SATRA
FOOTWEAR TECHNOLOGY CENTRE

TECHNICAL REPORT

Subject: TESTING OF HEEL AIR BLADDERS
Firm: Homax Int Tec-Development Co Ltd
For the Attention: Anka Shieh
Our ref: 15569/9601/4/O/D/MPW/DP
Date: 30th January 1996

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Testing
No. 0248

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Technical Services Report

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Technical Services Report

Homax Int Tec-Development Co Ltd
15569/9601/4/O/D/MPW/DP

TESTING OF HEEL AIR BLADDERS 30th January 1996

SAMPLES SUBMITTED

Three pairs of shaped air bladders which were referenced by you:- 1: 2; 3. We have assumed that these represent three different types air bladder, there appear to be some small differences between the bladders. The bladders have therefore been further referenced by SATRA as 1.1; 1.2; 2.1; 2.2; 3.1; 3.2.

For testing purposes each bladder was combined with other soling materials to simulate a whole shoe sole.

TESTS CONDUCTED

Whole Shoe Cushion Assessment Test (WSCATest) - SATRA PM183 D

The Prototype WSCATest (Bulletin June 1994) measures the cushioning properties of footwear by measuring the work done on a soling as it is compressed under load. The sole is loaded by a 'foot' which is intended to give contact areas in the heel and forepart of the shoe similar to that of a subject walking in shoes.

In order to provide a realistic method of assessing the bladders, it was tested on a quality running shoe sole. In this case we have chosen an firm EVA running shoe sole which has a 1 mm cellulose insole board in the heel region. Each of the air bladders was tested while placed in the heel region of the sole.

Shock Absorption Test - SATRA PM 142 : 1992

This test is a falling weight impact test in which a mass of 8.5 kg is dropped from 50 mm onto the footwear under test. These conditions are designed to simulate the impact of heel strike for a man running.

The impact striker is circular (45 mm diameter) with a semi-domed face (37.5 mm radius of curvature). An accelerometer and displacement transducer are attached to the mass from which the following information is obtained:

1. Maximum deceleration (m/s2) - the maximum deceleration of the mass on impacting with the samples. A low deceleration value indicates good shock absorption

2. Energy return (%) - the proportion of the energy returned after impact from the rebound height of the mass. High Energy Return (ER) is believed to be desirable with respect to energy expenditure and muscle fatigue.

3. Penetration (mm) - the maximum dynamic compression of the sample at impact.

The air bladder was tested while placed, on three soling materials which have been chosen to represent the performance of sports, casual and town shoes.

Repeated Vertical Compression (Durability) Tests

The test applies a repeated vertical compression of 750N, at a rate of 1Hz, using a 55mm diameter domed striker. The test duration is 500kc (half a million cycles).

When testing bladders the striker was positioned centrally in the flat portion of the Bladder approximately 40mm from the rear edge of the bladder. To simulate a shoe soling a 22mm thickness of EVA (ref M19) was placed below the bladder.

RESULTS

Table 1 Whole Shoe Cushion Assessment Test Results (PM183D)

	WSCATest (J)	**Increase Due to Bladder (J)**
Shoe sole only	0.52	-
Sole with:-		
Bladder 1.1	1.02	0.50
Bladder 1.2	1.05	0.53
Bladder 2.1	0.94	0.42
Bladder 2.2	0.94	0.42
Bladder 3.1	1.03	0.51
Bladder 3.2	1.12	0.60

Table 2: Shock Absorption Test Results (PM142:1992)

	Peak Deceleration (m/s^2)	**Energy Return (%)**	**Penetration (mm)**
Town (H3)	400	31	2.5
Town with :-			
Bladder 1.1	280	38	5.5
Bladder 1.2	290	41	5.5
Bladder 2.1	300	38	5.5
Bladder 2.2	320	39	5.5
Bladder 3.1	320	35	5.0
Bladder 3.2	300	39	5.0
Casual (H1)	250	23	4.0
Casual with :-			
Bladder 1.1	200	38	6.5
Bladder 1.2	190	38	6.5
Bladder 2.1	195	36	6.5
Bladder 2.2	190	38	6.5
Bladder 3.1	180	35	6.5
Bladder 3.2	190	40	7.0
Sports (M19)	130	34	8.0
Sports with :-			
Bladder 1.1	110	43	10.0
Bladder 2.1	110	42	10.0
Bladder 3.1	105	43	10.0

Table 3: Vertical Compression (Durability) Test Results

Reference	Cycles Completed (kc)	Observations
1.1	80	Failed:- Puncture under Striker
1.2	190	Failed:- Separation of Weld
2.1	530	Passed
2.2	500	Passed
3.1	420*	Failed:- Separation of Weld
3.2	330*	Failed:- Separation of Weld

* Bladders may have started to fail up to 50kc before this

COMMENT

WSCA Test

All three bladders have made a significant improvement to the cushioning of the soling. Combined with this particular sole the bladders have given cushioning values of 0.94 to 1.12J. These values compare well with the optimum cushioning value of 0.9 ± 0.2J.

It can be seen that there is some difference in cushioning between the three bladder types. The bladders on average ranking in the order 3 (most cushioning); 1; 2 (least cushioning). The difference however between 3.1 and 3.2. is greater than the difference between types 1 and 2.

Shock Absorption Test

The results show that each of the bladder types have significantly improved the shock absorption of the soling materials. The air bladders are most effective where the performance of the soling is relatively poor: greater reductions in peak deceleration (24%) occur for the harder town and casual solings than for the sports soling (17%).

There is a significant increase in energy return for each of the three types. The value of 43% [redacted] energy return is amongst the highest values recorded.

The shock absorption test has shown no significant difference between the bladder types. As with the WSCATest there is however a greater difference between the two type 3 bladders (3.1 & 3.2) than between types 1 and 2.

Vertical Compression Test

Table 3 shows that two of the three types have not survived the full test duration. Only the type 2 pads have passed. Three of the four bladders have failed due separation of internal welds between the two layers of the air bladder. These bladders have stayed inflated but have swelled where the welds have failed. This swelling is likely to cause discomfort to a wearer.

The back of bladder 3.2 also tore down from the top edge while being handled before testing was started. This damage did not effect the performance of the bladder in any of the tests, but does indicate a further potential weakness in the bladders

CONCLUSION

The design of the air bladders indicates that they are designed to be included as part of a shoe construction, sandwiched between or moulded into other cushioning materials. How this is done will effect the contribution of the air bladder to the total performance of the footwear. Ideally therefore the bladders should be tested in footwear that have been designed for air bladder.

The shock and cushioning tests carried out however do indicate that the bladders have a significant effect in reducing deceleration values and increasing WSCATest and energy return values.

The durability of the bladders is suspect. We do however consider that an improvement in durability could be achieved if the bladders were tested as part of a shoe construction.

Report prepared by: Rob Russell

Signed: M.P.Wilson
Materials PPE & Apparel