Test&Motion

Application Module:

KU 1 – Plastics Tensile Test acc. to EN ISO 527-1:1996

Version 1.0 (State 20160819)

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1 Introduction

Dear customer, thank you for choosing a product of **DOLI Elektronik GmbH**. **Test&Motion** is a modern application for the operating systems Microsoft Windows XP/7/8/10©.

This manual does not deal with the **Test&Motion software** in general but with the application module Plastics Tensile Test KU 1 in particular. Hence, it is recommended to read the **Test&Motion** application manual in order to get familiar with the software. Please follow the demands and safety hints listed in the manual!

1.1 Symbols

The different symbols in this manual will allow you to find your way more easily.

Table 1: Symbols and their meanings.

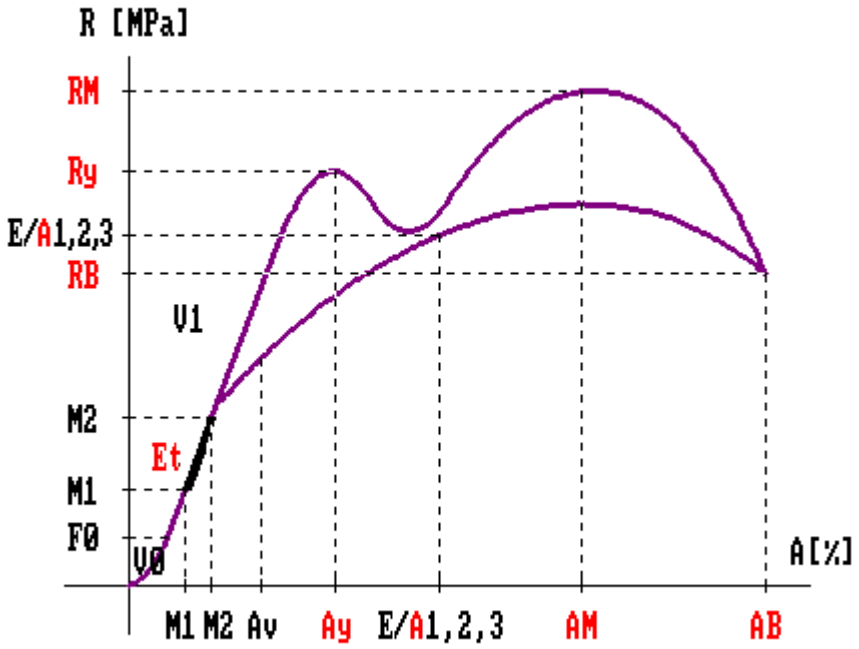
Symbol	Meaning
	**Safety Instructions:** **In order to avoid interruptions in the work flow as well as damages to man and machine, follow the safety instructions at all cost.**
	**Job/work instructions:** **Instructive part of the document with precise work instructions.** **Here you are asked to do something.**
	**Information:** **General information and descriptions of working procedures, etc.**
	**Note:** **Important note for the operation, the function or for the working procedures.**
	**Tip:** **Gives tips for easy handling of the Test&Motion Software, the EDCs or the testing instrument.**

2 Application module KU 1: Plastics Tensile Test acc. to EN ISO 527-1

2.1 Field of application

Determination of the tensile characteristics - tensile strength, yield stress, breaking stress, the corresponding loads and strains as well as tensile modulus, Poisson's rate and 3 pairs of reference values for plastics and plastic compounds.

2.2 Test graphic KU 1



2.3 Input values KU 1

1. Click Menu Test → Command Settings → Input values. Here you can find expedient input values for this test regulation, already. If necessary adjust the values to your needs.

Table 2: Input values for test KU 1.

Parameter	Meaning	Dimension / Selection possibilities
E1	Reference value 1	[N], [N/mm²], [mm_S], [mm_dL], [%], [s, min, h], [Dim User1], .. , [Dim User30]
E2	Reference value 2	Dimensions similar to E1
E3	Reference value 3	Dimensions similar to E1
Av	Strain value: Drop point for the width transducer	[%]
M1	Tensile modulus limit 1	[N, kN], [MPa, kPa, N/mm²], [mm], [%]
M2	Tensile modulus limit 2	[N, kN], [MPa, kPa, N/mm²], [mm], [%]
un	Strain value: Determination point of Poisson's ratio	[%]
S-time-speed	A speed switch can be carried out either with a default acceleration or with a speed ramp.	[s]
Choice:	Tensile modulus limits	• Search autom. 'secant' • Input value M1, M2 • Search autom. regress. line
Choice:	Behaviour at Av	• Continue test • End test • Stop, clip off ext. • Continue, clip off ext.
Zero point at	Zero point of elongation, strain at	• F0 • Intersection of modulus and x-Axis
Change in width	Determination of the sensor for detecting change in width	• Sensor4 • Sensor5 • … • Sensor15

2.4 Results KU 1

1. Click Menu Test → Command Settings → Results. Here you can already find expedient results. If necessary, adjust the values to your needs.

Table 3: Results for test KU 1.

