



EN 1177:2008

IMPACT ATTENUATING PLAYGROUND SURFACING – DETERMINATION OF CRITICAL FALL HEIGHT

PLAYGRADE WOODCHIP AT 100MM, 200MM AND 300MM DEPTHS

CLIENT	Firewood Express UK
CLIENT ADDRESS	K & D Henderson (Firewood Express UK) Newton of Boysack Farm Colliston Arbroath DD11 4PT
CLIENT CONTACT	Angus Cheyne

REPORT NUMBER	LSUK.18-0073	
REVISION NUMBER & DATE	1.0	05/03/2018
REPORTED BY		David Rigby Laboratory Manager
APPROVED BY		Dr Colin Young Managing Director

SUMMARY OF REPORT / FINDINGS	<p>In accordance with EN 1177:2008 test specimen(s) of impact attenuating material were struck by an instrumented headform in a defined series of impacts from different drop heights. The signal emitted by an accelerometer in the headform during each impact was processed to yield a severity from the measured impact energy, defined as head injury criterion (HIC).</p> <p>The HIC of each impact was plotted and the critical fall height was determined as the lowest drop height producing a HIC value of 1,000.</p> <p>The test specimen(s) submitted met the requirements of EN 1177:2008 when tested under laboratory conditions.</p>
------------------------------	---

<p>SCOPE OF TESTING / PROJECT</p>	<p>EN 1177:2008 specifies a method for determining the impact attenuation of playground surfacing. It defines a "Critical Fall Height" for surfacing, which represents the upper limit of its effectiveness in reducing head injury when using playground equipment conforming to EN 1176. It is based on the safety principles given in EN 1176-1 for playground equipment and provides a method for the assessment of impact attenuation of surfaces intended for use in the impact area as defined in EN 1176-1.</p> <p>On the basis of statistical analysis of available data, the Head Injury Criterion (HIC) at a tolerance level of 1,000 has been used as the upper limit for the brain injury severity unlikely to have disabling or fatal consequences. By choosing measurement of HIC as the criterion of safety, the method considers only the kinetic energy of the head when it impacts the surface of the impact area. This is considered to be the best model available to predict the likelihood of head injury from falls. Surfaces fulfilling the test requirements of EN 1177:2008 are considered to be in compliance with the requirements for impact attenuation in EN 1176-1.</p> <p>The HIC value of 1,000 is merely one data point on a risk severity curve where a HIC of 1,000 is equivalent to a 3% chance of a critical injury (MAIS 5), a 18% probability of a severe (MAIS 4) head injury, a 55% probability of a serious (MAIS 3) head injury, a 89% probability of a moderate injury (MAIS 2) and a 99.5% chance of a minor head injury (MAIS 1), to an average male adult.</p> <p>The Maximum Abbreviated Injury Scale (MAIS), was first developed by the Association for the Advancement of Automotive Medicine and is used extensively in the automotive industry as an indicator of the severity of head related injuries.</p>
-----------------------------------	---

