



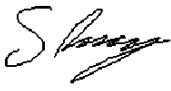

LABORATORY REPORT

on

SIMULATED WEAR TESTING USING BROCK PERFORMANCE BASE

For

**Brock LLC
2840 Wilderness Place
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REPORT STATUS:	Final	Signature	Date
Report No:	2490/2075		
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FOREWORD

1. This report has been prepared by Sports Labs Limited with all reasonable skill, care and diligence within the terms of the contract with the Client and within the limitations of the resources devoted to it.
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3. This report shall not be used for engineering or contractual purposes unless signed by the Author and the Checker and unless the report status is "Final".
4. Comments and opinions are outwith the scope of our ISO 17025 accreditation.
5. Not all tests are within the scope of our ISO 17025 accreditation.



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1.0 INTRODUCTION

- 1.1 Sports Labs Ltd have been commissioned by Brock to carry out a research project into the affects of a shock pad system, in this case a performance base supplied by Brock, on the performance and safety properties of an artificial turf system following exposure to long term simulated wear when conditioned in a Lisport device.
- 1.2 Sports Labs are an internationally accredited sports surfaces testing laboratory who hold ISO. 9001 and ISO.17025 accreditations and are authorized by several sports governing bodies to undertake testing on their behalf, including FIFA, UEFA and International Rugby Board (IRB).
- 1.3 A test program was carried out to determine the affect of simulated wear of a 3rd generation artificial turf over a rigid base when compared to a system of the same artificial turf installed over the Brock Performance Base F24 (*the U.S. version is known as – Powerbase*). The Brock Performance Base F24 is a pre-fabricated base system for use as an underlayment for artificial turf. The system is made from fused expanded polypropylene.
- 1.4 The artificial turf used in the test was a 63mm monofilament product filled using a mixture of cryogenic rubber/sand as used in the field to the specified quantities as given by the manufacturer.
- 1.5 The device selected for artificially wearing the carpets was the standard “Lisport” device as specified in BS.EN 15306:2007. The Lisport device has been designed to impart wear on laboratory prepared samples to simulate wear in the field. The device traverses a filled sample in a cyclical fashion building up a large simulated footfall onto the sample. Research has shown that one Lisport cycle roughly equates to one hour use of an artificial surface. The device is shown herein.



Plate showing Lisport in action on actual sample



- 1.6 Initially an artificial turf sample was prepared according to the manufacturers' specification using graded silica sand of 0.5 – 1.0mm and 0.8 - 2.5mm cryogenic rubber. The sample was then conditioned for 200 cycles using a studded roller as per standard pre-test protocol.
- 1.7 This sample was then tested on both the concrete base and with the Brock Performance Base F24 on concrete. This Pre-Lisport testing was performed to verify and compare the performance properties as provided by the turf manufacturer and to determine the initial safety properties of each system.
- 1.8 A further 2 samples were prepared and conditioned in an identical fashion. These samples were then placed into the Lisport artificial wear machine gradually building up the simulated wear within the samples. Each sample was interrupted after 1000 cycles, replacing any dislodged fill material, after which the sample was lightly sprayed with water to simulate the affects of periodic precipitation. This procedure was continued until the predetermined test interval was reached. At each test interval any dislodged fill material was replaced as previously and the sample received a further 200 cycles after which it was removed and tested. The sample was then returned to the Lisport machine and artificial wear continued, stopping at each 1000 cycles for infill replacement and spraying until the next test interval.
- 1.9 The wear cycles were truncated at predetermined intervals of 2200, 4200, 8200, 16200 and 20200 cycles to evaluate the sample.
- 1.10 HIC testing was carried out on the Pre-Lisport sample and on the conditioned sample after 20200 cycles.
- 1.11 A further 2 samples were prepared and tested in an identical fashion to the protocol described in section 1.8. These samples were then placed into the Lisport artificial wear machine gradually building up the simulated wear within the samples. Each sample was interrupted after 1000 cycles replacing any fill material which was dislodged after which the sample was lightly sprayed with water to simulate the affects of periodic precipitation. This procedure was continued until the predetermined test interval of 12,000 cycles was reached. At this test interval any dislodged fill material was replaced as previously and the sample received a further 200 cycles after which it was removed and tested.
- 1.12 In general 1 cycle equates to around 1 hour use, so with an average of 40 hrs use per week x 50 weeks per year gives a total of 2,000 hrs use per year. This was used as a benchmark to equate cycles to years of use



