ADVANCED SIMULATION TECHNOLOGIES

HYDSIM-FIRE-Coupling, FIRE v2010.1

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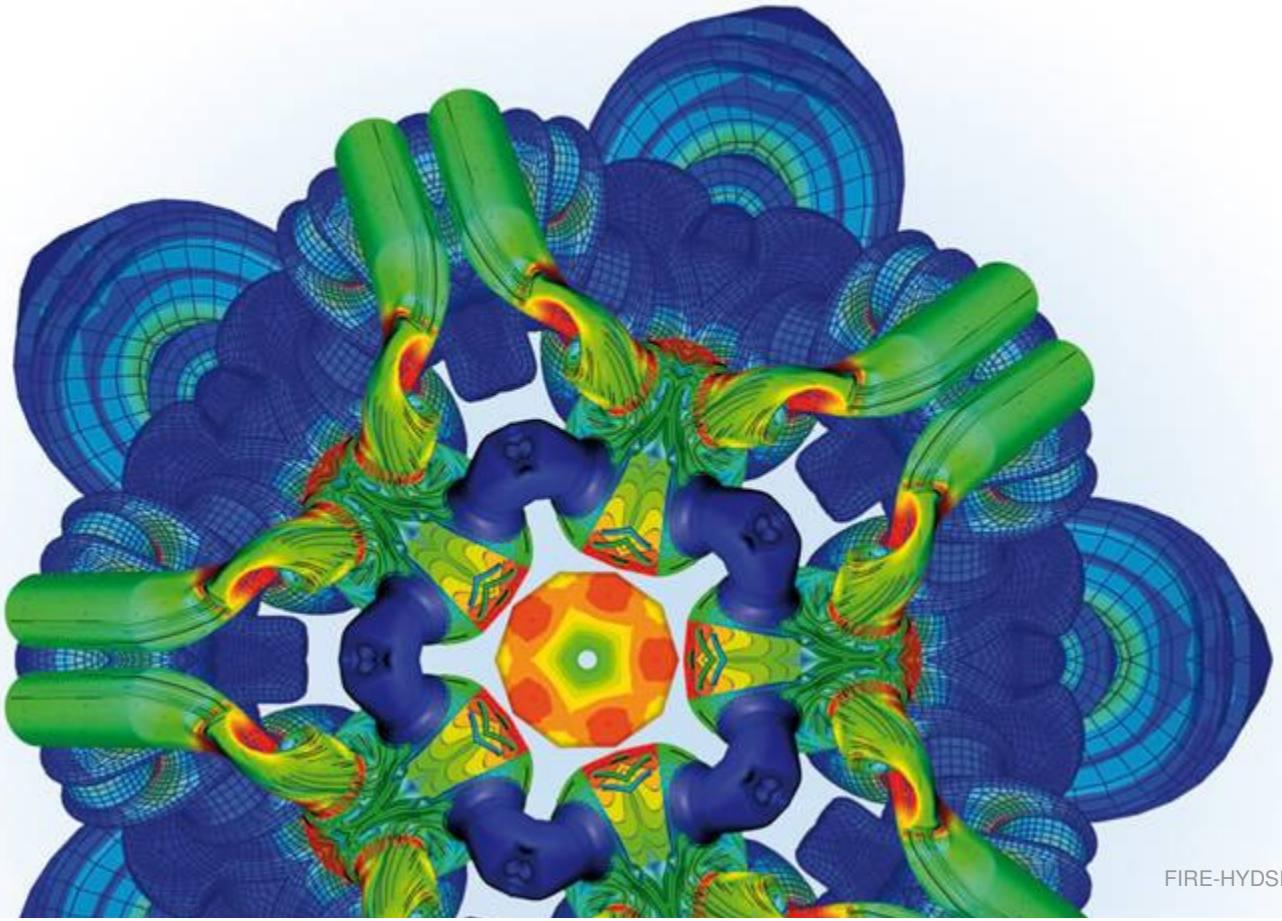


FIRE-HYDSIM Coupling Formulas

New FIRE-HYDSIM-Coupling-formulas support both longitudinal and lateral (radial) needle movement.

The formulas are part of the FIRE v2010.1 installation, but may be used also with FIRE v2010 and v2009.

Lateral needle movement is supported by HYDSIM v2011.

The formulas support FIRE full models (360° round nozzle axis), half models (180° with symmetry plane) and segment (cake) models. With half-models, needle movement is applied only along the principal lateral direction (parallel to the symmetry plane). With segment-models, only the longitudinal needle motion is taken into account.

