

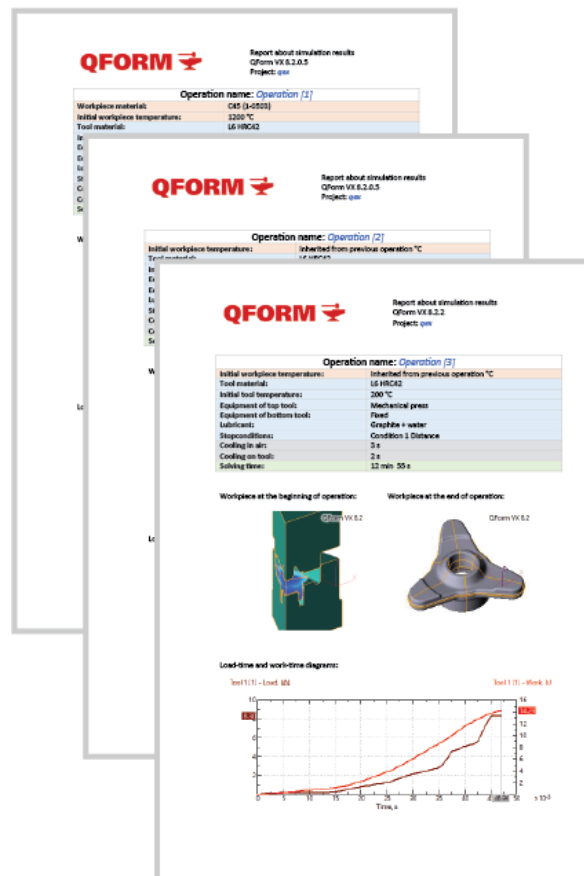
## QForm VX 8.2.4 new facilities and features

October 2017

The new version of QForm has some amazing new features, additional specialised models and options. Of course, many existing features have also been improved. For better comprehension we will divide the new information into two groups, i.e. general modifications and improvements that help most users and more specific features that are intended for simulation of certain types of technological processes. All of them are listed below.

### I. General features, options and improvements

1. The program has automatic generation of technical reports using customized Word templates as \*.dotx-files.



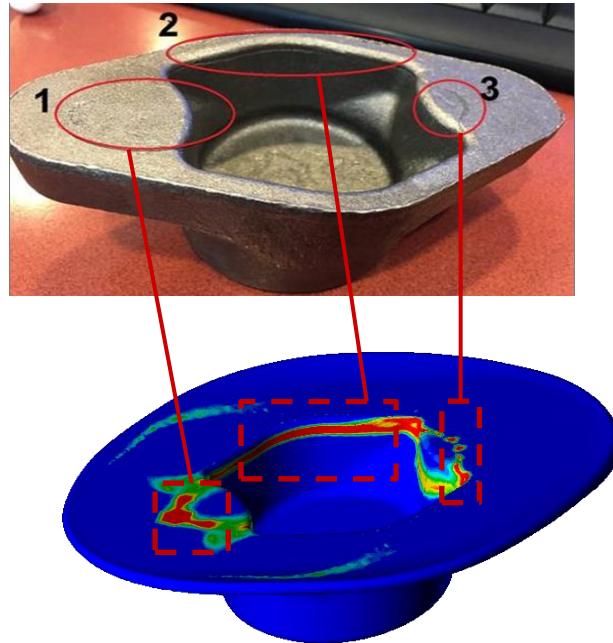
2. Direct automated import of geometry from \*.step files to QForm ready for simulation (No need to use QShape anymore for most geometry).
3. QShape also has been significantly improved with one-click automatic correction of most geometry defects when importing the model from CAD to QShape.

