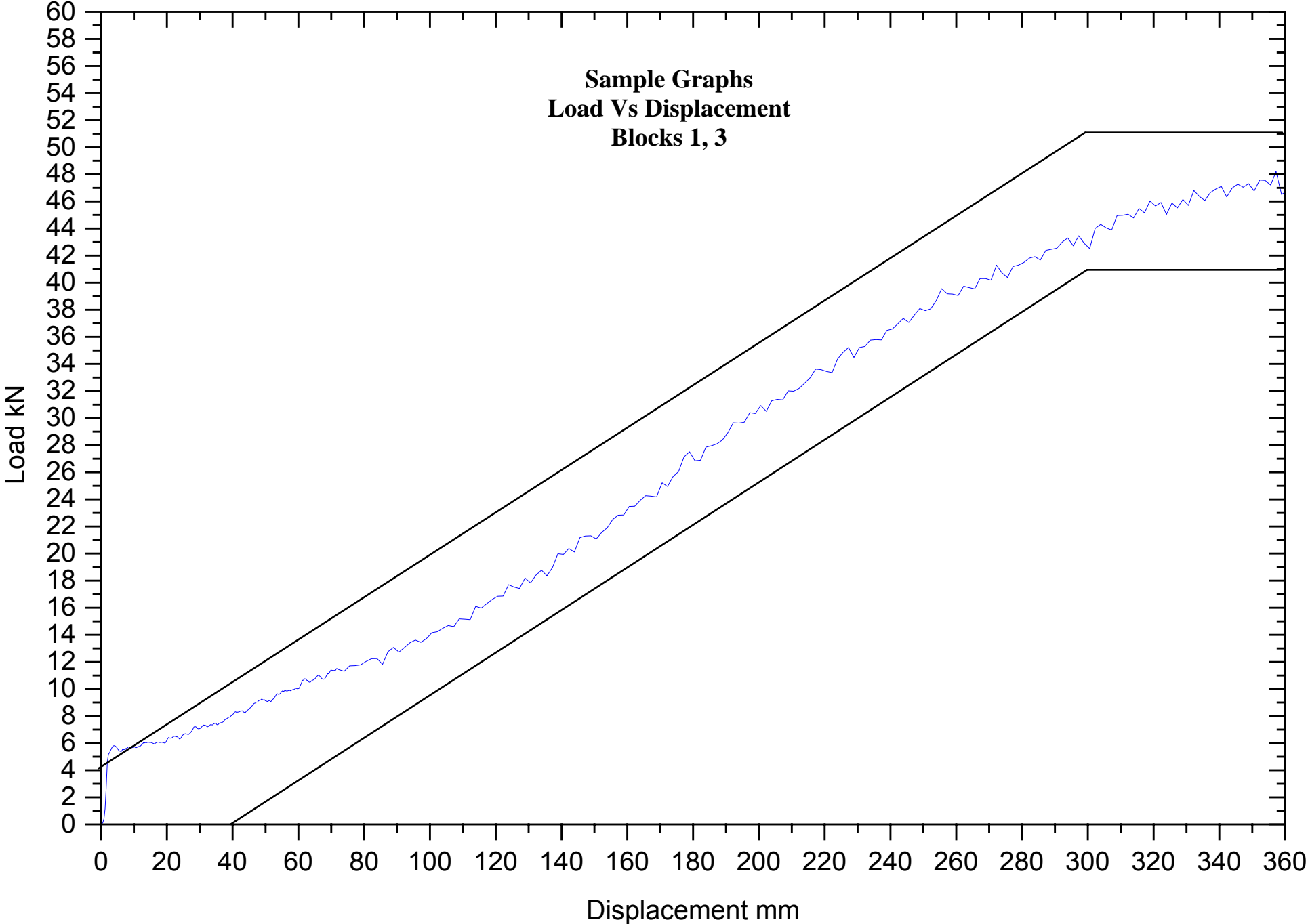
WG 13 CRUSH TEST

	Avg Ld Between Limits 1 (kN)	Avg Ld Between Limits 2 (kN)	Avg Ld Between Limits 3 (kN)	Stress Between Limits 4 (MPa)	Stress Between Limits 5 (MPa)	Stress Between Limits 6 (MPa)
1 020211-3	11.641	25.928	40.702	0.093	0.207	0.326
Mean	11.641	25.928	40.702	0.093	0.207	0.326
S.D.	0.000	0.000	0.000	0.000	0.000	0.000
C.V.	0.000	0.000	0.000	0.000	0.000	0.000
Mean +2.00 SD	0.000	0.000	0.000	0.000	0.000	0.000
Mean -2.00 SD	0.000	0.000	0.000	0.000	0.000	0.000
Minimum	11.641	25.928	40.702	0.093	0.207	0.326
Maximum	11.641	25.928	40.702	0.093	0.207	0.326

