FEMSnap

User Guide for the calculation tool at TechCenter Semi-Crystalline Products

1. Introduction

"FEMSnap" is the name for a calculation service of LANXESS Deutschland GmbH intended to support you during the design of several different kinds of snap fits made out of Durethan® und Pocan®.

FEMSnap is a self-explanatory web application. You should therefore be able to use FEMSnap without further preparation.

This document contains the following information:

- Structure and function of FEMSnap
- Menus and input fields you will find while using FEMSnap
- Explanation and interpretation of the results

Should you have any further questions, please contact us via email to durethan-pocan@lanxess.com.

We hope you will find FEMSnap useful and wish you much success using this tool.

2. Main page

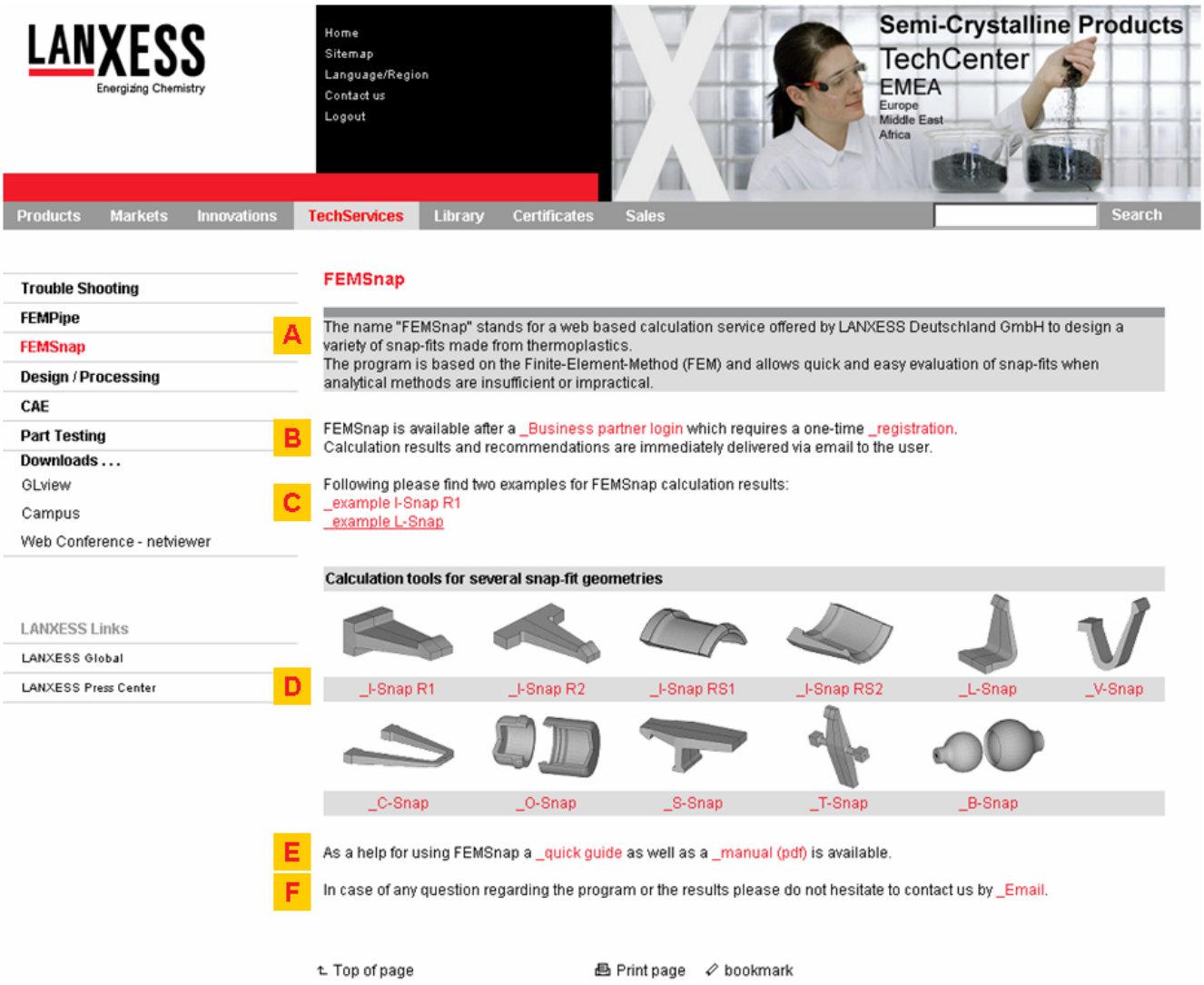


Figure 1 FEMSnap main page view

2.1 Main page – explanation

At FEMSnap‘s main page you will find:

