SPT Updated Design & Experimental results

This research project will focus on the use of the previously developed SPT experiment in order to compare experimental results to numerical simulations (use of the commercial code ABAQUS). If results are consistent, this would legitimize the use of the numerical model in a goal of generating SPT data (load-displacement curve) from randomly generated tensile data (plastic stress-strain). These data will then be used in order to build a model for prediction of the SPT load-displacement curve from given tensile characteristic. The final goal will then be to use the generated model in a reverse way in order to retrieve the tensile properties of a material that undergone a small punch test. In this approach turns out to be reliable, it could drastically reduce the cost and time necessary for the characterization of materials properties, especially plastic behavior and ductility.

However, we will focus here to the first part of the project, which is to perform experiments on a wide range of materials. Both SPT and tensile tests will be performed for each material. Mechanical properties will be extracted from the tensile test and be used as a material input in the numerical simulation. The latter will then be calibrated with the SPT results.

The materials

The goal here, as presented in this page, is to study materials with different mechanical properties, especially regarding their strain hardening and ductility behavior. All the materials properties, from information provided by sellers to tensile tests results, are summarized in the page linked below. The table summarizes the materials selected for this project. Add an image with all tensile tests results (curves)

Conventional tensile test
Materials

Properties – from sellers infos to Tensile tests results

- Page 1: Materials Properties – from sellers infos to Tensile tests results

This page summarizes the properties of the materials used in this project. First of all, information provided by the sellers, especially, composition, yield strength $\sigma_y$, ultimate strength $\sigma_{ut}$, and elongation. Then, tensile tests have been performed on the received plate, especially to extract their plastic behavior (in the form of the following power law $\sigma = \sigma_0 + K \times (\epsilon_0 + \epsilon_p)^n$).

The experimental setup

Many modifications have been brought to the initial design of our Small Punch Test apparatus in order to optimize it. This concerns especially the shape of the indenter, in a goal to reduce its compliance under high loads, but also to prevent its failure. The current design is presented on the image, with the general dimensions on the left and final punch design on the right. The technical drawing of the punch can be found here and can be used for its manufacturing with a lathe.