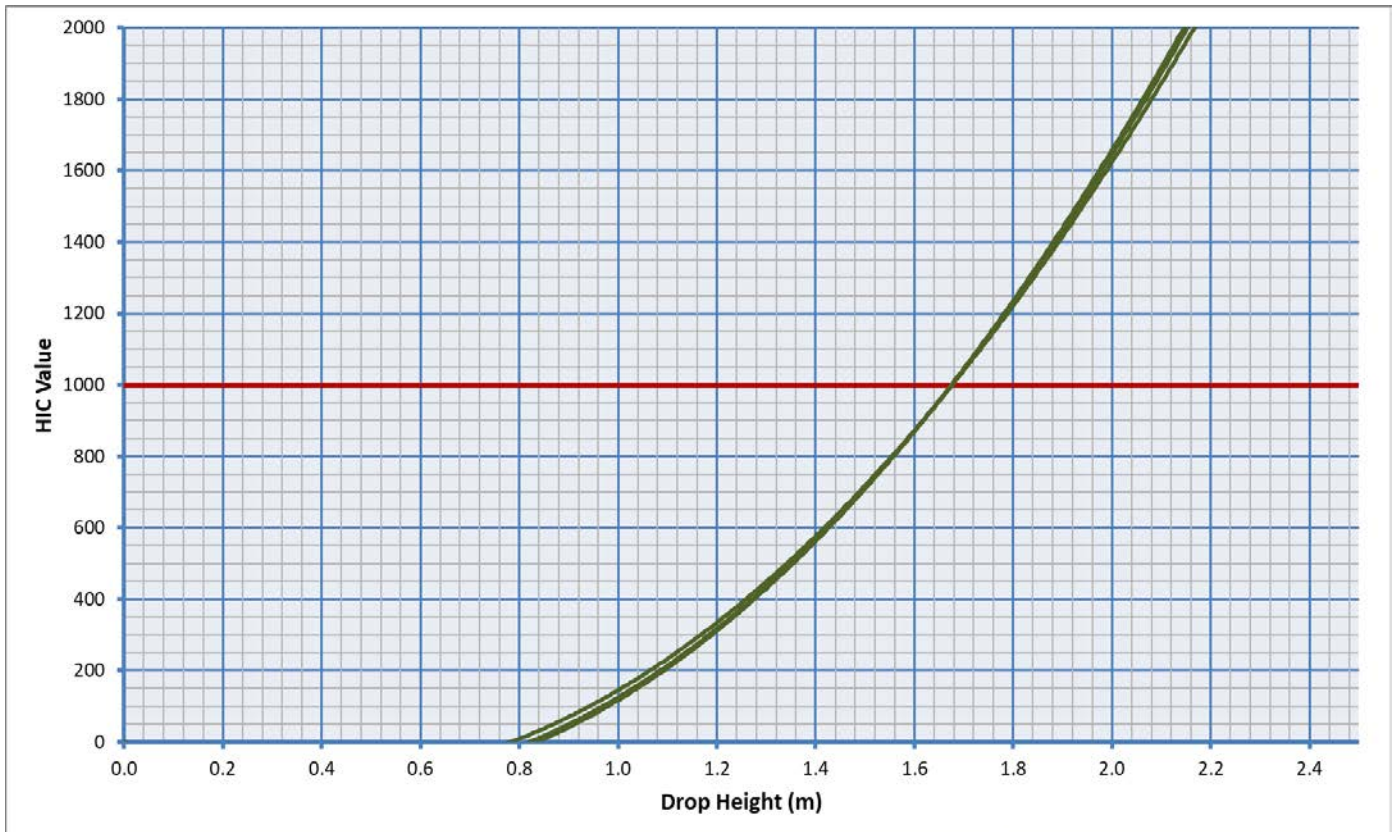
<p>TEST PROCEDURE / STANDARDS</p>	<p>EN 1177:2008 – Impact attenuating playground surfacing – Determination of critical fall height</p> <p>EN 1176-1:2008 – Playground equipment and surfacing – Part 1: General safety requirements and test methods</p> <p>EN 933-1 – Tests for geometrical properties of aggregates – Part 1: Determination of particle size distribution – Sieving method</p> <p>ISO 6487:2002 – Road vehicles – Measurement techniques in impact tests – Instrumentation</p> <p>EN ISO/IEC 17025 – General requirements for the competence of testing and calibration laboratories</p>
-----------------------------------	---

<p>PRODUCT (DETAILS / DESCRIPTION)</p>	<p>Size G 50 mixed softwood referred to as "Firewood Express Playgrade Woodchip" at 100mm, 200mm and 300mm depths.</p>
--	--

<p>TEST CONDITIONS</p>	<p>The test specimen(s) were tested at $23 \pm 2^{\circ}\text{C}$ and $50 \pm 4\%$ relative humidity and conditioned for a minimum of 24 hours prior to testing commencement.</p> <p>The test specimen(s) had a surface temperature of 22.0°C at the commencement of testing.</p> <p>All tests were carried out loose laid on a flat, rigid concrete, or equivalent substrate of sufficient mass, density and thickness that its deformation during the test made no significant contribution to the test result.</p> <p>For testing of particulate material, a test frame without a base was used, with internal dimensions of 1m x 1m.</p> <p>For products intended to be laid over another layer, the entire system, surfacing with under layer(s) was tested. This is classed as a composite product.</p>
------------------------	--

