

# Application Note

**Computing Forming-Limit Curves  
(FLC ISO 12004) in VIC-3D**

**VIC-3D 11**

2026

## VIC-3D 11

### Computing Forming-Limit Curves (FLC ISO 12004) in VIC-3D 11

This application note describes the recommended workflow for computing forming-limit strain pairs ( $\epsilon_1$ ,  $\epsilon_2$ ) from DIC measurements using two Correlated Solutions extensions for VIC-3D:

#### FLC ISO 12004

This per-sample analysis implements the position-dependent method of **DIN EN ISO 12004-2:2021** for a single fractured specimen and returns one ( $\epsilon_1$ ,  $\epsilon_2$ ) limit-strain pair per section line.

#### FLC ISO 12004 Annex F

This aggregator combines the per-sample CSV outputs into the consolidated table prescribed by **Annex F** of the standard, with means per-sample and per-geometry.

*Please note: This note assumes you are already following the standard for specimen preparation, speckle application, and test execution for your laboratory. It does not provide a step-by-step walkthrough of DIC (test set-up, calibration, image acquisition, normal post-processing, etc.). For a range of resources focused on DIC acquisition and analysis, please visit the Correlated Solutions Support Page at [www.correlatedsolutions.com/support](http://www.correlatedsolutions.com/support) or by clicking the QR code to the right.*



## Before You Begin

Each sample project must contain:

- A completed correlation through fracture
- The working directory named in the pattern 'X.Y.Z' (e.g. '1.20.1'), where the middle field is the **sample geometry** and the last is the **sample number**. Use numeric digits in all three fields — non-numeric values will break the Annex F aggregation.
- A single inspector line drawn on the analysis frame (see \*Step 2\*).

**Directory naming pattern**

1.20.1 /

- sample number
- sample geometry

- All three fields must be numeric digits.
- Other names break Annex F grouping.

**Legend**

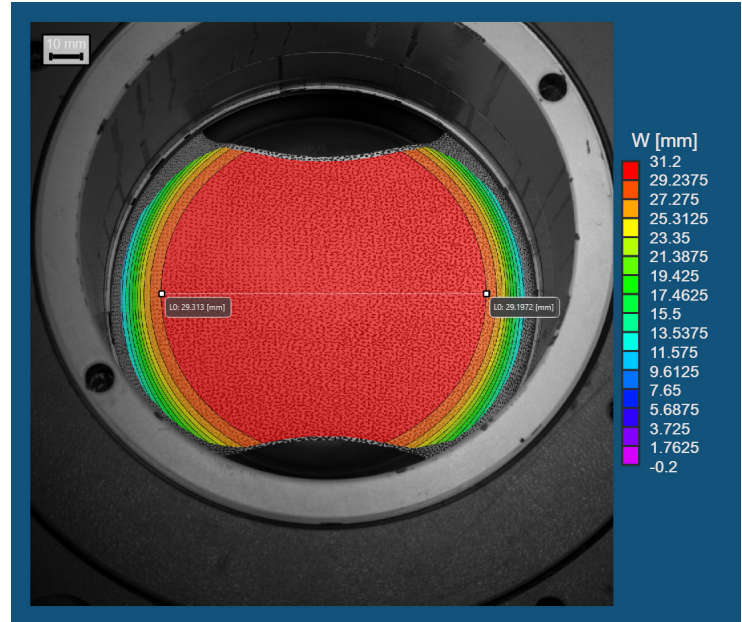
- Parent directory — run the Annex F extension from any sibling.
- Sample project — one per replicate, named X.Y.Z.
- 📄 Per-sample result — written by FLC ISO 12004.
- 📄 Aggregated output — written by FLC ISO 12004 Annex F.

The screenshot shows a file explorer view of a project directory. The root directory is 'project\_root/'. Inside, there are four sub-directories representing sample projects, each named with a pattern 'X.Y.Z'. The first two are '1.20.1' and '1.20.2', and the last two are '1.40.1' and '1.40.2'. Each sub-directory contains a 'VIC' folder (VIC-3D project files) and a 'flc\_results.csv' file. At the root level, there is also a 'flc\_annex\_F.csv' file, which is the aggregated output.

