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Ballistometer

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Overview —

The Ballistometer (BLS) is based on the traditional ballistometric principle of impacting an object at a constant force. Firmness is measured by indentation and dynamic resilience by the degree of rebound. The innovation in the Ballistometer arises from the inclusion of a torsional wire mechanism, which makes the instrument non-gravity dependant and well suited to less accessible test sites.

Principle benefits:

- Works at any angle, non-gravity dependant
- Measures small, inaccessible test sites
- Bespoke software with automated analysis
- User can define the amount of energy put into the skin so that different layers may be studied

Applications and claims:

- “Elasticity” and “firmness” claims
- “Hydration” and “anti-ageing” claims
- Cellulite related product claims
- Evaluating medical conditions such as scleroderma/oedema
- Assessing the quality of skin/wound healing and scar tissue

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Metrology principle —

The Ballistometer consists of a slim line probe only 25cm long and a small control unit connected to a PC USB port. The probe contains a rigid low mass arm suspended at its balance point on a torsion wire, with a ruby tipped stylus fixed to one end. The arm is activated by a solenoid that elevates the probe tip from the test surface. On release, the arm oscillates around its balance position and the stylus bounces repeatedly on the test site before coming to rest. The position of the arm is monitored by an optical sensor and the positional data transmitted to the PC via the control unit.

In free air, oscillations decrease slowly due to damping by the surrounding air and mechanical losses. When the oscillating probe comes into contact with a sample, the damping is much more rapid as energy is absorbed by the material. By measuring how much energy is absorbed and returned to the probe, the elasticity of the sample can be measured. By measuring the indentation of the probe into the sample, the 'hardness' of the sample can be measured.

The two main factors that influence the data are the impact force and the dynamic properties of the test site. The user can control the impact force of the stylus using a mechanical switch that is recessed into the Ballistometer probe. At any one setting the elevation and release of the arm generates a constant amount of kinetic energy so that the data is influenced only by the nature of the test site.

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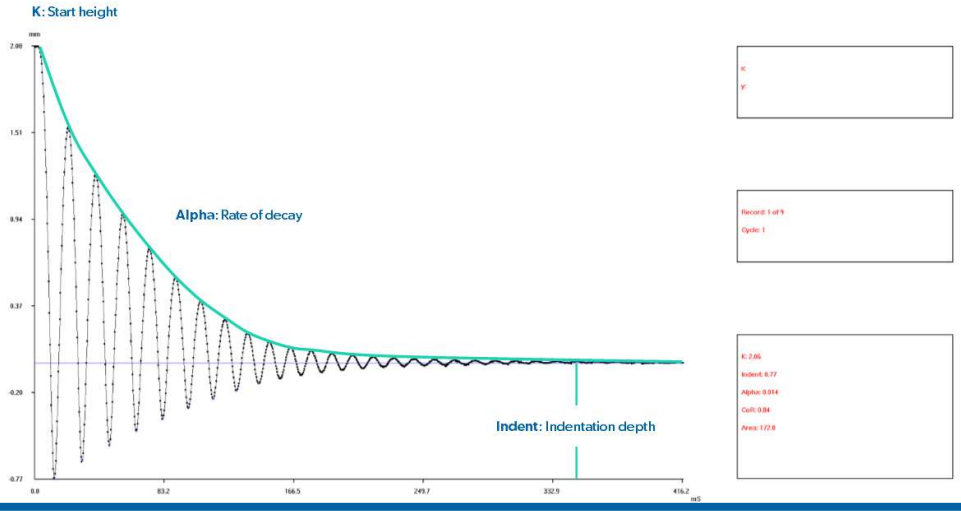

Control and analysis software —

The Ballistometer is supplied with Windows MApp software to control the instrument, to display the acquired data and to run the data analysis. The following relevant parameters are calculated.

- Indentation: the peak penetration depth of the probe tip beneath the skin level (skin datum)
- K: the start height of the probe tip above the skin surface. This is related to the energy stored in the torsion wire
- Alpha: the rate of energy damping. Large values indicate energy absorbing (in-elastic) samples
- Coefficient of Restitution - CoR: a high value indicates a highly elastic sample
- Area: the area between the bounce profile and the skin zero datum

The user can view the graphical display and the numerical parameters are calculated automatically and displayed on the screen. The analysed parameters and raw data can be exported into tab delimited text files.

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References —

Publications:

- Langton, A.K., Graham, H.K., Griffiths, C.E.M., Watson, R.E.B. (2019), "Ageing significantly impacts the biomechanical function and structural composition of skin", Exp. Dermatol., 28:8, 981-984.
- Jongmi Lim, M.S., et al. (2019) "Antiaging and antioxidant effects of topical autophagy activator: A randomized, placebo-controlled, double-blinded study", Journal of Cosmetic Dermatology, 18:1, 197-203
- Willard, J. (2012) "Mechano-modulation of Burn Wound Repair", Thesis, The Ohio State University

Examples of use in patent claims:

- WO2019245229A1 Cosmetic composition comprising nanoemulsion in which 7-dehydrocholesterol, cholesterol, and stearic acid encapsulated in internal phase of hyaluronic acid-ceramide np complex, Dec 2019 (Gowoon Sesang Cosmetic Co.)
- WO2017077497 Synergistic extract of Palmaria Palmata and Jasmine, compositions comprising same and uses thereof, May 2017 (Ashland)
- US20120115956 Use of isoleucine n-hexadecanoyl as a "volumizing" and/or "plumping" agent for human skin, May 2012 (Seppic)
- US7737179 Methods for treatment of dermatological conditions, June 2010 (Johnson and Johnson)