

**Test&Motion**  
**Application Module:**  
**KU 3 – 3-point bending test**

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**DOLI Elektronik GmbH**

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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 3 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                                                                                                                                                            |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|    | <b>Safety Instructions:</b><br>In order to avoid interruptions in the work flow as well as damages to man and machine, follow the safety instructions at all cost. |
|  | <b>Job/work instructions:</b><br>Instructive part of the document with precise work instructions. Here you are asked to do something.                              |
|  | <b>Information:</b><br>General information and descriptions of working procedures, etc.                                                                            |
|  | <b>Note:</b><br>Important note for the operation, the function or for the working procedures.                                                                      |
|  | <b>Tip:</b><br>Gives tips for easy handling of the <b>Test&amp;Motion Software</b> , the <b>EDCs</b> or the testing instrument.                                    |

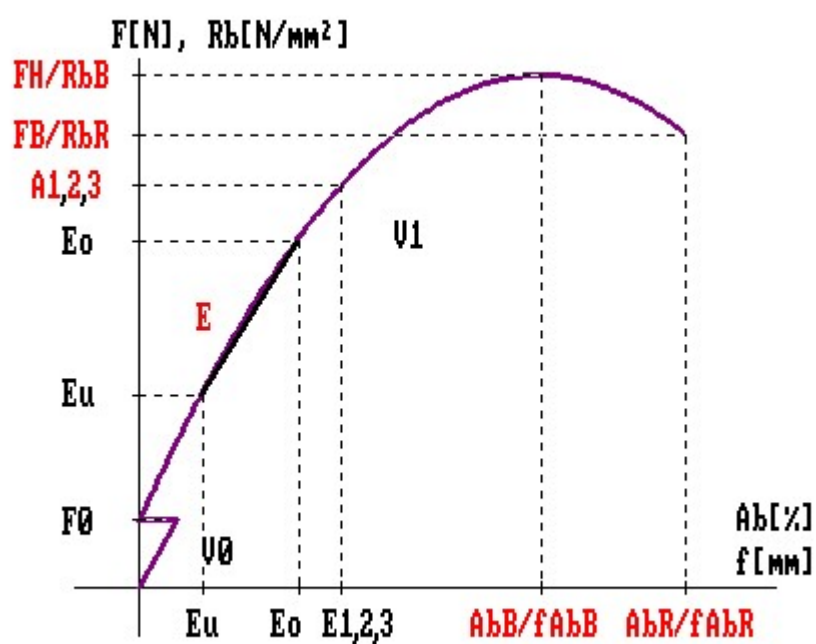


## 2 Application module KU 3: 3-point bending test

### 2.1 Field of application

Determination of bending strength, edge fibre extension and E module on plastics in the 3 point bending test..

### 2.2 Test graphic KU 3





## 2.3 Input values KU 3



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 3.

| Parameter  | Meaning                                                                                  | Dimension / Selection possibilities                                                                    |
|------------|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| Eu         | Limit 1 for calculation of module                                                        | [N], [N/mm <sup>2</sup> ], [mm] or [%]                                                                 |
| Eo         | Limit 2 for calculation of module                                                        | [N], [N/mm <sup>2</sup> ], [mm] or [%]                                                                 |
| Selection  | Zero point deflection at                                                                 | <ul style="list-style-type: none"> <li>• F0</li> <li>• Intersection point modul with x-axis</li> </ul> |
| E1, E2, E3 | The meaning of the input values is specified by the different units that can be selected |                                                                                                        |
| V0         | Test rate until the preliminary force F0 is reached                                      | [mm/min]                                                                                               |
| V1         | Test rate as of exceeding the preliminary force F0                                       |                                                                                                        |



## 2.4 Results KU 3



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 3.

| Parameter | Meaning                                            | Dimension                    |
|-----------|----------------------------------------------------|------------------------------|
| FH        | Maximum force                                      | [N]                          |
| RbB       | Bending strength (bending stress at maximum force) | [N/mm <sup>2</sup> ], [MPa]  |
| AbB       | Edge fibre extension at maximum force              | [%]                          |
| fAbB      | Deflexion at maximum force                         | [mm]                         |
| FB        | Break force                                        | [N]                          |
| RbR       | Bending stress at sample break                     | [N]                          |
| AbR       | Edge fibre extension at sample break               | [N/mm <sup>2</sup> ], [MPa]  |
| fAbR      | Deflexion at sample break                          | [mm]                         |
| Fx        | Force at edge fibre extension Abx                  | [N]                          |
| Rbx       | Bending stress at edge fibre extension Abx         | [%]                          |
| E         | Elasticity module                                  | [kN/mm <sup>2</sup> ], [GPa] |
| S0        | Test piece section                                 | [mm]                         |
| b         | Test piece width                                   | [mm]                         |
| h         | Test piece height                                  | [mm]                         |
|           |                                                    |                              |



### 2.5 Hints for the test KU 3

#### 2.5.1 Pre-load F0

- For creating uniform test conditions
- Deflexion  $f = 0$
- Switching over from V0 to V1

#### 2.5.2 Test end criteria

For reasons of safety you should use the end criteria "crosshead path".

#### 2.5.3 Calculation of bending stress

$$Rb = \frac{3 L v}{2 b h^2} * F$$

F Force in [N]

b Width of the test piece body in [mm]

h Height of the test piece body in [mm]

Lv Support width in [mm]

or

$$Rb = \frac{8 L v}{\pi d^2} * F$$

F Force in [N]

d Diameter of the test piece body in [mm]

Lv Support width in [mm]



#### 2.5.4 Calculation of edge fibre extension

$$Ab = \frac{600 h}{Lv^2} * f$$

h Height of the test piece body in [mm]

Lv Support width in [mm]

f Deflexion in the centre of the  
test piece body in [mm]

#### 2.5.5 Calculation of elasticity module

$$E = \frac{Lv^3 (F2 - F1)}{4 (f2 - f1) b h^3}$$

Lv Support width in [mm]

h Height of the test piece body in [mm]

b Width of the test piece body in [mm]

f1, f2 Deflexions at Eu and Eo

F1, F2 Forces at Eu and Eo



or

$$E = \frac{4 (F_2 - F_1) L v^3}{3 (f_2 - f_1) \pi d^4} * F$$

Lv Support width in [mm]

d Diameter of the test piece body in [mm]

f1, f2 Deflexions at Eu and Eo

F1, F2 Forces at Eu and Eo



Pairs of reference values

Three pairs of reference values are available. Here, you can define the wanted result type by choosing 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/mm <sup>2</sup>                     | 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 an 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 possibility 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 automatic 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 preferably not interrupt a test if possible!