A Introduction
purpose and basic structure of FEMSnap

B Premises of use
here you will find the requirements for the use of FEMSnap as well as the link to the registration procedure. Registration is mandatory to access this calculation tool.

C Examples
showing what FEMSnap is capable of

D Links to the calculation of several geometries
Icons illustrating the snap-fit to be chosen

E Help - links to
- quick guide
- comprehensive instructions (this manual)

F Contact
Room for question, critics and suggestions

3. Data entry form

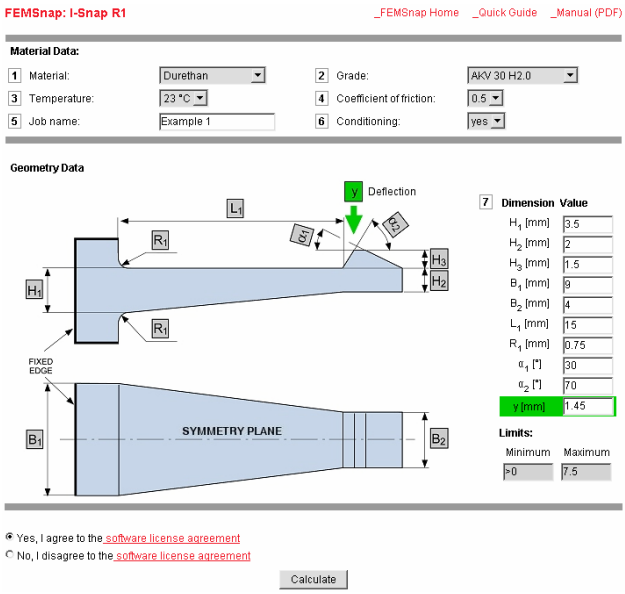


Figure 2 Form before calculation

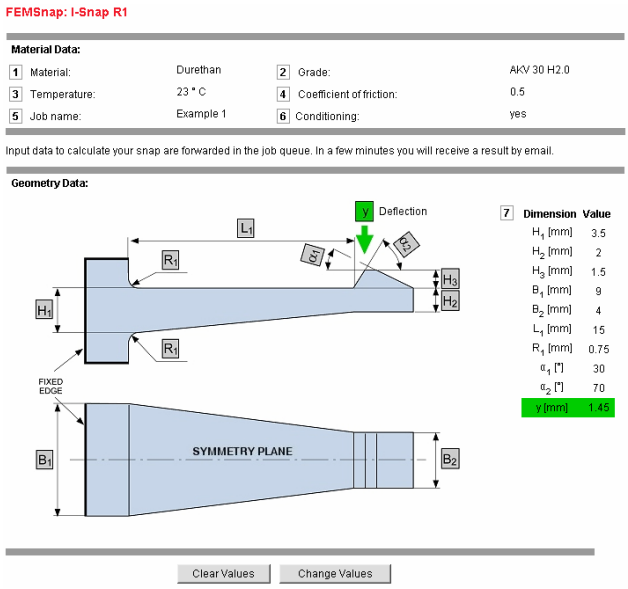


Figure 3 Form after start of calculation

3.1 Data entry form - explanations

The data entry form of FEMSnap is accessible to registered users only. Its basic items are the same for all snap-fit geometries and it consists of following fields which should be entered in the following order:

1	Material data:	Selection of plastic type
2	Material grade:	Selection of specific grade
3	Temperature:	Selection of environmental temperature
4	Coefficient of friction:	Selection of the coefficient of friction
5	Job name:	Title for the calculation, documentation
6	Conditioning:	Choice of the condition (dry or wet) of Durethan®
7	Geometry data:	Dimensions of the snap-fit and the deflection. In order to avoid technical problems, the entry of the geometry data is tied to a feasibility check which admits only technically meaningful dimensions. The allowable values are shown below the input table under the "limits" field. In order to avoid unnecessary problems, the input should be done in the given order.

