

# Mathematical Model to Measure Energy Absorption of Sports Bra

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**Abstract** - Measuring the shock absorbency of sports garments is pivotal for ensuring stability and support during exercise, minimizing injury risk in high-impact sports. It assesses a garment's capacity to absorb impact, curbing excessive breast movement and potential harm through compression, encapsulation, and structural support. This evaluation aids in predicting production outcomes and alleviating athletes' discomfort during physical activities. Prior research primarily concentrated on vertical nipple displacement using motion-capture cameras and live models, often neglecting the three-dimensional aspects of breast motion such as velocity, acceleration, and trajectory. This study introduces a novel approach using a sensor system to gather displacement, velocity, and acceleration data at specific points. It employs an artificial model to assess shock absorbency in sports garments during physical activities. The derived mathematical model, based on breast displacement data, offers insights into material and design choices prior to sample preparation. The study's findings yield invaluable insights for sports bra design and development, as well as selecting appropriate options for diverse physical activities. The authors aimed to develop a test method and mathematical model for measuring sports bra shock absorbency, addressing challenges related to cost, accuracy, and complexity. This research strives to enhance understanding and advance the evaluation of shock absorbency in sports bras, contributing to safer and more effective athletic experiences.

**Keywords**- *Sports bra, Shock absorbency, mathematical model, test method, breast displacement*