4. Improved import of geometry files from CAD systems that have some specific peculiarities such as NX and Solid Edge.
5. For better visualisation of the simulation results we added the ability to export in vrml-file format for coloured 3D printing.
6. We can display the amount of heat (in Joules) added to the tool due to heat transfer from a workpiece and due to friction.
7. New hyperbolic sine expression for the flow stress of deformed material.
8. For better control of a computer performance the priority of QForm Solver is now set to "Normal" allowing other programs to run on the same computer more effectively. For the same purposes it is also possible for the user to set the number of logical processors to be used for a particular simulation.
9. "Process templates" have been added for even faster setup of similar simulations.
10. Setting the "stop" condition is now even easier for the most common case of just two tools.
11. Extended options for copying the source data from previous operations to the next ones. Including: boundary conditions, tools settings with or without previously calculated results.
12. The screen image with picture of the simulation results and legend can be copied to the clipboard with one click. The same can be done for any graph.
13. The user can set the resolution of a still picture or video clip to be recorded and saved.
14. The left side control panel tabs can be switched to compact view to make more screen space for the other information.
15. It is now possible to set up the workpiece axis at any intermediate operation (previously it was possible only at the very first operation).
16. It is now possible to copy local boundary conditions (boxes) from previous operation and select the parameters to be copied, i.e. with or without their positioning in previous operation.
17. It is possible to choose parameters when copying tools to the next operation, i.e. to inherit positioning from the previous operation or not.
18. Velocity vectors are now coloured for easier analysis while a workpiece body is not hidden and the vectors are shown on its surface.
19. The batch mode has new options, i.e. starting simulation from the selected operation, starting from the beginning of the list, recalculating scheduled tasks again.
20. In the license control window, the QExDD license duration is displayed among the other QForm features.

## II. Specific features and special modules

### 1. Programming in QForm and User's Defined Subroutines

- 1.1. Programming has become even easier because the LUA code can be now debugged directly in QForm when running user defined subroutines.
- 1.2. The facilities for programming of subroutines have been extended.
- 1.3. New standard subroutine for prediction of flow induced defects ("Gartfield") has been added.



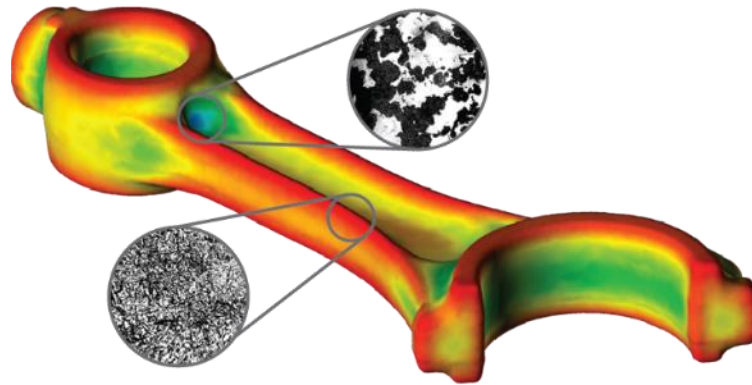
- 1.4. New standard subroutine for prediction of low cycle fatigue failure of tools has been included.



- 1.5. Directions of main stress and strain components are now displayed in the standard subroutines "Stress tensor" and "Strain tensor" respectively.