The "calculate" button is used to start the process and the user is asked to confirm the required conditions.

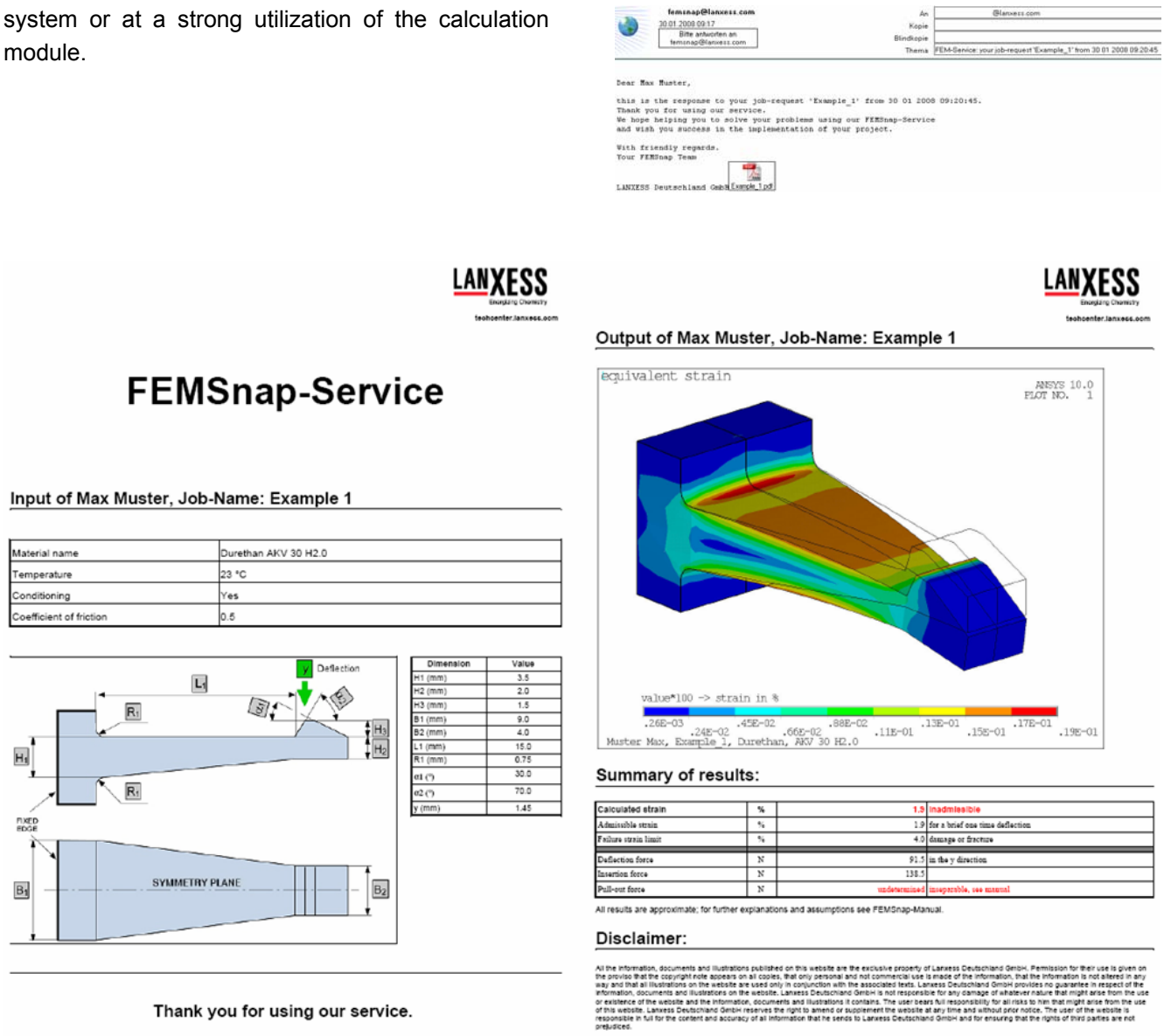
To explore design alternatives, the user may change the input data and submit other calculation requests (Figure 3).