## Test Report

Sample ID: IN223694

**Sample Graphs**  
**Load Vs Displacement**  
**Blocks 1, 3**



WG 13 BARRIER SECTION 1,2,3 CRUSH TESTING  
 TESTING ON ETCHED HONEYCOMB CORE

Test type: Compression  
 Operator name: ABHI  
 Sample Identification: IN223729  
 Interface Type: 4200

Instron Corporation  
 Series IX Automated Materials Testing System 7.51.00  
 Test Date: Friday, February 15, 2002

Humidity ( % ): 50  
 Temperature: 73 F

Sample Rate (pts/secs): 5.0000  
 Crosshead Speed: 100.0000 mm/min  
 2nd Crosshead Speed: 0.0000 mm/min

Full Scale Load Range: 150.000 kN

SECTION # SECTION 2  
 PROCESS FILE 020215-2

Specimen Geometry: Rectangular

Width: 250.0000 mm  
 Thickness: 500.0000 mm  
 Extensometer G.L.: 500.0000 mm  
 Specimen G. L.: 500.0000 mm

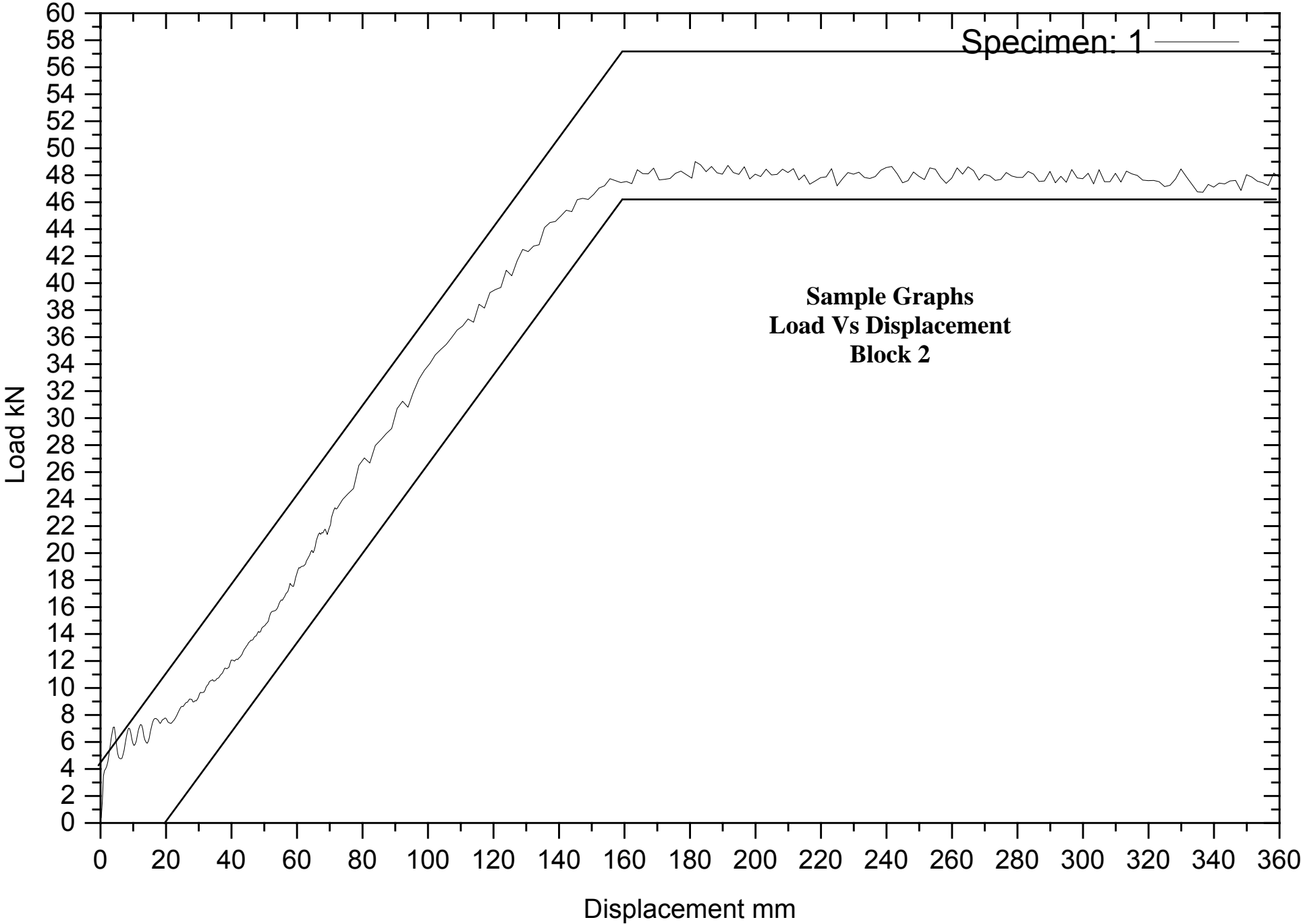
Sample comments:

