Test&Motion
Application Module

BA 20

Flexural tensile strenght of Fiber-Reinforced Concrete
EN 14651

Version 1.0 (State 20.05.2016)

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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 BA 20 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 meaning.

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 BA 20 - Flexural tensile strenght of Fiber-Reinforced Concrete EN 14651

2.1 Field of application

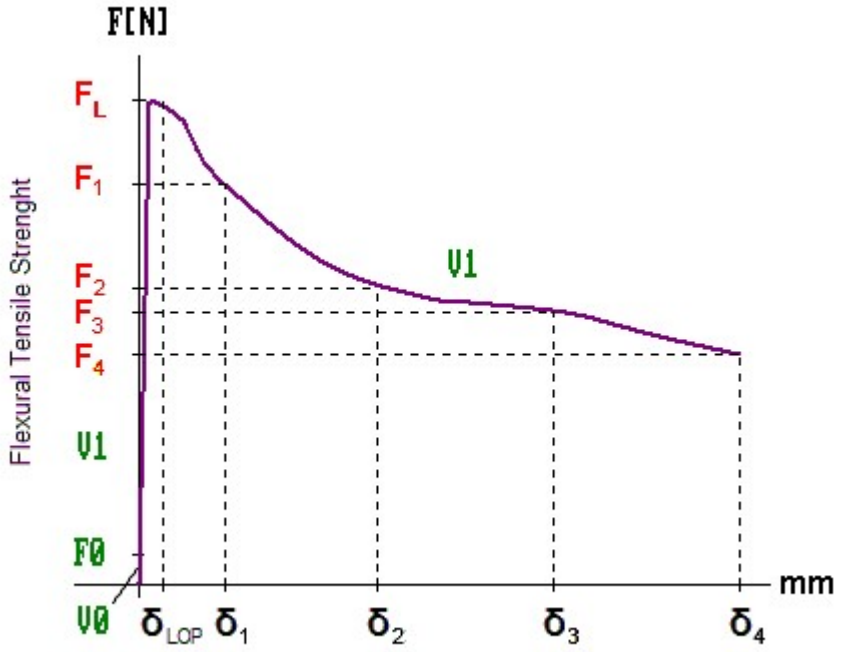
Test method for metallic fibered concrete - Measuring the flexural tensile strength (limit of proportionality (LOP), residual). German version EN 14651:2005.

This European Standard specifies a method of measuring the flexural tensile strength of metallic fibered concrete on moulded test specimen. The method provides for the determination of the limit of proportionality (LOP) and of a set of residual flexural tensile strength values.

This testing method is intended for metallic fibres no longer than 60 mm. The method can also be used for a combination of metallic fibres and, a combination of metallic fibres with other fibres.

The tensile behaviour of metallic fibre concrete is evaluated in terms of residual flexural tensile strength values determined from the load-crack mouth opening displacement curve or load-deflection curve obtained by applying a centre-point load on a simply supported notched prism.

2.2 Test graphic BA 20



2.3 Input values for test BA 20

Table 1: Input values for test BA 20

Parameter	Meaning	Dimension
delta 1	deflection value, where fR,1 is to determine	[mm]
delta 2	deflection value, where fR,2 is to determine	[mm]
delta 3	deflection value, where fR,3 is to determine	[mm]
delta 4	deflection value, where fR,4 is to determine	[mm]
deltaL → vS	If the deflection is changing more than input value mm in 1 second, the controlmode of the xhead is switching to xhead contro with the same xhead speed like before.in elongation control. If input value = 0, this feature is deactivated.	[mm]
l	Length of span	[mm]
b	Width of specimen	[mm]
h_{sp}	Distance between the tip of the notch and the top of the test specimen in the mid-span section	[mm]

We start measurement so that the piston advances at a constant rate of 4 mm/min up to maximal central displacement of at least 45 mm.

