SSNA103 - Chock of the parameters of the Summarized

Weibull model:

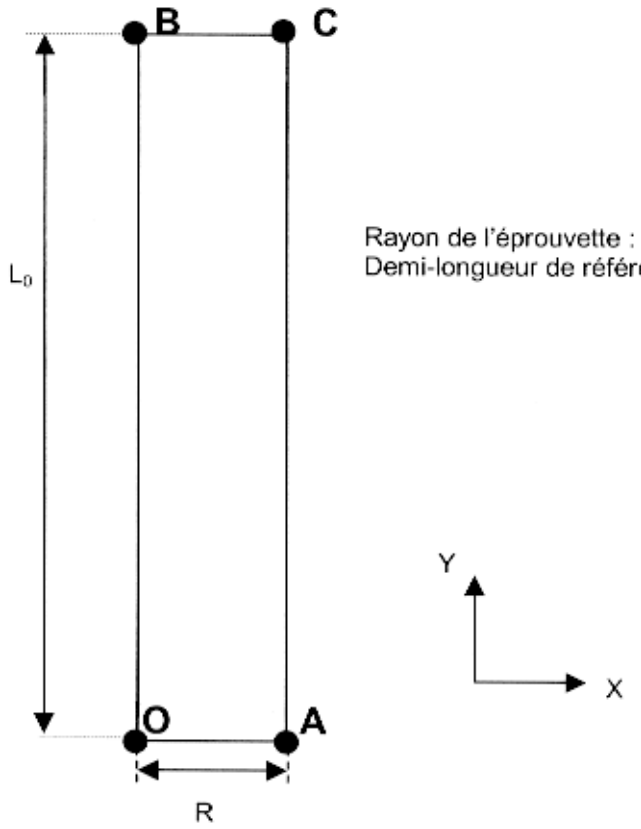
This test validates command RECA_WEIBULL allowing the identification of the parameters m and σ_u the Weibull model.

The identification is carried out using a data base made up of 45 tests, all carried out on smooth cylindrical test-tubes with three different temperatures $-150\,°C$, $-100\,°C$ and $-50\,°C$. This data base is obtained by random pulling of a representative sample of the statistical model of Weibull corresponding to values of m and σ_u arbitrarily fixed.

1 Problem of reference

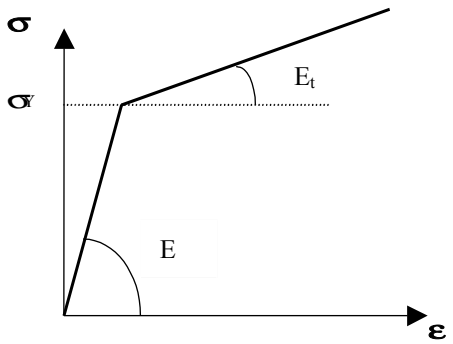
1.1 Geometry

Each test is carried out on a smooth cylindrical test-tube. For obvious reasons of symmetries, a modelization 2D axisymmetric of the quarter of structure is sufficient.



1.2 Properties of the material

One describes the behavior of the material studied by an elastoplastic model of Von Mises with linear isotropic hardening, "VMIS_ISOT_LINE". The strains used in the behavior model are the linearized strains.



The Poisson's ratio does not depend on the temperature $\nu = 0,3$.

The values of the Young modulus E, the tangent modulus E_t and the elastic limit are given in the following table:

Temperature $[°C]$	**– 150**	**– 100**	**– 50**
$E[MPa]$	200000	200000	200000
$Et[MPa]$	2000	2000	2000
$\sigma_Y[MPa]$	750.700.650		

1.3 Boundary conditions and loadings

By referring to the figure of the §1.1 the boundary conditions and loadings are the following:

On the segment BC ($Y=L_0$), imposed displacement following the direction OY:

$T[°C]$ **Displacement (** $l-l_0$ **) with the fracture for a reference length** l_0 **of** $203.5\,mm$ $[mm]$

the results for each temperature are classified by order ascending

-50	10,68	28,78	30,31	31,66	32,53	33,90	34,38	35,82	36,69	37,09	37,37	37,49	38,45	39,77	44,39
-100	20,57	21,68	23,32	24,37	24,66	25,59	25,84	27,51	28,44	29,30	29,68	30,16	30,18	30,20	30,95
-150	11,33	14,70	14,79	14,90	18,62	18,87	19,00	19,37	19,61	20,07	21,19	22,79	23,28	24,17	24,41

On the segment OA ($Y=0$) displacements blocked according to the direction OY.
On the segment OB ($X=0$) displacements blocked according to the direction OX.