WG 13 CRUSH TEST

	Avg Ld Between Limits 1 (kN)	Avg Ld Between Limits 2 (kN)	Avg Ld Between Limits 3 (kN)	Stress Between Limits 4 (MPa)	Stress Between Limits 5 (MPa)	Stress Between Limits 6 (MPa)
1 020215-2	24.289	47.009	47.927	0.194	0.376	0.383
Mean	24.289	47.009	47.927	0.194	0.376	0.383
S.D.	0.000	0.000	0.000	0.000	0.000	0.000
C.V.	0.000	0.000	0.000	0.000	0.000	0.000
Mean +2.00 SD	0.000	0.000	0.000	0.000	0.000	0.000
Mean -2.00 SD	0.000	0.000	0.000	0.000	0.000	0.000
Minimum	24.289	47.009	47.927	0.194	0.376	0.383
Maximum	24.289	47.009	47.927	0.194	0.376	0.383

## Test Report

Sample ID: IN223729



WG 13 BARRIER SECTION 4,5,6 CRUSH TESTING  
TESTING ON ETCHED HONEYCOMB CORE

Test type: Compression  
Operator name: INSTRON  
Sample Identification: IN223832  
Interface Type: 4200

Instron Corporation  
Series IX Automated Materials Testing System 7.51.00  
Test Date: Thursday, February 28, 2002

Humidity ( % ): 50  
Temperature: 73 F

Sample Rate (pts/secs): 5.0000  
Crosshead Speed: 100.0000 mm/min  
2nd Crosshead Speed: 0.0000 mm/min

Full Scale Load Range: 150.000 kN

SECTION # SECTION 4  
PROCESS FILE 020228-1

Specimen Geometry: Rectangular

Width: 250.0000 mm  
Thickness: 500.0000 mm  
Extensometer G.L.:500.0000 mm  
Specimen G. L.: 500.0000 mm