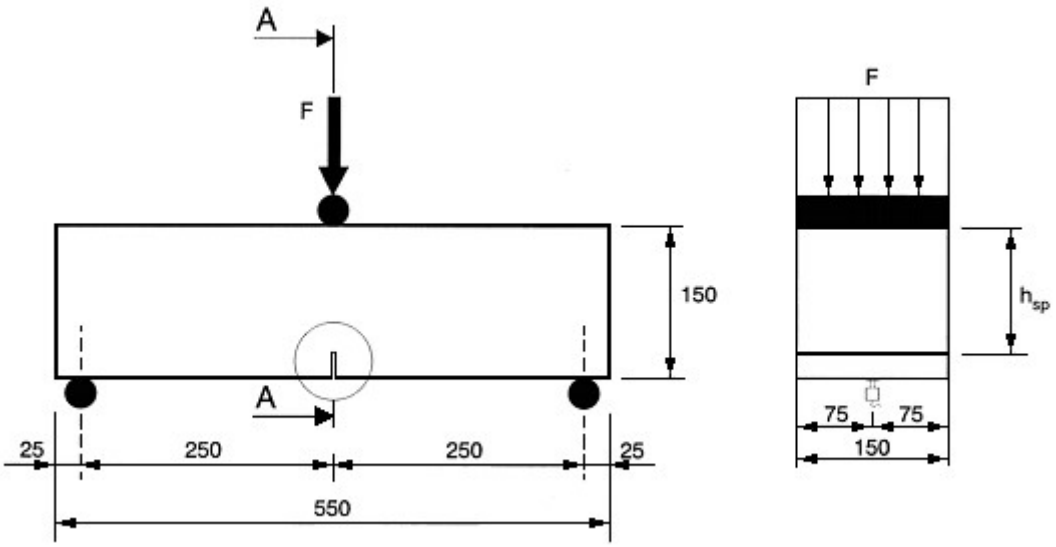
2.4 Results BA 20

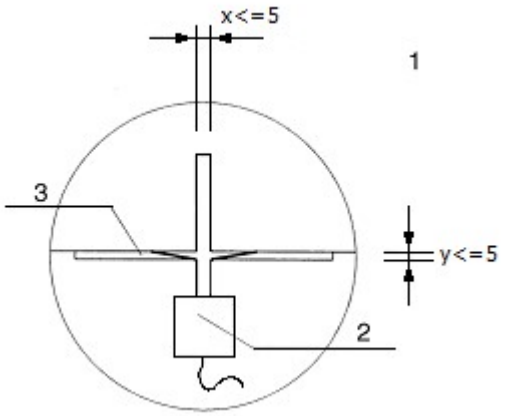
Table 2: Results of test BA 20

Result	Meaning	Dimension
F_L	The maximum load in the range from 0 to 0,05 mm of deflection.	[kN]
f_L	The residual flexural strength at the LOP	[N/mm²]
$F_{R,1}$	The load at CMOD = 0,5 mm	[kN]
$F_{R,2}$	The load at CMOD = 1,5 mm	[kN]
$F_{R,3}$	The load at CMOD = 2,5 mm	[kN]
$F_{R,4}$	The load at CMOD = 3,5 mm	[kN]
$f_{R,1}$	Residual flexural tensile strength at F1	[N/mm²]
$f_{R,2}$	Residual flexural tensile strength at F2	[N/mm²]
$f_{R,3}$	Residual flexural tensile strength at F3	[N/mm²]
$f_{R,4}$	Residual flexural tensile strength at F4	[N/mm²]

2.5 Measuring arrangement CMOD or deflection

2.5.1 CMOD



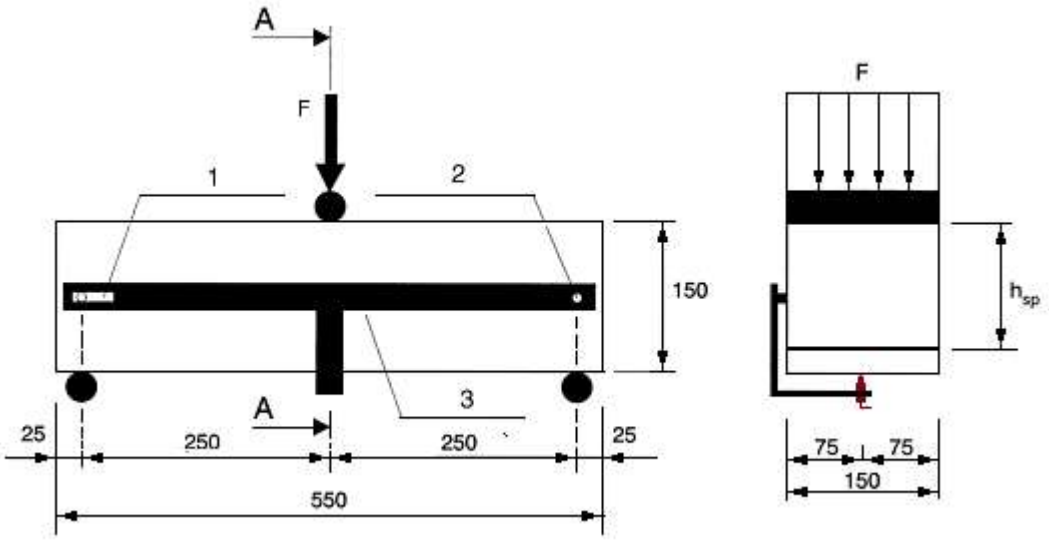


1. Detail (notch)
2. Transducer (clip gauge)
3. Knife edge

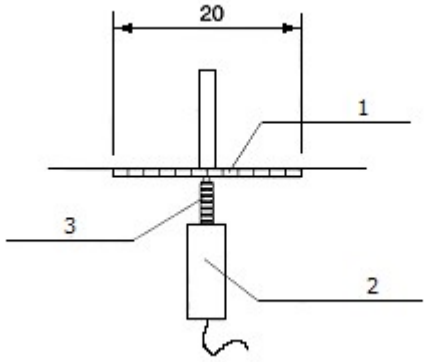
In case of a testing machine controlling the rate of increase of CMOD, the machine shall be operated so that CMOD increases at a constant rate of 0,05 mm/min. When CMOD= 0,1 mm, the machine shall be operated so that CMOD increases at a constant rate of 0,2 mm/min.