1.4 Forced

initial conditions and null strains.

2 Reference solution

2.1 Method of calculating

No computation is necessary to obtain the reference solution. The values m and σ_u (M and SIGM_REFE in option WEIBULL of DEFI_MATERIAU) which one seeks to identify with *Code_Aster* are known and allow to generate the base of the experimental data. Thus, the elongations with fracture are in the following way given:

For each couple m and σ_u associated with a temperature of test, a sample of 15 values of stress of Weibull to the fracture were determined by random pulling taking into account the following statistical model:

$$P_f(\sigma_w) = 1 - \exp\left[-\left(\frac{\sigma_w}{\sigma_u}\right)^m\right]$$

The stress of Weibull is defined by:

$$\sigma_w = \sqrt[m]{\sum_i \left(\sigma_I^i\right)^m \frac{V_i}{V_0}}$$

The summation relates to plasticized volumes of V_i matter, σ_I^i indicating the maximum principal stress in each one of these volumes (volume V_0 (VOLU_REFE in option WEIBULL of DEFI_MATERIAU) is equal to $(50\,\mu m^3)$).

In the case of a request in simple tension with the assumption of the small strains, the stress of Weibull σ_W , is expressed according to the elongation with the fracture $(l-l_0)/l_0$, according to:

$$\sigma_W = \left[E_t\left(\frac{l-l_0}{l_0}\right) + \left(1-\frac{E_t}{E}\right)\sigma_Y\right]\sqrt[m]{\frac{V}{V_0}}$$

One thus deduces from this statement and preceding random pulling the values of the lengthenings with fracture deferred in the table of [§1.3].

2.2 Quantities and results of reference

the variables reference of m and σ_u used to create the bases of experimental tests are the following ones:

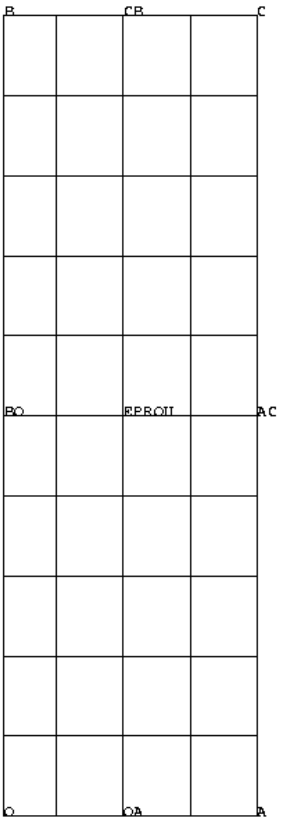
Temperature $[°C]$	**– 50**	**– 100**	**– 150**
m	24	24	24
σ_u $[MPa]$	2800	2700	2600

2.3 Uncertainties on the solution

uncertainty on the solution cannot be given in a precise way. It can be rather high. Indeed, the values of reference can be found only if one considers experimental populations made up of an infinite number of samples.

3 Modelization A

3.1 Characteristic of mesh

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GROUP_MA: CB
GROUP_MA: BO
GROUP_MA: OA
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Nombre of nodes: 149
Number of meshes and types: 40 elements QUAD8

3.2 Quantities tested and Identification

results of m a commun run at the three experimental bases and of one σ_u per base.

Temperature $[°C]$	Reference		*Code_Aster*	
	m	σ_u $[MPa]$	m	σ_u $[MPa]$
– 50	24	2800	26,7	2536
– 100	24	2700	26,7	2428
– 150	24	2600	26,7	2372

3.3 Remarks

Although the difference between the values of (m , σ_u) obtained with RECA_WEIBULL and their values of reference remains considerable, he in conformity with is result sought taking into account the relatively low number of samples used for retiming (15 per temperature). To obtain the values of reference it would be necessary considerably to increase the number of samples per temperature (

$N > 1000$). The noted variation remains however reasonable (about 10%). In addition, the growth of σ_u according to the temperature is respected

4 Summary of the results

the results got by *Code_Aster* show that the automatic procedure of chock of the parameters of the Weibull models functions and gives coherent results with the expected theoretical results.