Nozzle geometry / FIRE domain
Required selections

Required Face Selections

needle_seat: conical seat surface

needle_tip1…n: arbitrary number of conical needle-tip-segments

needle_tip: union of all needle_tip* selections

inlet: inlet of FIRE domain

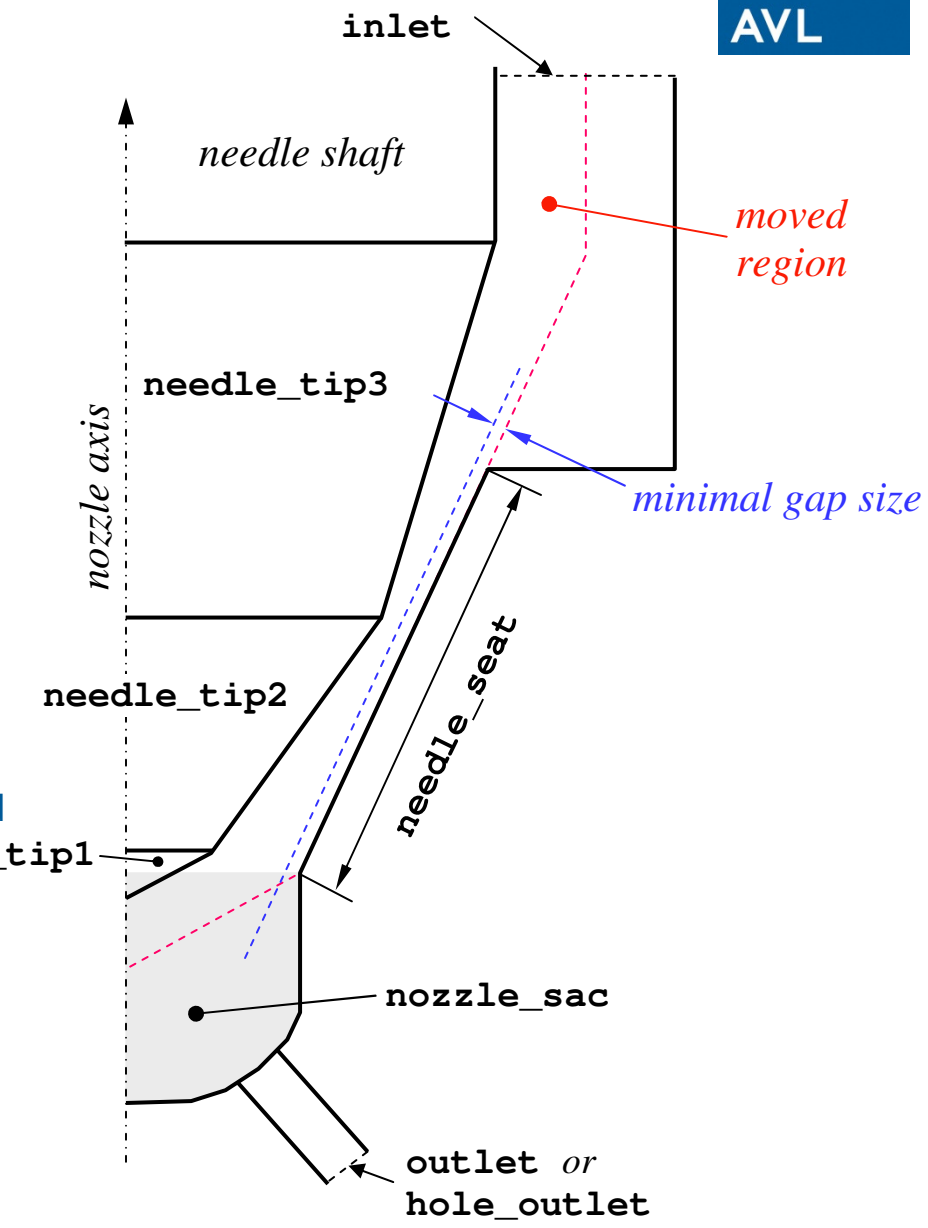
hole_outlet or **outlet** (if former missing): outlet of FIRE domain or hole-exit-surface into chamber

Required Cell Selections

nozzle_sac: sac volume (used to average pressure for HYDSIM). Should be volume at VCO for VCO-cases.

Moved mesh region (red): full needle movement at needle surface decreases to zero movement at red dashed line.

Parts of (moved) needle surface that protrude the dotted blue line (cone in 3D) are shifted back, so as to keep the user-specified minimal gap size, needed for mesh quality.
Mesh cells with center actually located within the needle solid can optionally be „blocked“ (zero velocity enforced).