The test shall be terminated at a CMOD value not less than 4 mm.

2.5.2 Deflection



1. Sliding fixture
2. Rotating fixture
3. Rigid frame



1. 1mm thick aluminium plate
2. Transducer (linear variable differential transformator)
3. Spring shaft

2.6 Equivalence between CMOD and deflection

The relation between CMOD and deflection may be approximated by:

$$\delta = 0{,}85\ CMOD + 0{,}04$$

where

δ is the deflection, in millimetres

CMOD is the CMOD value, in millimetres, measured in case the distance between the bottom of the test specimen and the line of measurement y= 0.

2.7 Limit of proportionality LOP

The LOP is given by the expression

$$f\frac{f}{ct,L} = \frac{3\,F_L\,l}{2bh_{sp}{}^2}$$

where

$f\frac{f}{ct,L}$	is the LOP	[N/mm²]
F_L	load corresponding to the LOP	[N]
l	span length	[mm]
b	width of specimen	[mm]
h_{sp}	distance between the tip of the notch and the top of the specimen	[mm]

The load value FL shall be determined by drawing a line at a distance of 0,05 mm and parallel to the load axis of the load-CMOD or load-deflection diagram and taking as FL the highest load value in the interval of 0,05 mm.

2.8 Residual flexural tensile strength

The residual flexural tensile strength $f_{R,j}$ is given by the expression

$$f_{R,j} = \frac{3\,F_j\,l}{2bh_{sp}{}^2}$$

where

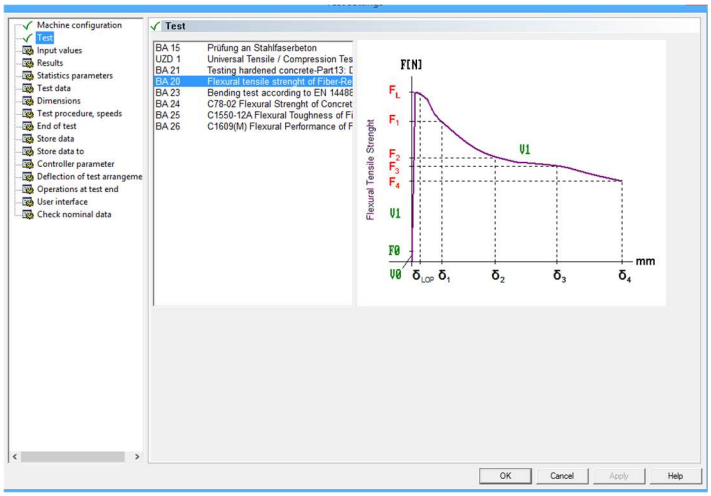
$f_{R,j}$	is the residual flexural tensile strength corresponding with $\mathrm{CMOD} = \mathrm{CMOD}_j$	
	or $\delta = \delta_j$, (j= 1,2,3,4)	[N/mm²]
F_j	is the load corresponding with $\mathrm{CMOD} = \mathrm{CMOD}_j$ or $\delta = \delta_j$, (j= 1,2,3,4)	

l	span length	[mm]
b	width of the specimen	[mm]
h_{sp}	distance between the tip of the notch and the top of the specimen	[mm]

3 Carry out test

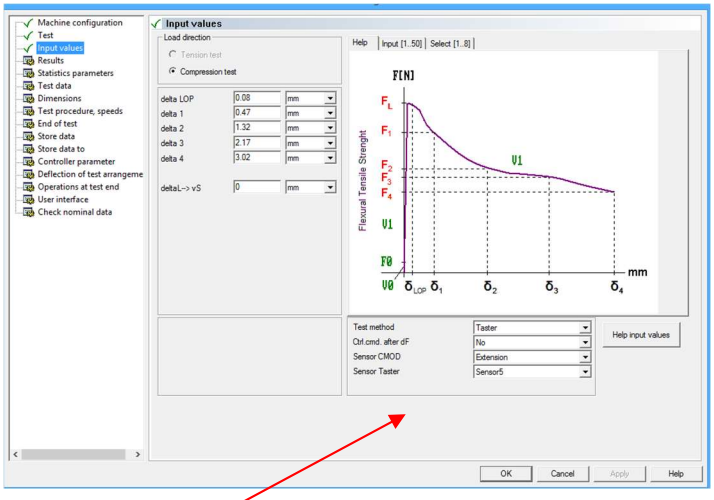
3.1 Selection of basic test

Select test procedure from list of available tests or load a parameter file (SVL) for that test.



