Fiber Stress Test for Bead Pull Measurement

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Abstract

This Paper presents results of mechanical stress tests of different fibers, which are needed for bead pull measurements.

I. Introduction

For perturbation measurements a perturbation, the bead, is necessary. This bead needs to be mounted on something. This something, called the support, is unfortunately a perturbation by itself. So one must endeavor to keep that inevitable second perturbation as small as possible.
So, a small thread is needed which has a diameter of less than 30 micrometer. Generally it is not easy to find the right support for beads in the W-Band, because everything is very tiny. A simple solution was to use stuff from medical applications, like very thin threads, so called fibers, for sensible eye operation. Nothing is known without the length, diameter and that they are sterile. Important properties like dielectric constant or mechanical parameters are unknown. These are important parameters which need to be determined. This examination shall be a small candle and bring a bit of light in the darkness of mechanical properties.

II. Used Fibers

Two kinds of fibers [1] will be examined as follows:

Test piece:	TP-I	TP-II
diameter:	9/0 (0.3 metric)	7/0 (0.5 metric)
length:	6” (15 cm)	18” (45 cm)
Model No.:	7063-B	1276-B

Material: Nylon, Black Monofilament
Product of LOOK, Inc., USA

III. Fiber-Bead Performance

For bead pull measurements a really straight bead support is needed. To get this flexible fiber straight, simple weights are mounted at both ends, see figure 1. The question now is, how many weights may we use? So, the maximal weight which breaks the fiber will now be determined. With this number, a stress of, for example 30 %, might be used for further bead pull measurements. This seems to be a good number, because it is not so much, where critical length dilatation is expected and it is enough to get it straight, as observed with a video microscope.
Beads stay in principle a longer time in the apparatus. It needs to be adjusted and measurements are time consuming. Therefore it is necessary to consider the flow properties of molecular strings of nylon. A big load applied for a longer time, decreased the determined maximal weight, because it was a temporary short stress. A load of 30 % is suggested.

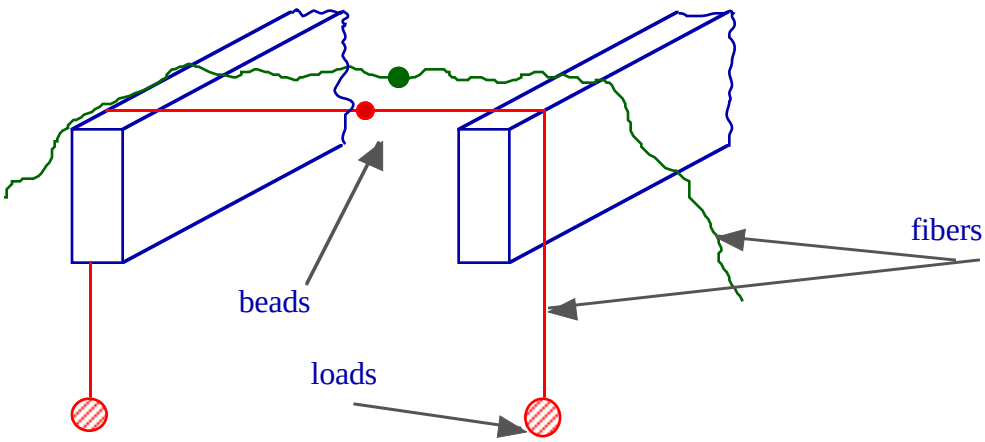

FIGURE 1. Finally application of fibers.

IV. Loads, Weights

For weights simple paper clips were used. 10 paper clips were measured by using a micro balance device, with a accuracy of 5 mg. The average weight of one paper clip is:

$$1 \text{ PC} = 1.243 \text{ g}$$

V. Stress Test

To determine the maximal weight a fiber can carry, a stress test was necessary. Critical points are the fixing points at both ends. To insure that the fiber breaks in the middle, the ends were fixed and stabilized with tape, see figure 2.a. The first attempts in bead pull measurements are done without a metallic bead. Instead a knot was used. Such a knot is a additional stress for the structural integrity of the fiber. So a second test was done with a knot in the middle of the fiber, see figure 2.b.

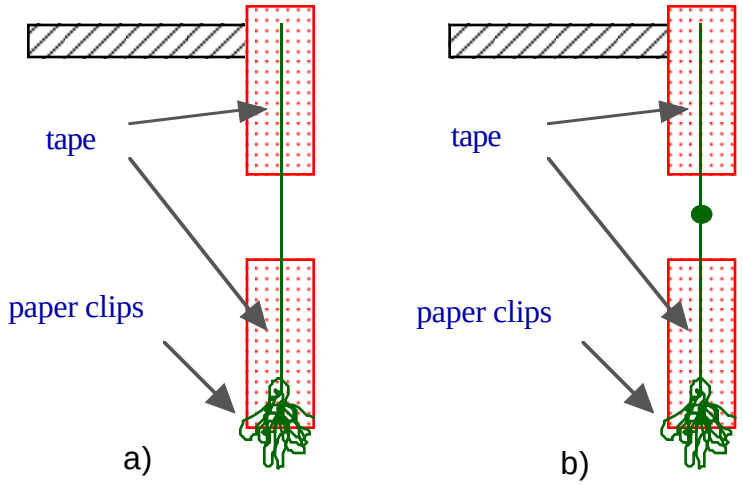

FIGURE 2. a) Test 1: without a knot, b) Test 2: with a knot.

VI. Results

In table 1 the results of the stress test are shown. The determined numbers are the maximal weight a fiber can carry.

	test piece 1	test piece 2	remark
test 1, # of clips in g	34 42.262	84 104.412	--- ---
test 2, # of clips in g	34 42.262	83 103.169	TP 1 broke not at the knot ---

TABLE 1. Results of stress test, determined maximal weights.

VII. References

[1] Available at Cameron Medical Supply, 1-800-777-3723