## 2. QForm Heat Treatment module (new!)

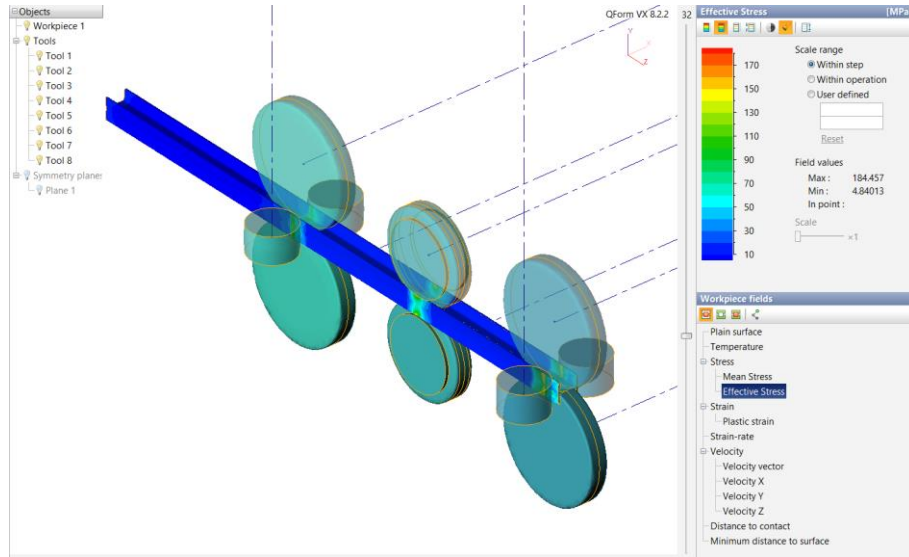
- 2.1. This module allows simulation of phase transformation in different types of metallic materials including steels and alloys based on aluminium, titanium, nickel and some others. The model is very flexible and can be widely used for various tasks.



- 2.2. The material data required for phase transformation simulation include individual physical properties of each phase that may appear in the process. The final properties in every point of the workpiece after completion of the transformation simulation are calculated by the rule of mixtures using properties of each phase in the proportion defined by local phase constitution.
- 2.3. The user can specify a complete set of possible phases that may appear in multiphase material as well as kinematics of direct and inverse transformations between the phases in steels, Ti-alloys, and some of Ni-alloys to allow simulation of heat treatment of different materials having polymorphic transformations. Precipitation hardening in Al-alloys is also possible to simulate.
- 2.4. Several models of phase transformations are now supported:
- 2.4.1. JMAK (specifying kinematics transformation by means of TTT diagrams),
  - 2.4.2. JMAK (specifying kinematics of transformation in the form of equations that is useful, for example, for tempering simulation).
  - 2.4.3. Koistinen&Marburger (for martensitic transformations).
  - 2.4.4. Leblonde&Devauux (another form of the phase transformation representation).
- 2.5. Two methods of hardness and tensile strength calculation after the heat treatment have been implemented, i.e. by using the phases properties with the rule of mixtures and by valuation of cooling time in specific temperature intervals (e.g. by  $t_{85}$  for steels).
- 2.6. The material data can be imported directly from JMatPro software or typed as a table directly in QForm database or loaded from Excel files. Thus, any kind of material data from textbooks, monographies or other technical publications as well as the customer's own data can be used.
- 2.7. Cooling media options required for heat treatment simulation have been extended by including a water sprayer as a new type of boundary condition for quenching simulation.

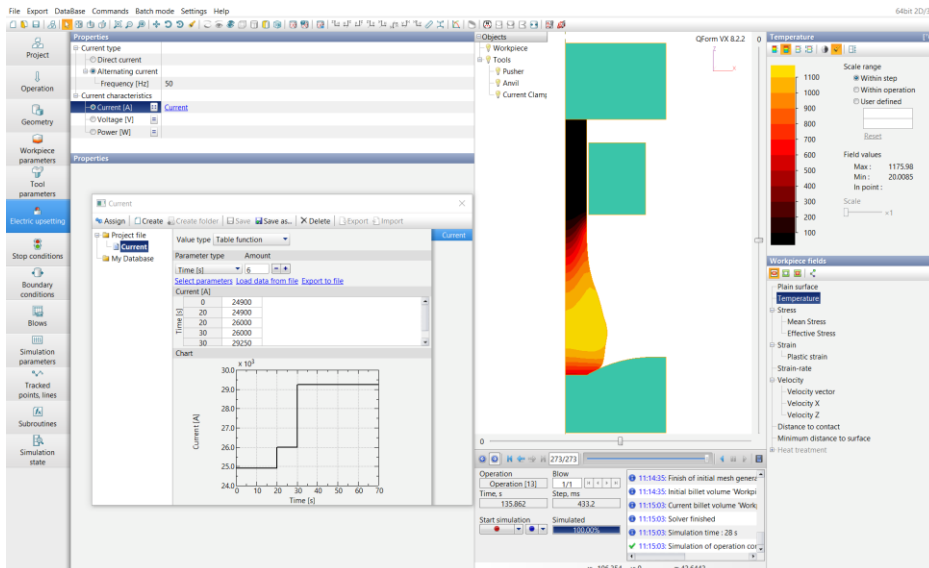
### 3. Special module for longitudinal rolling simulation (new!)