Parameter	Meaning	Dimension
FM	Maximum test load	[N]
RM	Tensile strength (tensile stress at maximum test load)	[N/mm²], [MPa]
FM / b	Maximum load / sample width	[N/mm]
FB	Breaking load	[N]
RB	Breaking stress	[N/mm²], [MPa]
Fy	Load at yield stress	[N]
Ry	Yield stress	[N/mm²], [MPa]
AM	Strain at tensile strength	[%]
dLM	Elongation at tensile strength	[mm]
AB	Breaking strain	[%]
dLB	Elongation at break	[mm]
Ay	Yield strain	[%]
dLy	Elongation at yield strain	[mm]
Et	Tensile modulus	[kN/mm²], [GPa]
µn	Poisson's ratio	
FMB	Maximum test load related to sample width	[N/mm]
A11, A12	Reference value for input value E1 (Dimension of the output value determines the physical value)	
A21, A22	Reference value for input value E2	
A31, A32	Reference value for input value E3	
L0	Measuring length	[mm]
S0	Sample diameter	[mm²]
PA1	Sample dimension 1 (not available for all sample shapes)	[mm]
PA2	Sample dimension 2 (not available for all sample shapes)	[mm]
A-Lu	Breaking strain (after manual input of sample elongation Lu)	[%]

2.5 Hints for the test KU 1

2.5.1 Pre-load F0

For the test control, the elongation and the strain will be set to zero when pre-load F0 is reached (see explanations about elongation and strain further down, also).

The measuring length then will be corrected to **L0' = L0 + dL(F0)**

whereas
L0' *corrected measuring length*
L0 *measuring length*
dL(F0) *sample deformation at F0*

2.5.2 Yield stress criteria

The following criteria are applied to the load-elongation-curve *F = f(dL)* in order to determine the yield limits. If the first one does not lead to the detection of a yield limit, the next one will be applied, in the order you see below.

1. **Local load maximum, local load minimum**

   A local load maximum is a yield limit, if the load drops with at least 0.5%, and then increases again with at least 1%.

2. **Local load maximum, point of inflexion**

   A local load maximum is a yield limit, if the load drops with at least 0.5%, followed by a point of reflexion in the curve (i.e. a change from falling direction to increasing direction).

3. **Load plateau**

   If a range with constant load is found while elongation increases, the beginning of this range represents a yield limit. Pre-condition: The load must not deviate with more than 0.5% over a elongation range of 0.2% of the measuring length.

2.5.3 Tensile modulus limits

The tensile modulus limits can either be detected automatically or pre-defined by the user.

Automatic detection: On the load-elongation-curve *F = f(dL),* within the range between pre-load F0 and maximum load FM, the software searches the steepest increase line over an elongation range of 0.2% of the measuring length L0 (normally, between 0.05% and 0.25% strain). Then, the tensile modulus Et will be calculated between the end points of this line. Whereas the tensile modulus Et can be calculated either as secant or regression line. In case the elongation range of 0.2% L0 will not produce a reasonable tensile modulus, the modulus will be calculated over a range of 10% of Fmax instead.

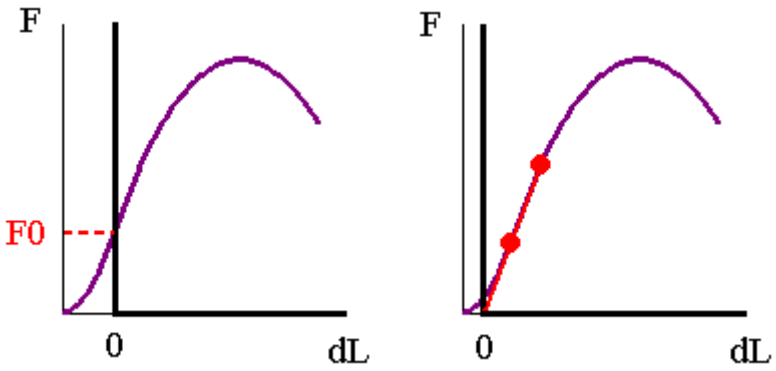
Manual detection: In case the tensile modulus should not be detected automatically, you can define the end points of the tensile-modulus-line via the input values M1 and M2 by yourself.

2.5.4 Elongation, strain

During the test: Elongation and strain are identical untill reaching the pre-load F0 = 0 (see left picture below). The elongation is the increase in length of the sample from the point F0. The strain will be calculated out of the elongation via the following formula:

$$Ax = \frac{dL(Fx) - dL(F0)}{L0} * 100\%$$

After the test: At the end of the test, elongation and strain will be calculated again. Hereby, the zero point of elongation is defined by extending the tensile-modulus-line until it reaches the x-axis in the load-elongation-diagram (see right picture below).



2.5.5 Pairs of reference values

Three pairs of reference values are available. Here, you can define the wanted result type by chosing the dimensions for these pairs See the following table:

Table 4: Meaning of the input and output values.

Dimension of input- and output values	Meaning
N, kN	Load
N/mm²	Stress
%	Strain
mm_dL	Elongation
mm_S	Crosshead travel
s, min, h	Time period
Dim User1	User defined meaning 1
Dim User2	User defined meaning 2
…	…
Dim User30	User defined meaning 30

2.5.6 Behaviour at Av

The elongation/strain can be detected either via the crosshead travel or by using an extensometer. As a option, a width extensometer can be used to detect the change in sample width during the test, in order to detect the Poisson's ratio of the sample. The software offers the possibillty to remove the extensometer for length as well as the one for width during the test. This happens at strain value Av.

When strain value Av is reached, the test can be continued in one of the following manners:

1. **Continue test:** The test will be continued in a normal manner. Av has no influence.
2. **Stop test:** The test will be stopped at reaching Av.
3. **Pause test, drop extensometer:** The test will be interrupted. Now, the user can remove the clip gauge before continuing the test. An automatic extensometer will be removed automatically before the test continues.
4. **Continue, drop extensometer:** The test will not be interrupted. A message will inform the user about the possibility to remove the clip gauge. However, the test will continue during removing. An aotomativ extensometer will be removed automatically during the test.

Note: Please note that the tensile characteristics of plastics do very much depend on the test speed. Hence, we recommend to prefereably not interrupt a test if possible!