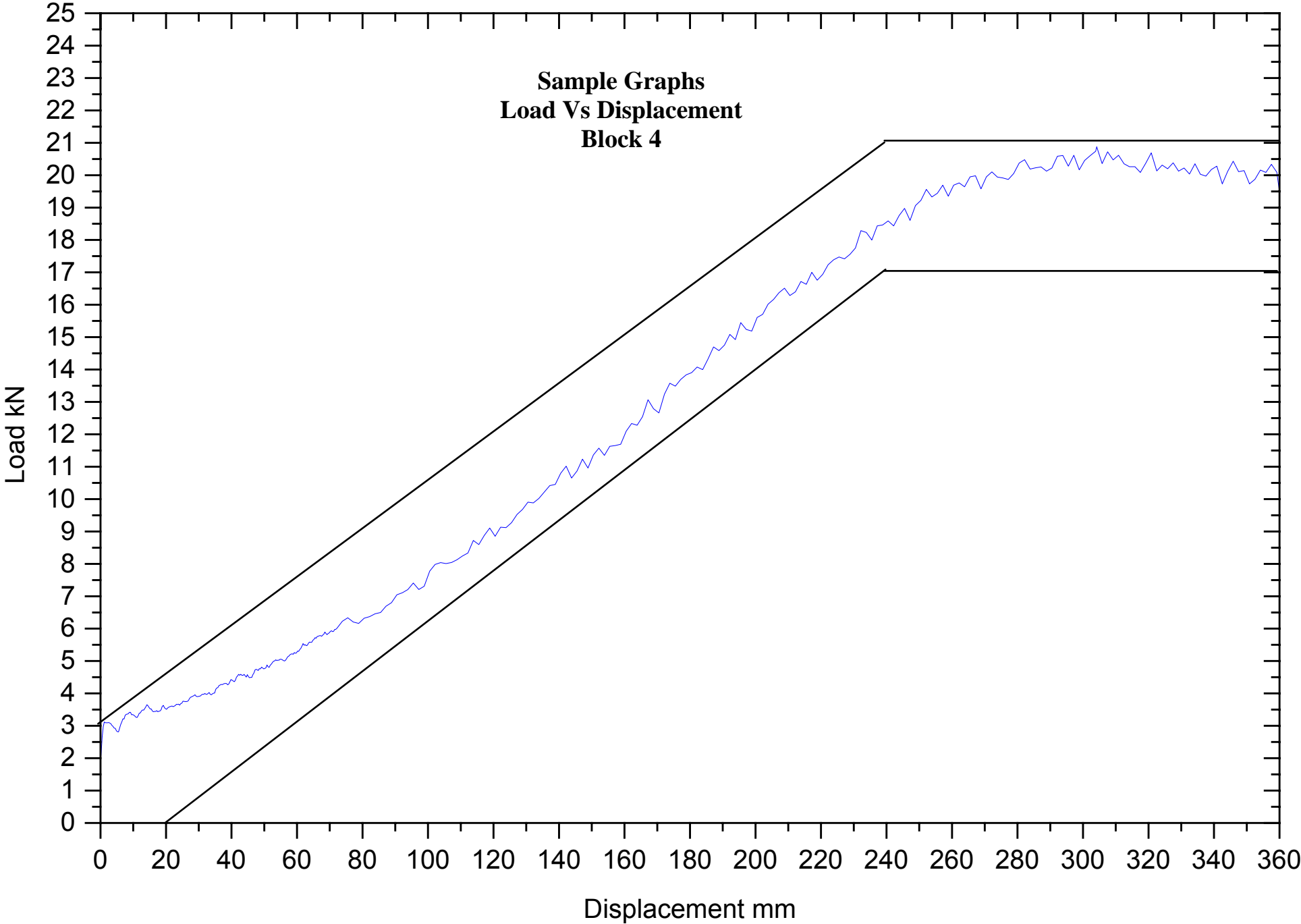
Sample comments:

WG 13 CRUSH TEST

	Avg Ld Between Limits 1 (kN)	Avg Ld Between Limits 2 (kN)	Avg Ld Between Limits 3 (kN)	Stress Between Limits 4 (MPa)	Stress Between Limits 5 (MPa)	Stress Between Limits 6 (MPa)
1 020228-1	6.245	13.422	19.672	0.050	0.107	0.157
Mean	6.245	13.422	19.672	0.050	0.107	0.157
S.D.	0.000	0.000	0.000	0.000	0.000	0.000
C.V.	0.000	0.000	0.000	0.000	0.000	0.000
Mean +2.00 SD	0.000	0.000	0.000	0.000	0.000	0.000
Mean -2.00 SD	0.000	0.000	0.000	0.000	0.000	0.000
Minimum	6.245	13.422	19.672	0.050	0.107	0.157
Maximum	6.245	13.422	19.672	0.050	0.107	0.157

## Test Report

Sample ID: IN223832



WG 13 BARRIER SECTION 4,5,6 CRUSH TESTING  
TESTING ON ETCHED HONEYCOMB CORE

Test type: Compression  
Operator name: ABHI  
Sample Identification: IN223754  
Interface Type: 4200

Instron Corporation  
Series IX Automated Materials Testing System 7.51.00  
Test Date: Tuesday, February 19, 2002

Humidity ( % ): 50  
Temperature: 73 F

Sample Rate (pts/secs): 5.0000  
Crosshead Speed: 100.0000 mm/min  
2nd Crosshead Speed: 0.0000 mm/min

Full Scale Load Range: 150.000 kN

SECTION # SECTION 5,6  
PROCESS FILE 020219-2

Specimen Geometry: Rectangular

Width: 250.0000 mm  
Thickness: 500.0000 mm  
Extensometer G.L.:500.0000 mm  
Specimen G. L.: 500.0000 mm

Sample comments:

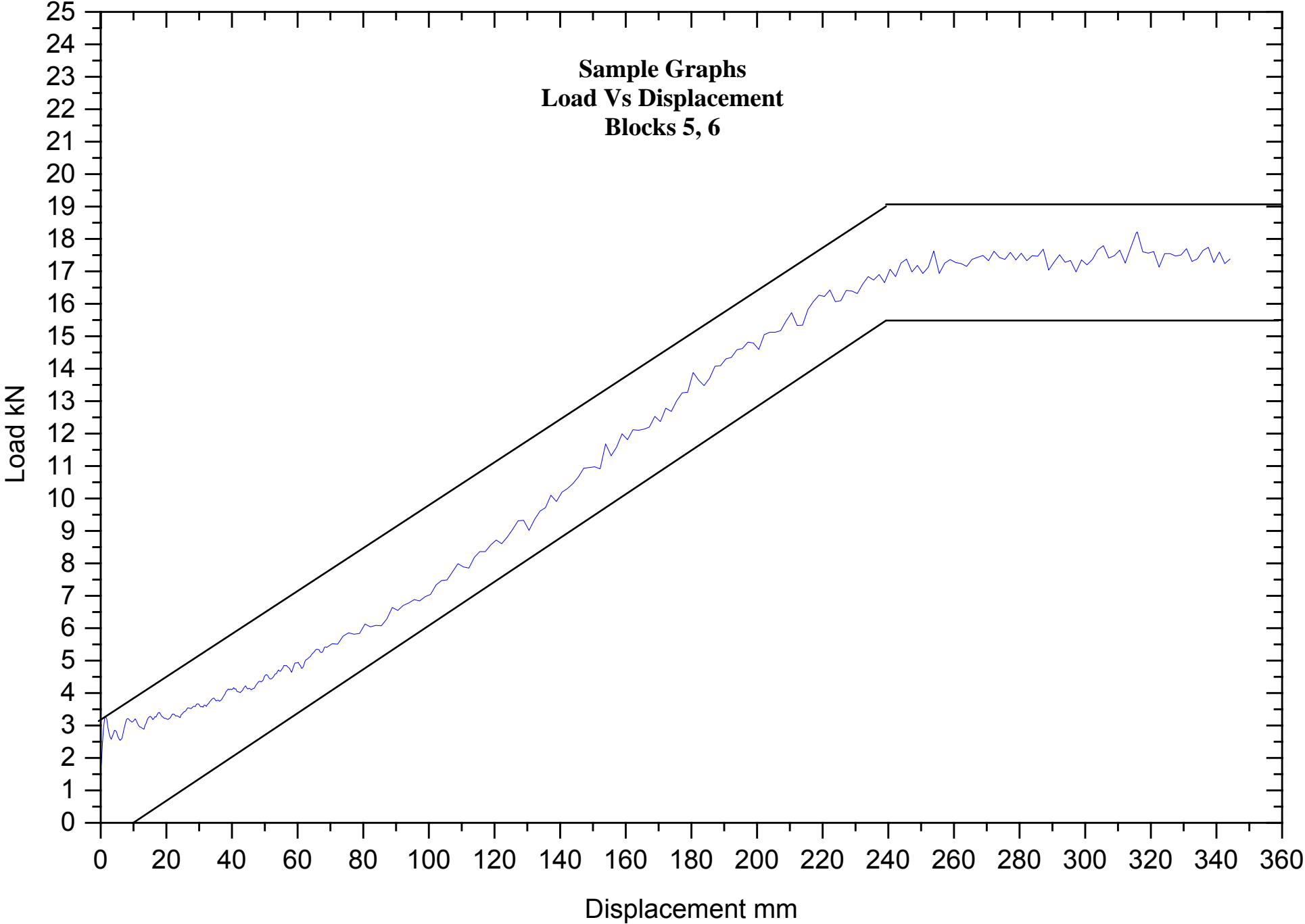
WG 13 CRUSH TEST

	Avg Ld Between Limits 1 (kN)	Avg Ld Between Limits 2 (kN)	Avg Ld Between Limits 3 (kN)	Stress Between Limits 4 (MPa)	Stress Between Limits 5 (MPa)	Stress Between Limits 6 (MPa)
1 020219-3	5.852	12.886	17.259	0.047	0.103	0.138
Mean	5.852	12.886	17.259	0.047	0.103	0.138
S.D.	0.000	0.000	0.000	0.000	0.000	0.000
C.V.	0.000	0.000	0.000	0.000	0.000	0.000
Mean +2.00 SD	0.000	0.000	0.000	0.000	0.000	0.000
Mean -2.00 SD	0.000	0.000	0.000	0.000	0.000	0.000
Minimum	5.852	12.886	17.259	0.047	0.103	0.138
Maximum	5.852	12.886	17.259	0.047	0.103	0.138

## Test Report

Sample ID: IN223754

**Sample Graphs**  
**Load Vs Displacement**  
**Blocks 5, 6**



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