This module makes it easier and faster to set up the initial data for shape and section rolling simulation and to run the simulation process. It provides automated setting of the dual mesh with necessary mesh densification in deformation zones, sets special boundary conditions for that provide guiding of the rolled product through the rolling stands.



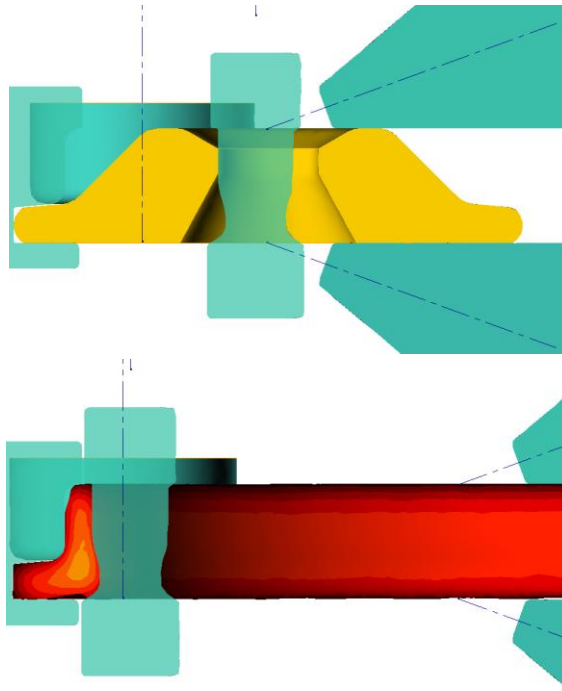
### 4. Electric upsetting simulation module (new!)

This module includes simulation of the upsetting task when the heating of the bar is provided by electric current between the vice and anvil. The Joule heat causes the temperature to increase and softening of the material that in turn causes local plastic deformation in this zone. The shape of the product (the "bulb") and possible material flow defects depends on many parameters including the electric current graph, velocity of the tools and the load applied. The product of electric upsetting is usually used as a preform for further closed die forging when making shafts with large flanges and valves.



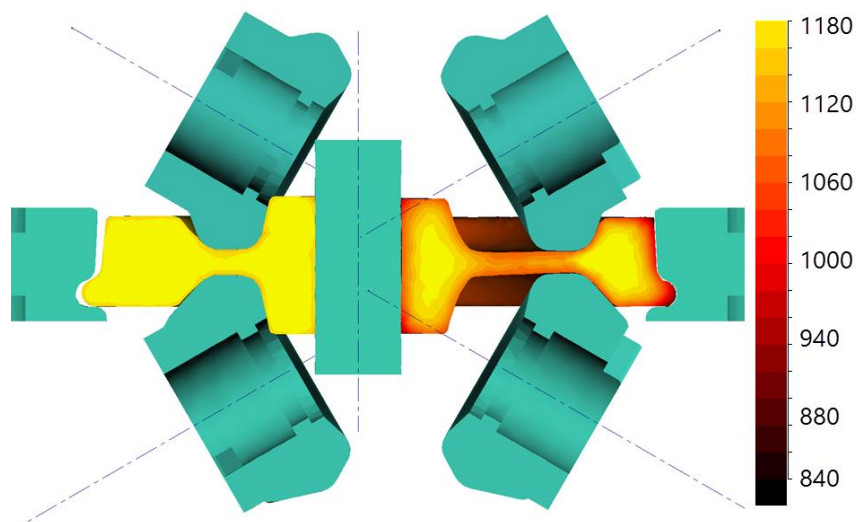
## 5. Ring rolling simulation module

5.1. This module has several important improvements that make it even more robust and accurate for simulation of industrial processes of ring rolling in different types of the machines.



