

# Focus on IFA's work

Edition 10/2015

617.0-IFA:638.22

## Human mechanical strain limits (pain thresholds)

### Problem

In more and more areas of industry, risk assessments must now also extend to low-level stresses/strains resulting from mechanical contact and collisions between human beings and machines. In risk assessments, such strains are regarded not as injuries, but as unpleasant strain events. Residual risks of collisions during human-robot collaboration are an example. For this "low-level" area, research must define physical strain criteria against which tests can be performed. One such strain criterion is the human pain threshold. For occupational safety and health purposes, a pain threshold map was required for relevant parts of the human body, containing test criteria suitable for use in the field and in standards development.

### Activities

In DGUV research project FP 317, the Johannes Gutenberg University in Mainz measured the pain thresholds on a collective of 100 persons, and produced a pain threshold map. Altogether, pain thresholds were measured three times on each of 29 body points based upon a body model. The mechanical stress was imparted by a new design of algometer developed by the IFA. The stimulus was triggered by a small, square-section plunger with rounded edges, and the stress applied in a controlled fashion almost linearly. The test persons were placed in a range of positions on a larger testing bench and the body points to be placed under stress fixed in position.



Test facility with algometer

The total force and the pressure distribution of the mechanical stress were measured in the collision plane. The test persons used a button to signal their pain thresholds.

## Results and Application

The results are available in the form of comprehensive biomechanical, medical and psychological data on pain thresholds for 100 test subjects, constituting a representative collective. Besides the exertion of pressures and forces, a new study method was developed for the application of mechanical body stimuli. For standardization work in the area of collaborative robots, specific pressure values were selected from the data distribution and employed in the relevant documents. Useful pain threshold values are thus available for use in risk analysis of the mechanical hazards arising during human-robot collaboration: the actual strain to which the body is subjected can be examined with reference to these values.

The results of Project FP 317 have been used in standardization activity, particularly in the development of Technical Specification (TS) 15066, "Robots and robotic devices – Collaborative robots".

## Area of Application

Accident insurance institutions, standards committees, institutes and companies concerned with mechanical stress/strain reactions at the human-machine interface

## Additional Information

- [www.dguv.de/webcode/ep82505](http://www.dguv.de/webcode/ep82505) (research report)

## Expert Assistance

IFA, Division 5: Accident Prevention – Product Safety

Medical faculty of the Johannes Gutenberg University, Mainz, Institute of Occupational, Social and Environmental Medicine

German Social Accident Insurance Institution for the woodworking and metalworking industries (BGHM), Mainz

## Literature Requests

IFA, Central Division