2.0 TEST PROCEDURES

- 2.1 The samples were all tested for Shock Absorption, Vertical Deformation, G max and HIC (Head Injury Criteria). HIC testing was only carried out on the Pre-Lisport samples and on conditioned samples after 12200 and 20200 cycles.
- 2.2 Shock absorption was carried out in accordance with BS EN 14808:2005
- 2.3 Vertical Deformation was carried out in accordance with BS EN 14809:2005
- 2.4 HIC testing was carried out in general accordance with BS EN 1177:1998 (loose laid)
- 2.5 G Max testing was carried out in accordance with ASTM F1936-07, F355-01

3.0 RESULTS

- 3.1 A table of the test results obtained at each stage along with graphs illustrating the results are shown overleaf. The graphs illustrate the relationship between the performance and safety of the artificial turf system after simulated wear when the Brock performance base is incorporated within the system.

4.0 CONCLUSIONS

The results obtained show that there is a clear benefit to the incorporation of the Brock Performance Base (or Powerbase) as part of an artificial turf system. The use of the base system reduces the significant reduction in shock absorption observed with an artificial turf system over a solid base. The results also highlight that in spite of the heavy wear imparted; the safety properties as determined by GMax and HIC testing are retained when the Brock base system is used.



Table 1: Summary of Test Results on Concrete Base

Sample 1 – Turf Only		Approximate simulated years use	Sample conditioned in the Lisport on hard base and Tested on Concrete base						
No. of cycles		40hrs / wk x 50 weeks	Force Reduction	Vertical Deformation	G max over concrete	HIC (head injury criterion)	HIC score of 500	HIC score of 1,500	HIC score of 2,000
Sample conditioned in the Lisport on hard base	0	0	63.3	7.8	119.4	1.1	0.6	1.3	1.5
	2200	1	56.1	5.6	183.9				
	4200	2	54.4	5.1	201.9				
	8200	4	54.3	4.8	217.4				
	12200	6	52.8	4.7	228.5	0.8	0.5	1.0	1.1
	16200	8	52.1	4.4	233.2				
	20200	10	50.8	4.1	237.1	0.8	0.5	1.0	1.2
Results in red fail all international football and rugby performance standards									



Table 2: Summary of test results on Brock base

Sample 2 - Turf + 24mm Brock		simulated years use	Sample conditioned in the Lisport on Brock F24 base and Tested on Brock F24						
No. of cycles		40hrs / wk x 50 weeks	Force Reduction	Vertical Deformation	G max over concrete	HIC (head injury criterion)	HIC score of 500	HIC score of 1,500	HIC score of 2,000
Sample conditioned in the Lisport on Brock 24mm base	0	0	65.6	8.0	84.9	1.8	1.0	2.4	3.1
	2200	1	62.5	6.7	90.1				
	4200	2	62.2	6.5	92.3				
	8200	4	61.9	6.2	97.1				
	12200	6	61.0	5.7	99.0	1.8	1.0	2.4	3.0
	16200	8	61.4	5.6	99.4				
	20200	10	61.0	5.2	99.9	1.8	1.0	2.4	3.1



Prepared Sample Photographs taken Pre-Lisport at 0 wear cycles



General surface view.

Close up of infill and Yarn Fibre.



Yarn Close up.



Samples Tested On Concrete Photographs taken at 20200 cycles



General surface view.

Close up of infill and Yarn Fibre.



Yarn Close up.



Samples Tested On Brock Performance Base over Concrete Photographs taken at 20200 cycles



General surface view.

Close up of infill and Yarn Fibre.



Yarn Close up.