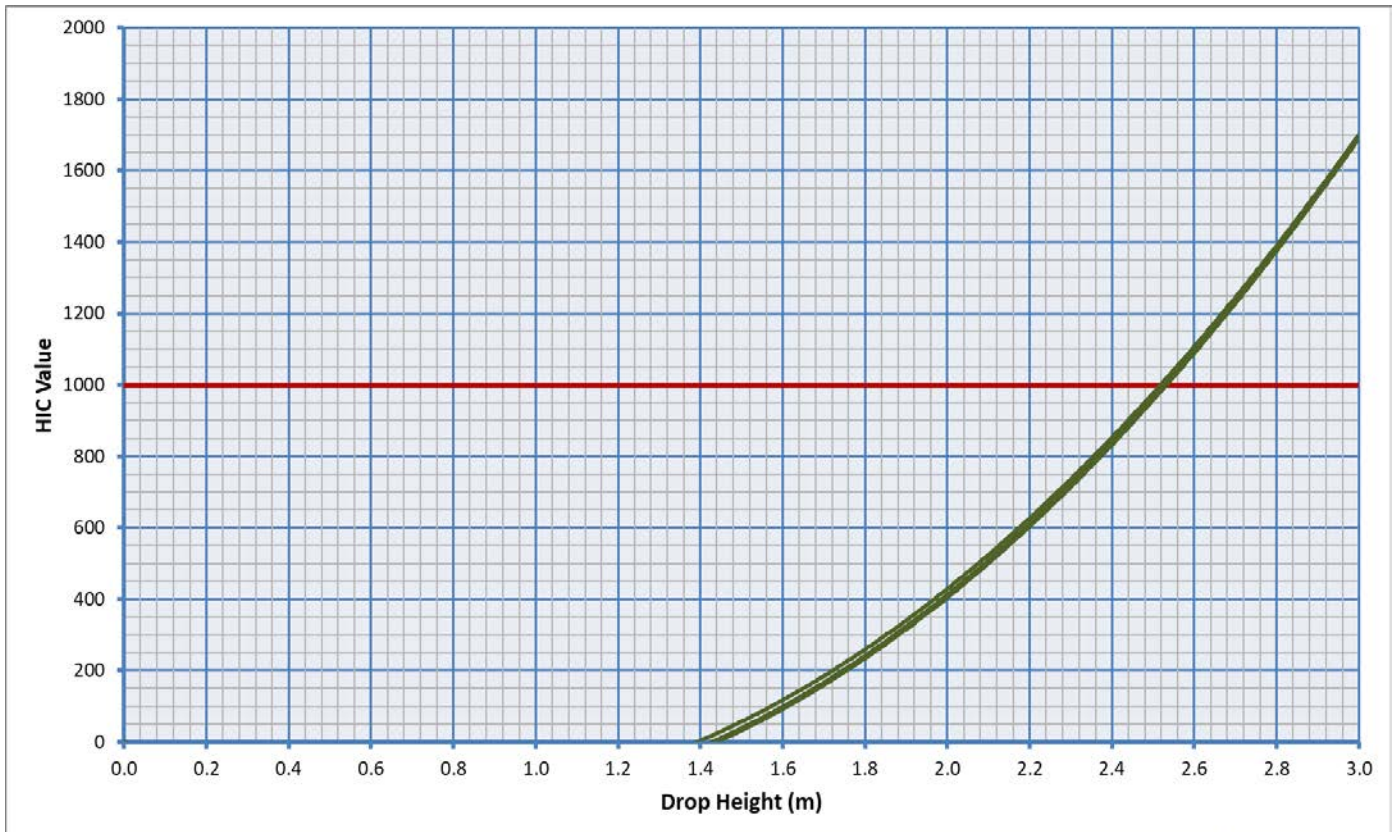
TEST RESULTS		CRITICAL FALL HEIGHT (CFH) AND HEAD INJURY CRITERION (HIC) VALUES									
Playgrade Woodchip at 100mm depth											
Drop Height (m)	Test Position									Delta T	Lowest CFH (m)
	1			2			3				
0.00	0	0	0	0	0	0	0	0	0	≥3ms	1.6
1.45	291	418	682	285	426	692	297	432	680	Yes	
1.60	289	529	848	282	525	843	296	534	855	Yes	
1.75	414	531	1062	419	535	1068	409	523	1055	Yes	
1.90	530	916	1481	520	905	1462	536	924	1496	Yes	
CFH (m)	2.5	2.0	1.6	2.5	2.0	1.6	2.5	2.0	1.6	Yes	

These results are only valid for impact events with a HIC duration (Delta T) of more than 3 ms, i.e. (t2 – t1) ≥ 3 ms.