### Step 1 - Load the Analysis Frame

The position-dependent method assumes the localized neck is fully developed and the crack has **not yet** propagated through the gauge region.

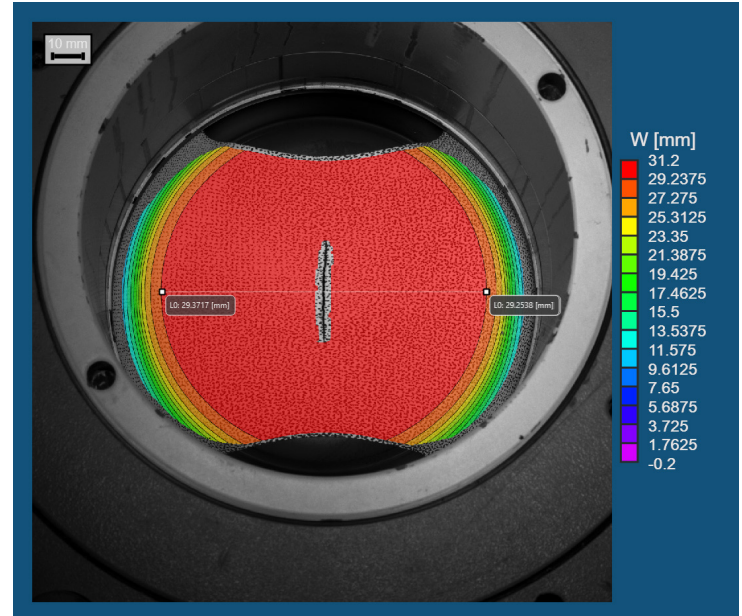
Step backward through the test until you find the **last frame before crack-through**. Note the frame number, this will be the data file selected within the extension.



### Step 2 - Draw the Inspector Line

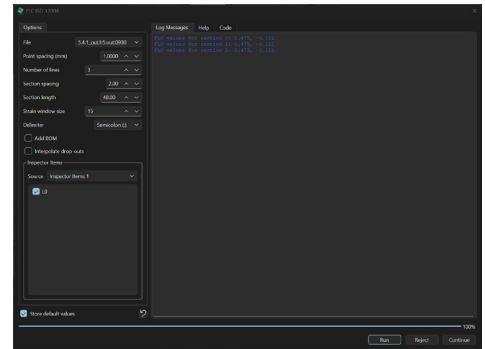
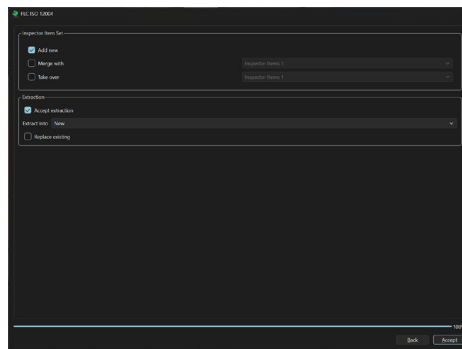
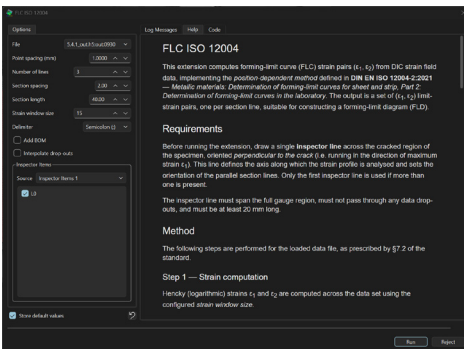
Draw one inspector line across the cracked region. It should be:

- Perpendicular to the crack (along the direction of maximum  $\epsilon_1$ ).
- At least 40 mm long. The extension rejects lines shorter than 20 mm and §7.2.2 of the standard requires a 40 mm section length. Draw with at least 20 mm of usable data on each side of the visible crack.