3.2 Enter input data

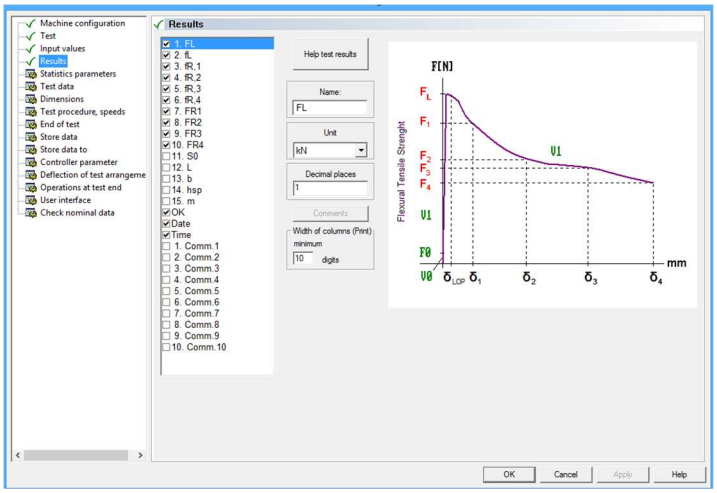
Here you can enter test data acc. table 1.



Selection of actual sensors.

3.3 Define test results

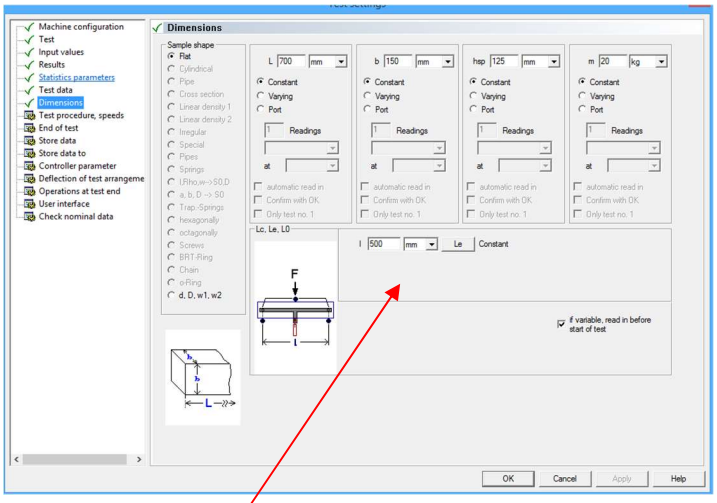
In this dialog you can activate the required test results and define their dimensions and number of digits.



3.4 Enter sample dimensions

Please enter here the values for sample width (b) and sample length L.

hsp is the height of the beam minus notch) acc. standard 125 mm).



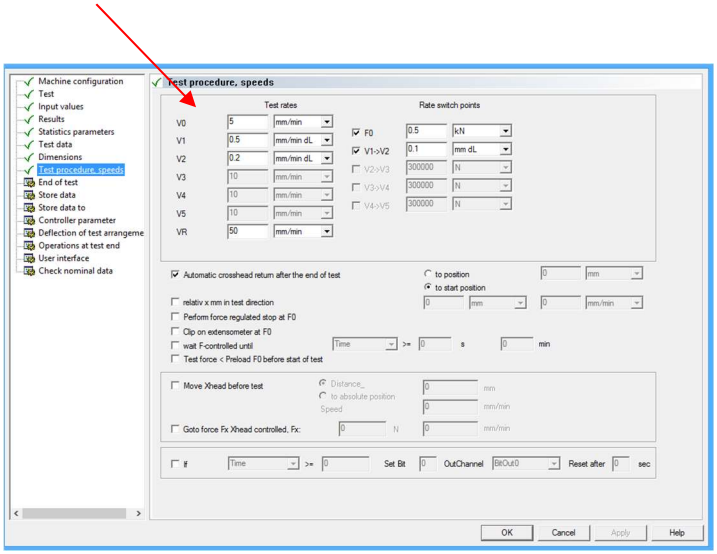
L is the span length.

3.5 Enter test speeds

Definition of test speeds and switching points according standard.

We start with speed v0 = 5 mm/min (xhead controlled) until preload 0,5 kN reached.

After reaching preload we continue with speed v1 = 0,5 mm/min dL (elongation controlled) until elongation value 0,1 mm is reached, from that we continue with v2 = 0,2 mm/min dL.



3.6 Definiton of test end criterions

The test will be terminated if elongation = 2 mm is reached.