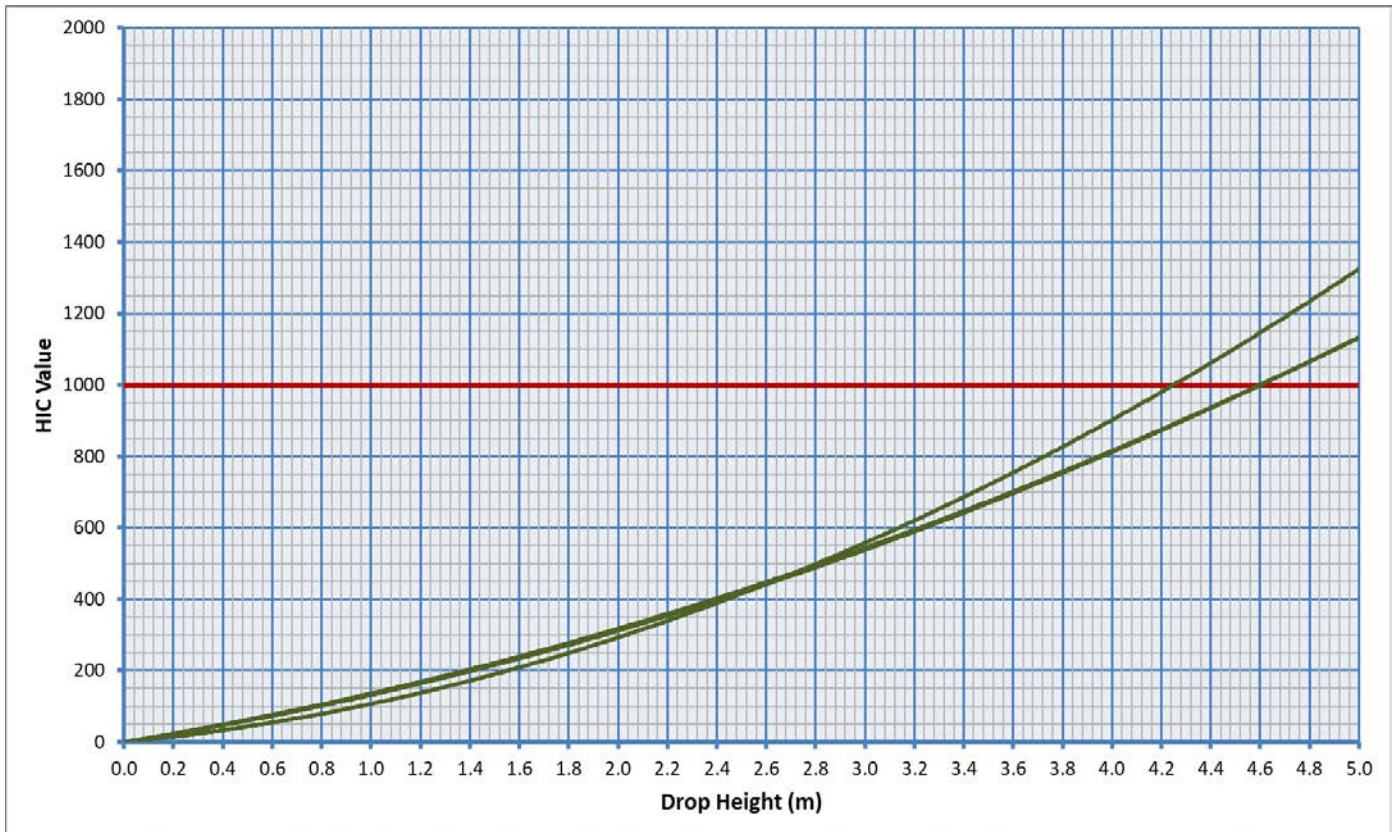
TEST RESULTS	CRITICAL FALL HEIGHT (CFH) AND HEAD INJURY CRITERION (HIC) VALUES										
Playgrade Woodchip at 200mm depth											
Drop Height (m)	Test Position									Delta T	Lowest CFH (m)
	1			2			3				
0.00	0	0	0	0	0	0	0	0	0	≥3ms	2.5
2.20	403	464	627	389	455	620	415	469	638	Yes	
2.35	423	490	710	410	479	699	435	499	728	Yes	
2.50	391	609	1064	378	602	1055	397	617	1073	Yes	
2.65	515	801	1128	503	790	1119	529	803	1135	Yes	
CFH (m)	4.7	2.9	2.5	4.7	2.9	2.5	4.7	2.9	2.5	Yes	

These results are only valid for impact events with a HIC duration (Delta T) of more than 3 ms, i.e. (t2 – t1) ≥ 3 ms.