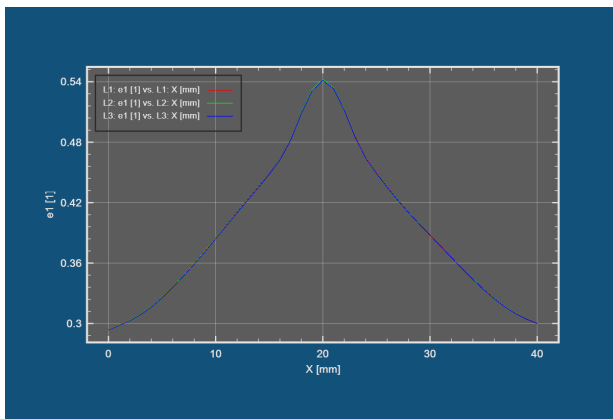
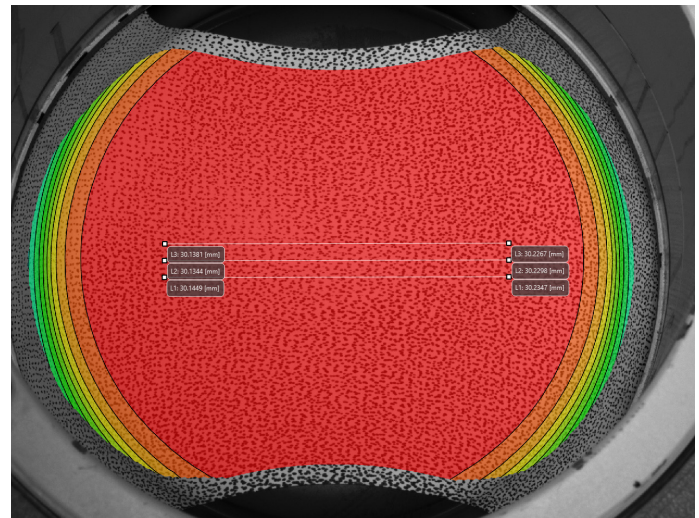


### Step 3 - Run the FLC ISO 12004 Extension

- The FLC ISO 12004 Extension default settings are set according to the standard.
- Options are well documented within the extensions help page.
- The only inputs required will be the 'File' that was noted previously as the last frame before crack-through, and the inspector item drawn across the crack in Step 2.
- Complete this step for all of the samples in the series.



Once this is complete, **Section lines (right)** should be visible in the data viewer, centered on the crack and perpendicular to it.



**Additionally, Line Extractions** are added to the project. These contain the  $\epsilon_1$  and  $\epsilon_2$  profiles for each section line. Each  $\epsilon_1$  profile should show a single sharp peak as shown in the example (left).

In addition to these new values within the project there will also be two CSV files written to the working directory:

- `flc_profile_data.csv` — full  $\epsilon_1$  and  $\epsilon_2$  profiles for every section line
- `flc_results.csv` — one ( $\epsilon_1$ ,  $\epsilon_2$ ) limit-strain pair per successfully analyzed section line.

Verify that the **Sample geometry** and **Sample number** columns contain the expected values from your directory name. If they read `NA`, the directory does not match the `X.Y.Z` pattern. If this is the case, rename it and rerun.

### Step 4 - Aggregating Multiple Samples - FLC ISO 12004 Annex F

Upon execution of the FLC ISO 12004 extension on every sample, use the Annex F extension to combine the results.

All sample projects must sit as siblings under a common parent directory. Each directory name must follow the `X.Y.Z` pattern with **numeric digits** in all three fields — the middle field groups by geometry; the last groups duplicates within a geometry.

**Directory naming pattern**

1.X.Y.Z

- 1 — sample number
- X — sample geometry
- Y — sample geometry
- Z — sample geometry

• All three fields must be numeric digits.  
• Other names break Annex F grouping.

