

Measuring the compression resistance of soles

Numerous tests exist to evaluate comfort and resistance. One aspect that has not been well covered in the past is the ageing of a shoe, and in particular the sole, when subjected to repetitive stress. The stress to which the heel of a shoe is subjected through the impact as it hits the ground and the weight of the wearer's body has never been fully reproduced in a laboratory.

French testing house CTC now has a special test to fill this gap using a machine it has developed that can test sports footwear (running, trekking, basketball, etc.) and men's and women's everyday footwear. It is designed to reproduce the compression that the rear part of the sole is subjected to due to repetitive impact during walking or running. Results are presented in terms of type and conditions of use (for walking a specified distance, running, etc.), making them immediately useful for both the manufacturer and the consumer.

Principles of the test

An articulated last is placed inside the shoe and a jack is used to simulate the pressure applied by the walker or runner during 200,000 cycles of compression. At the end of the test,



a degradation value is obtained, representing the degree to which the sole has collapsed.

It is difficult to describe the movement involved in walking or running completely, but the principle of the test is to apply force in a downward direction to compress the heel. This is repeated at a variable rate depending on the activity for which the shoe is being tested. There are several biomechanical aspects to the test:

1. Pressure is exerted by the tibia on the astragal at 35mm from the rear extremity of the calcaneus (heel bone). The jack comes down precisely 35mm from the rear end of the last.
2. Pressure must be applied at the heel (where the foot hits the ground). A metal plate is placed under each jack on to which the heel zone of the test shoe is placed.
3. The walk and run signals used must realistically represent these actions. For walking, CTC used a maximum pressure of 700N and frequency of 1Hz. For running, the maximum pressure used is increased to 3,000N and the frequency to 2.6Hz. These values correspond to the biomechanical readings taken *in situ*.

Test equipment

The machine is fairly simple and has two hydraulic jacks, its own hydraulic pump and an air-cooling system regulated by a thermostat. It is controlled through a panel located at the front of the machine and has pressure sensors to take the measurements.

The software chooses the number of cycles and the signal to be sent to the jack, depending on the sole being tested (walking, running, etc.). It is possible to test two different shoes independently, at the same time, as the pressure and frequency can be programmed separately for each jack and shoe. The machine can accommodate shoes from size 37 to 43 which can be quickly and easily fitted to the jack so that tests are easy to reproduce or repeat.

The jack is constructed so that the shoe and last return to the same starting position each time they come down, ensuring that each stroke is the same. It connects with the last at precisely 35mm from the rear of the heel so that the pressure applied corresponds to the reality of the body's movement and the pressure exerted by the tibia at 35mm from the rear of the calcaneus. Stops are fitted to the end of the jack to prevent the shoe from slipping sideways.



The shoe is located with the last inside under the jack

A degradation value is given after 200,000 cycles, relevant to running or walking, depending which of the two the machine was set for:

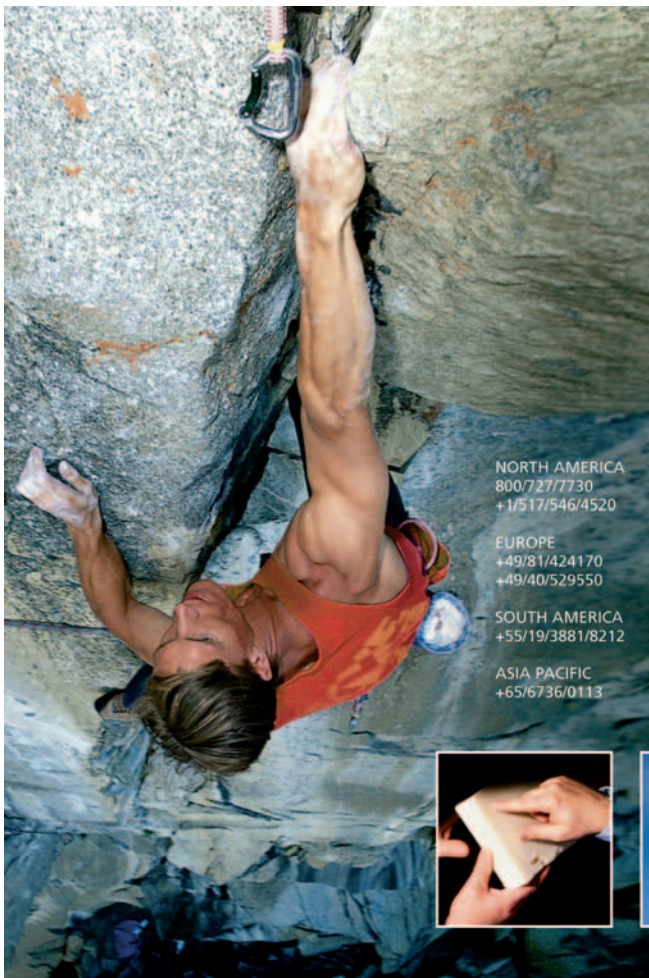
1. Walking pressure is set at minimum 50N and maximum 700N, with a frequency of 1Hz (200,000 cycles take over 55 hours).
2. Running pressure is set at a minimum of 50N and maximum 3,000N, with a frequency of 2.6Hz (200,000 cycles now take just over 21 hours).

**All test parameters are managed by the specific software*

Results

Calculation of the degradation value is based on the minimum material compression within the sole at the time of impact. This corresponds to the difference between the minimum material compression at the end of the test compared with the beginning. The reference value is calculated from the tenth cycle, as the first cycles are more likely to be erroneous.

The machine provides a method for establishing new criteria of comfort and durability for footwear soles. Premature collapse of the sole is a major indicator of quality and ageing. It is also a factor that affects comfort, as it has a major influence on the stability of the rear portion of the shoe. 



NORTH AMERICA
800/727/7730
+1/517/546/4520

EUROPE
+49/81/424170
+49/40/529550

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