



AD FALCON API Manual

Initial Assignments

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1 Initial Assignments

% Initial Assignments defines **initial fields at Gauss points** (stress, pore pressures, void ratio, damping, and optional UMAT custom state variables). Values can be prescribed as:

- **Height-based profiles** (H <...> values ...) with linear interpolation, or
- a **spatial coordinate file** (@CoordinateFile) with inverse-distance weighting (IDW).

1.1 Syntax

```
% Initial Assignments
@Stress: H 0.0 values -36 -60 -36 0 0 0 H 10.0 values -50 -80 -50 0 0
0
@PW: H 0.0 values -10 H 10.0 values -30
@Void: H 0.0 values 0.45 H 10.0 values 0.50
@CoordinateFile: path/to/coords.txt
%%%
```

Notes:

- Section name variants such as % InitialAssignments are accepted.
- Built-in assignment headers are **case-sensitive**: @Stress:, @TotalStress:, @PW:, @PA:, @Void:, @Damping:, @Alpha_p_c:.
- @CoordinateFile may have one or more leading @ characters (e.g. @@CoordinateFile) and may be written with or without a trailing :.
- Custom variables use @Name: where Name matches [A-Za-z_][A-Za-z0-9_]*. These refer to **UMAT custom state variables**; the name must exist in the UMAT custom-variable registry.
- Each @...: assignment line must contain **at least two** H <height> values <...> groups.
- Step targeting is optional:
 - lines before any @Step <id> header apply at **step 0** (initialization, the default behavior),
 - @Step <id> blocks define **step-start overrides** applied at the beginning of that step (values overwrite the current state at step start).

Example (override pore pressures at the start of step 3):

```
% Initial Assignments
@PW: H 0 values -10 H 10 values -30
```

```
@Void: H 0 values 0.45 H 10 values 0.50

@Step 3:
  @PW: H 0 values -5   H 10 values -15
  %%%
```

@CoordinateFile is supported only for the default (step 0) assignments; place it above the first @Step header.

1.2 Height-Based Assignments (2D/Axisymmetric and 3D)

Height-based assignment is supported in **2D/axisymmetric and 3D**.

1.2.1 What “H” means

- **2D / Axisymmetric:** H is the **global Y** coordinate.
- **3D:** H is the **global Z** coordinate.

1.2.2 Built-in variables and required value counts

- @Stress: provides **6 values** per height: StressXX StressYY StressZZ StressZY StressZX StressXY.
- @TotalStress: provides **6 values** per height. The normal components are stored as TotalStressXX TotalStressYY TotalStressZZ. The shear components are stored in StressZY StressZX StressXY (there are no separate “total shear” state variables).
- @PW: provides **1 value** per height and sets InitialPoreWaterPressure.
- @PA: provides **1 value** per height and sets InitialPoreAirPressure.
- @Void: provides **1 value** per height and sets VoidRatio (and InitialVoidRatio is kept equal to it).
- @Damping: provides **1 value** per height and sets Damping.
- @Alpha_p_c: provides **1 value** per height, must be in [0, 1], and sets alpha_p_c.

!!! note "2D stress components" Even for 2D/axisymmetric analyses, @Stress: and @TotalStress: still require 6 values per height. Components that do not apply to your kinematics should be set to 0.

1.3 Signed-distance profile (3D only, optional)

For **3D models only**, you can replace “height = global Z” with a signed-distance coordinate:

$$s = (\mathbf{x} - \mathbf{x}_0) \cdot \mathbf{d}_{\text{unit}}$$

Enable this mode by adding a profile line anywhere inside % Initial Assignments:

```
@Profile3D: SignedDistance Origin <x0> <y0> <z0> Direction <dx> <dy> <dz>
```

- The direction vector is normalized internally.
- When this profile is present, the H <...> values on all assignment lines are interpreted as **signed distances** (not elevation z).

1.4 Coupled and Fully Coupled Analyses

!!! warning "Void ratio is mandatory" For **Coupled** and **Fully Coupled** analyses, VoidRatio must be assigned at every Gauss point (and must be > 0). If it is missing or non-positive, FALCON aborts with a data-format error.

1.4.1 Saturated coupled analyses

Typical initial fields:

- @PW (baseline pore-water pressure) and @Void (void ratio)
- either @Stress **or** @TotalStress (do not use both in the same % Initial Assignments block)

At initialization, saturation is set to 1.0 and Xi is set to 1.0.

1.4.2 Fully coupled unsaturated analyses (SWRC)

For fully coupled unsaturated analyses, initial pressures and void ratio are used to form initial suction and saturation (through the SWRC), and then Xi is computed from the effective-stress law.

- @PW and @PA define the **baseline** pore pressures (InitialPoreWaterPressure, InitialPoreAirPressure).
- @Alpha_p_c is only needed for **hysteretic** SWRCs; if omitted it defaults to 0.

1.5 External Coordinate Files (@CoordinateFile)

Use @CoordinateFile when the initial field is not well-represented by a 1D profile in H.

1.5.1 Main input file

```
% Initial Assignments
@CoordinateFile: /path/to/coords.txt
%%%
```

1.5.2 Coordinate file format

```
@Coords
X 0.0 Y 0.0 Z 0.0 InitialPoreWaterPressure -10.0 VoidRatio 0.30
X 1.0 Y 0.0 Z 0.0 InitialPoreWaterPressure -12.0 VoidRatio 0.32
X 0.0 Y 1.0 Z 0.0 InitialPoreWaterPressure -15.0 VoidRatio 0.35
X 0.0 Y 0.0 Z 0.0 StressXX -50.0 StressYY -60.0 StressZZ -40.0 StressXY 0.0
StressZX 0.0 StressZY 0.0
%%%
```

Rules:

- @Coords (case-insensitive) starts the block; the block ends at %%%.
- Each line must start with X <.> Y <.> Z <.> (tokens X/Y/Z are case-sensitive).
- For 2D/axisymmetric models, Z is still required in the coordinate file; use Z 0.0.
- Variable names are case-sensitive and must match either:
 - a recognized **state variable name** (see [State Variables](#)), or
 - a registered **UMAT custom state variable** name.

!!! note "Initial vs current pore pressures" @PW: / @PA: set the baseline fields (InitialPoreWaterPressure / InitialPoreAirPressure). In coordinate files you can set these explicitly using the state-variable names InitialPoreWaterPressure and InitialPoreAirPressure.

1.5.3 Interpolation

Values are interpolated to Gauss points using inverse-distance weighting (IDW) with power $p = 2$.

If no points define a requested variable (or weights degenerate), the value falls back to 0.0 and a warning is printed. In **Coupled/Fully Coupled** analyses, make sure the coordinate file provides VoidRatio everywhere you need it (otherwise the fallback 0.0 will be invalid).

1.6 Full sample

```
% Initial Assignments
@Stress:  H 0.0 values -36 -60 -36  0 0 0   H 10.0 values -50 -80 -50  0 0
0
@PW:      H 0.0 values -10           H 10.0 values -30
@Void:    H 0.0 values 0.45         H 10.0 values 0.50
@CoordinateFile: /path/to/coords.txt
%%%
```

