

International Students Olympiad in Hot Bulk Forging and Extrusion Technologies 2022

Profile extrusion

Task

A profile extrusion company received an order to produce a **40 tons** batch of hollow aluminium profile (Fig.1) from **AA6063-T5** alloy. A press for direct extrusion was chosen to fulfill the order. There is **1** extrusion line available at the facility with a container diameter of **135 mm** and nominal press load of **14 MN**.

Company has designed first model of tool for profile extrusion. Brief report with simulation results could be found in the attachment. Any participant of student Olympiad has 2 options: 1) optimization of existing design, 2) creation and optimization of new design. There is a **special requirement** for the profile: all welding seams should have structural welded bondings (see more in Qform Extrusion Users manual - *Users manual > Extra package of standard subroutines > Welding quality*).

Using simulation of profile extrusion process, develop a die set design required to complete the order and choose technological parameters of the process.

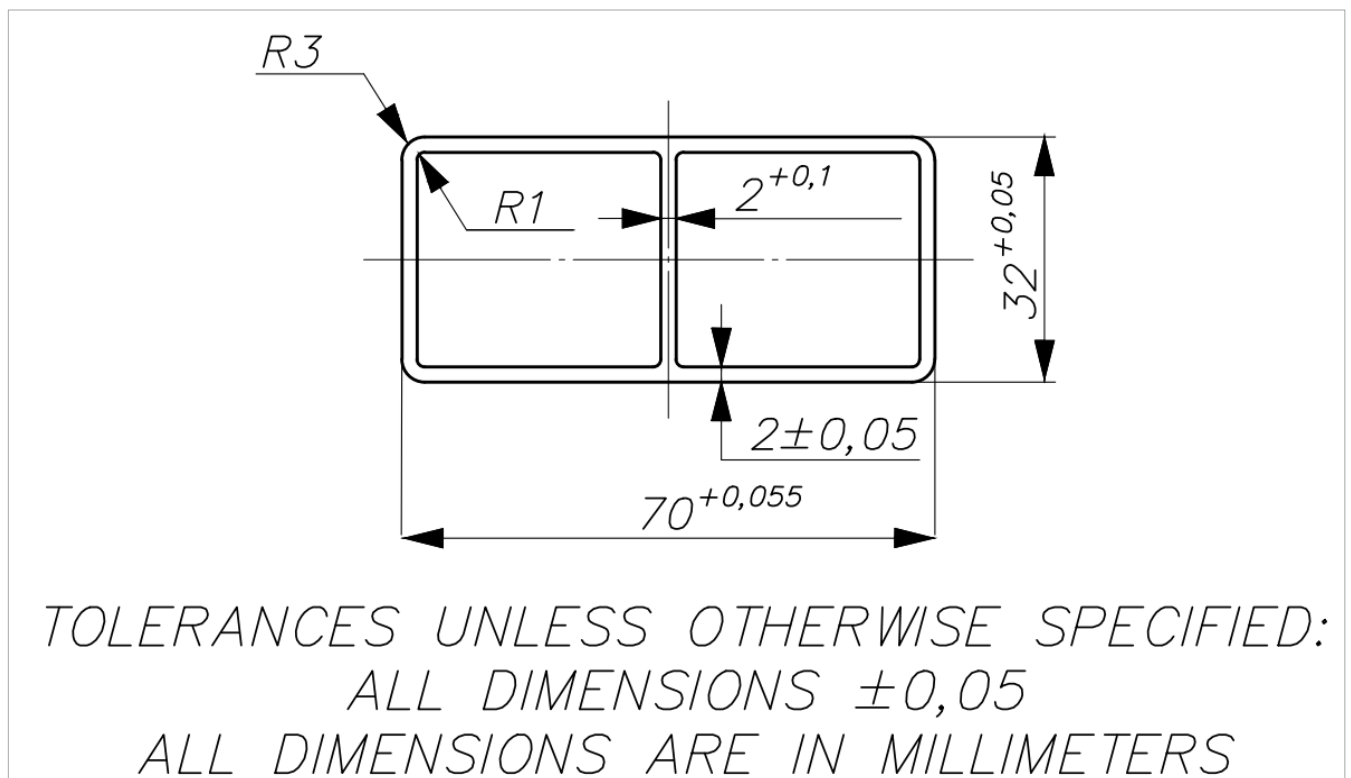


Fig.1. Profile

Please note! Profile dimensions are presented as for hot profile. So, participant doesn't need to calculate die orifice based on cold profile dimensions and thermal expansion coefficient. To achieve the requirement of tolerances on the profile, participant should achieve the following goal: hot profile dimensions in **QForm Extrusion** should be in tolerances indicated on profile drawing.

We recommend to use $\frac{1}{4}$ symmetrical model to save your time. **Note:** welding quality cannot be assessed using the respective subroutine in case when welding seam is located on symmetry plane. Make sure that welding quality is good enough or use half of the model instead of quarter.

Step-file with model as well as template model with uncombined mandrel parts are in the attachment.

Task notes

Create a report containing description of task execution, process simulation and steps of results analysis including calculations and technology verification. Use **QForm Extrusion** as a tool for assessment and justification of the proposed technology.

Quality, reliability and reasonability of approaches used to solve technological problems have an influence on the final mark, taking into account the following criteria:

- balance of material flow and lack of profile intersection with die set
- adjustment of extrusion temperature-velocity mode
- profile orientation on the die face
- adjustment of extrusion load mode (selection of billet length)
- analysis of die stress-strain condition
- productivity rate of the proposed technology (number of profiles extruded simultaneously and weight of profile per 1 press stroke)
- transversal seam length value and welding quality estimation of longitudinal seam
- universality of proposed components of support tools
- analysis of potential extrusion defects; prediction and elimination
- suggestion of appropriate heat treatment

6 hours provided to design the technology, to simulate it and to create a report using a text editor.

At the end of the work create an archive (use special number provided by committee to name the archive) including the report and resulting simulation files of a single final version of technology. Report title and QForm files have to contain your special number. Name of participant shouldn't be specified.

Additional data

Die set length – **180 mm**

Die set diameter – **250 mm**

Bolster length – **230 mm**

Pressure ring inner diameter – **150 mm**

Material conditions – **T5**

Other requirements – according to local standards