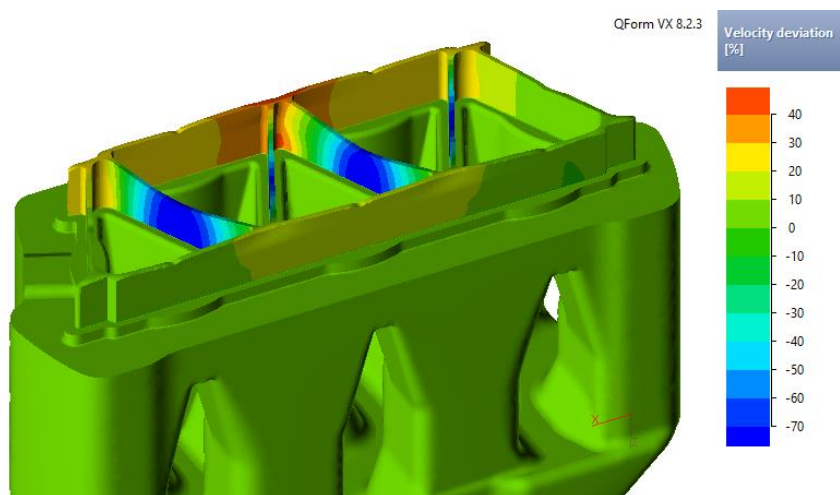
5.2. Now it is possible to take into account the influence of horizontal table level, switch on and off the horizontal ring stabilization for better prediction of the actual ring behaviour. The rotational velocity of the main roll can be variable depending on the ring diameter. Now the program displays the ring thickness in the "Simulation state" tab concurrently with the progress of the simulation for better control.

5.3. Ring Rolling module is also used for the wheel rolling simulation. To extend its facilities a new algorithm of initial data setup for different kinds of the machines has been developed and added to the program.



## 6. Extrusion simulation module

- 6.1. Extrusion module has been significantly extended and improved to increase its accuracy and extend facilities for analysis of the results.
- 6.2. Improved algorithms of coupled simulation of material flow and die set deformation in case of large die displacement.
- 6.3. More advanced remeshing method when simulating coupled deformation.
- 6.4. New and more precise algorithm for solving coupled temperature problem in dies and extruded material.
- 6.5. Several important diagnostic messages have been added.
- 6.6. Some specific extrusion process parameters have been added to the Simulation state tab, i.e. extrusion ratio, die filling time and extrusion load.
- 6.7. New field showing the velocity deviation from the average profile velocity has been added.



- 6.8. The new "Distance from stop-mark" field has been added.
- 6.9. The new fields "Material streams borders" and "Material streams" have been added.
- 6.10. The "Plastic strain in profile" field is changed to just "Plastic strain" field and it is available now for the entire material flow domain (not just for the profile).
- 6.11. Flow stress data for all aluminium alloys used for extrusion simulation have been verified and updated.
- 6.12. Possibility to display tool simulation results after the very first iteration, i.e. before coupling with the material flow has been added for better understanding of the die set behaviour under the loading.
- 6.13. Ram displacement is added to the graphs.

And, finally, maybe not the best news for someone but it is the reality. New version 8.2.4 is available only in 64-bit. We decided do not make 32-bit variants of new versions anymore because almost all computers that are now produced are 64-bit systems. Thus, the last 32-bit variant exists only for the version 8.1.4.