TEST RESULTS		CRITICAL FALL HEIGHT (CFH) AND HEAD INJURY CRITERION (HIC) VALUES									
Playgrade Woodchip at 300mm depth											
Drop Height (m)	Test Position									Delta T	Lowest CFH (m)
	1			2			3				
0.00	0	0	0	0	0	0	0	0	0	≥3ms	4.2
2.35	283	341	396	289	347	402	279	338	391	Yes	
2.50	311	356	414	305	361	421	305	349	408	Yes	
2.65	315	408	436	319	412	439	322	410	432	Yes	
2.80	402	408	502	408	415	509	405	412	516	Yes	
CFH (m)	4.5	5.7	4.6	4.5	5.7	4.5	4.4	5.2	4.2	Yes	

These results are only valid for impact events with a HIC duration (Delta T) of more than 3 ms, i.e. (t2 – t1) ≥ 3 ms.



DISCUSSION	<p>The test specimen(s) submitted were found to have critical fall height values of:</p> <table style="margin-left: 20px;"> <tr> <td>Playgrade Woodchip at 100mm depth</td> <td>1.6</td> </tr> <tr> <td>Playgrade Woodchip at 200mm depth</td> <td>2.5</td> </tr> <tr> <td>Playgrade Woodchip at 300mm depth</td> <td>4.2</td> </tr> </table> <p>In accordance with EN 1177:2008 these materials should also conform to the requirements of EN 1176-1, in particular, Clauses 4 and 6.</p>	Playgrade Woodchip at 100mm depth	1.6	Playgrade Woodchip at 200mm depth	2.5	Playgrade Woodchip at 300mm depth	4.2
Playgrade Woodchip at 100mm depth	1.6						
Playgrade Woodchip at 200mm depth	2.5						
Playgrade Woodchip at 300mm depth	4.2						

CONCLUSIONS	<p>The test specimen(s) submitted met the requirements of EN 1177:2008 when tested under laboratory conditions.</p>
-------------	---

APPENDIX

Diagram showing all test positions

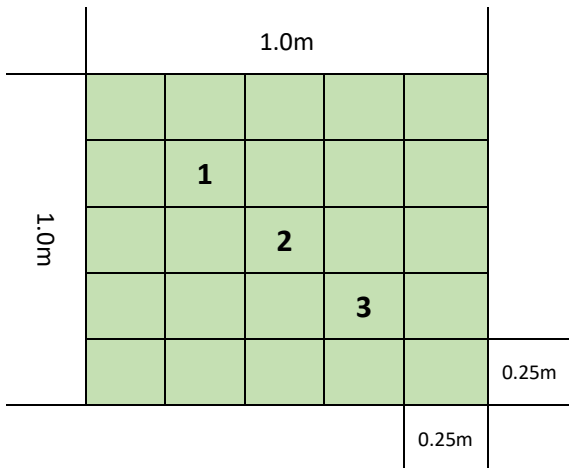
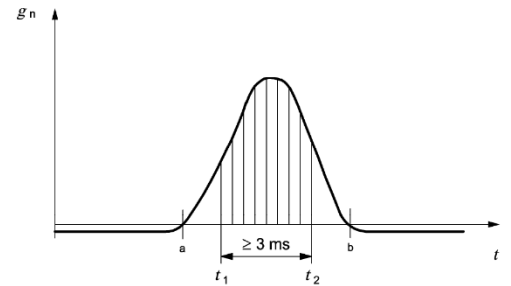


Diagram not to scale

Example of time / acceleration curve



Key
 g_n acceleration
 t time
 a t_{start}
 b t_{end}

Woodchip material – Photograph



Woodchip material – Photograph