**Legend**

- Parent directory — run the Annex F extension from any sibling.
- Sample project — one per replicate, named X.Y.Z.
- Per-sample result — written by FLC ISO 12004.
- Aggregated output — written by FLC ISO 12004 Annex F.

Open any of the sample projects (or a dedicated summary project in the same parent), then **Run** the extension *Extensions* → *Forming limit curve* → *FLC ISO 12004 Annex F*.

Executing the extension triggers a scan of all sibling directories in the current project for `flc_results.csv` and

- Concatenates all rows into a single table.
- Computes the **mean  $\epsilon_1$  and  $\epsilon_2$  per-sample** (grouped by sample geometry + sample number).
- Computes the **mean  $\epsilon_1$  and  $\epsilon_2$  per-geometry** (grouped by sample geometry).
- Writes the aggregated CSV to the parent directory.

The per-sample and per-geometry mean columns appear on the last row of each sample / each geometry, matching the Annex F table format.

$\epsilon_1$	$\epsilon_2$	$\epsilon_1$ - Mean sample	$\epsilon_2$ - Mean sample	$\epsilon_1$ - Mean geometry	$\epsilon_2$ - Mean geometry	Sample geometry	Sample number	Section line
0.494407922	-0.225146781						1	1
0.506876114	-0.223545249						1	1
0.509517531	-0.218689753	0.502319698	-0.217805425				1	2
0.513156183	-0.222643733						1	2
0.510168945	-0.221764868						1	2
0.505709023	-0.218790681	0.508633404	-0.224630386				1	2
0.504590419	-0.227966258						1	3
0.514275835	-0.218908373						1	3
0.508939729	-0.219885998	0.500240587	-0.22112135	0.507233338	-0.223956257		1	3
0.50700477	-0.196351904						2	1
0.50974718	-0.190808476						2	1
0.515660284	-0.196738648	0.517861947	-0.19449056				2	1
0.507910866	-0.192325528						2	2
0.500300642	-0.187504554						2	2
0.509630786	-0.188902173	0.511095606	-0.188715061				2	2
0.505007439	-0.194574429						2	3
0.500668963	-0.194513781						2	3
0.505139678	-0.196753829	0.505402118	-0.193219563	0.498657334	-0.189648007		2	3
0.49219864	-0.149559934						3	1
0.477852984	-0.151189535						3	1
0.495020844	-0.152946243	0.483870237	-0.149331878				3	1
0.489586922	-0.154504271						3	2
0.492980555	-0.153637104						3	2
0.4848902	-0.155433138	0.483710037	-0.154981313				3	2
0.479746162	-0.150662225						3	3
0.478401955	-0.149486863						3	3
0.495532284	-0.154415315	0.483566701	-0.149531801	0.476313346	-0.148869363		3	3
0.468239144	-0.109827418						4	1
0.471797648	-0.110587062						4	1
0.475653772	-0.110075452	0.480388754	-0.113552745				4	1
0.467065382	-0.110620216						4	2
0.47853246	-0.108331976						4	2
0.466576395	-0.109573597	0.466987543	-0.108948812				4	2
0.470888475	-0.107964886						4	3
0.470888413	-0.109463485						4	3
0.46474947	-0.107399829	0.464888696	-0.108539252	0.473714219	-0.107738746		4	3
0.473107847	0.44404994						8	1
0.470867027	0.453531939	0.466224424	0.446863907				8	1
0.479000504	0.453032846						8	3
0.477430641	0.462096254						8	3
0.465308673	0.460181149	0.481602157	0.451110939	0.475176919	0.44949313		8	3

## Support

If you have any questions about this document or any other questions, comments, or concerns about our software, please contact us at [support@correlatedsolutions.com](mailto:support@correlatedsolutions.com), or visit our website at [correlatedsolutions.com/support](http://correlatedsolutions.com/support).

The powerful extensions feature is available exclusively in VIC-3D 11.2. Contact one of our Sales Engineers at [sales@correlatedsolutions.com](mailto:sales@correlatedsolutions.com) for information on updating your software.