4. Calculation results

The calculation results are delivered per e-mail to the user as a pdf-document (Figure 4).

According to experience, you should not need to wait longer than five minutes for your results. Longer delivering times may be due to a slow mail delivery

system or at a strong utilization of the calculation module.


femsnap@lanxess.com
30.01.2008 09:17
Bitte antworten an femsnap@lanxess.com
An @lanxess.com
Kopie
Blindkopie
Thema FEM-Service: your job-request 'Example_1' from 30.01.2008 09:20:45

Dear Max Muster,

this is the response to your job-request 'Example_1' from 30.01.2008 09:20:45.
Thank you for using our service.
We hope helping you to solve your problems using our FEMSnap-Service
and wish you success in the implementation of your project.

With friendly regards.
Your FEMSnap Team

LANXESS Deutschland GmbH Example_1.pdf

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FEMSnap-Service

Input of Max Muster, Job-Name: Example 1

Material name	Durethan AKV 30 H2.0
Temperature	23 °C
Conditioning	Yes
Coefficient of friction	0.5

Dimension	Value
H1 (mm)	3.5
H2 (mm)	2.0
H3 (mm)	1.5
B1 (mm)	9.0
B2 (mm)	4.0
L1 (mm)	15.0
R1 (mm)	0.75
α1 (°)	30.0
α2 (°)	70.0
y (mm)	1.45

Thank you for using our service.

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Output of Max Muster, Job-Name: Example 1

Summary of results:

Calculated strain	%	1.9	inadmissible
Admissible strain	%	1.9	for a brief one time deflection
Failure strain limit	%	4.0	damage or fracture
Deflection force	N	91.5	in the y direction
Insertion force	N	138.5	
Pull-out force	N	undetermined	interpretable, see manual

All results are approximate; for further explanations and assumptions see FEMSnap-Manual.

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Figure 4 calculation results (example)

4.1 Calculation results - explanations

The pdf-document consists of two pages. On the first page, the entire input is documented. The second page contains graphics of the strain distribution of the snap-fit in the distorted condition. The legend shows contour plot colors corresponding to the maximum principal strains in percentage values.

Below the graphic results, a table shows the following values:

– Calculated strain	maximum principal strains in percentage including a comment on whether the maximum value is allowable or not for the specific material in question
– Admissible strain	allowable strain for a one-time loading for the corresponding ambient temperature
– Failure strain limit	strain-value from which permanent deformation (major plastic strain) or failure (break) is to be expected. The gap between the admissible strain and the failure strain limit is an area the designer may use if he has made positive experiences with similar parts. Verification that the part will meet the requirements in practical use will be the manufacturer's responsibility.
– Deflection force	force magnitude that results in the specified deflection for the chosen material
– Insertion force	force magnitude to assemble the snap-fit
– Pull-out force	force magnitude to disassemble the snap-fit

FEMSnap-calculations are based on linear material-data, as a Secant-Modulus at approx. 1 % strain and a Poisson-ratio of 0.4. Due to it, under unfavorable conditions (local strain concentrations and high strain values), the calculated deflections force can be afflicted by an error of about 25 %. As a rule, the calculated deflection forces are expected to be too high.

The insertion and pull-out force are determined by the calculated deflection force, the slant angle ($\alpha_1$or α_2) and the coefficient of friction (μ). In theory, the forces needed for insertion and pull out become infinitely high when the slant angle and the friction angle (ρ =arctan μ) add up to 90° or more. In this case, no values but the comment "undetermined" is shown, i.e., there is no solution for the snap-fit and the snap-fit is considered to be inseparable.

Since the force values are strongly dependent on friction and the assembling conditions, the user is advised to keep the calculate forces only as a theo-retical order of magnitude.