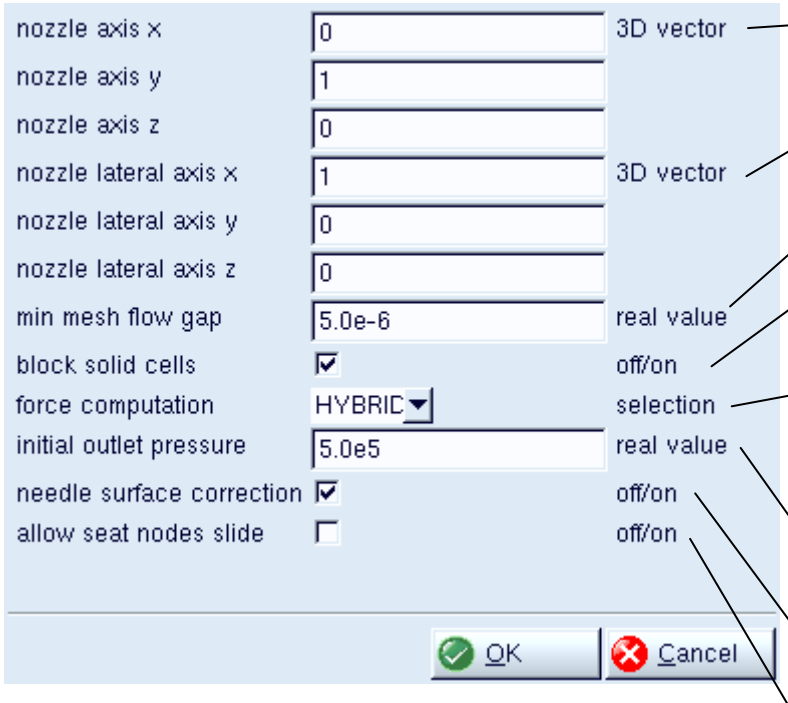


Required formulas

Note that the global formula (see below) must be loaded in the SolverGUI as first of these formulas! The formulas are part of the FIRE installation with version v2010.1 and later. The can be loaded on **Import example** in the Formula Editor.

1. Global formula (must be loaded first): `fire_hydsim_coupling_global.h`
   This formula contains **Formula parameters** to be defined by the user (see next slide). The formulas below do not contain any further parameters.
   (Note that this formula automatically loads the formula file *`fire_hydsim_coupling.h`*, which is also contained in the installation.This formula contains the major formula functions for the FIRE-HYDSIM-coupling.)
2. Mesh-deformation-formula: `fire_hydsim_coupling_mesh.h`
3. Result-2D-formula (apply to selection needle_tip): `fire_hydsim_coupling_2D_result.h`
   This formula triggers the computation of the FIRE results that are sent to HYDSIM (needle force, mass flow etc.)
4. Initialization of pressure: `fire_hydsim_coupling_init_pressure.h`
   Above the needle seat edge, pressure is set to the HYDSIM-value received at the inlet. Below the edge, it is set to the outlet-pressure, as defined in the global formula.
5. Initialization of temperature: `fire_hydsim_coupling_init_temperature.h`
6. Inlet-pressure: `fire_hydsim_coupling_inlet_pressure.h`
7. Inlet-temperature: `fire_hydsim_coupling_inlet_temperature.h`

Formula parameters in global formula



Nozzle axis direction, pointing against tip. Note that the nozzle axis must pass through the origin of the FIRE model!

Nozzle lateral direction: must conform to HYDSIM principal lateral displacement direction, if lateral displacement is considered.

Minimal gap size [m] to keep mesh quality in the flow gap

Activation of cell-blocking: due to the minimal gap size, cells may actually be located within the needle-solid. These cells are blocked if this option is active.

Mode for computing needle force in FIRE:

- **HYDSIM**: force computed by HYDSIM always.
- **FIRE**: force computed by FIRE.
- **HYBRID**: force computed by FIRE, if no cells are blocked at the time. If cells are blocked, the force is computed by HYDSIM.

Initial outlet pressure [Pa]: used for pressure-initilization (by formula of previous slide) below the needle seat edge.

If active, mesh nodes in `needle_tip` are repositioned so as to match the respective conical surfaces exactly. Might move nodes in selection `symmetry` as well.

If active, mesh nodes in `needle_seat` are moved according to the current needle displacement along the conical surface. This option must NOT be used for VCO nozzles! It might improve mesh quality in SAC-nozzle cases.