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Application News

No. i278A

Material Testing System

Tensile Test of Fabrics (JIS L 1096 Strip Method)

People change clothes every day, depending on the season, time of day, circumstances, and scene. For example, on a summer day we might wear a T-shirt with good permeability for air, but in cold winter weather, we would wear a down jacket with a high heat-retaining property. People who work at actual worksites wear work clothes that are made of sturdy material and allow easy movement. Thus, various types of performance are required in clothing, depending on which value that the wearer prioritizes, e.g. comfort, functionality, or design, and new products are appearing daily to meet these needs.

Since clothing is a product, strength evaluation is necessary in order to maintain a certain quality. JIS L 1096 : 2020 not only provides methods for measuring the tensile strength and tear strength of the woven and knitted fabrics that are indispensable in our daily lives, but also describes various evaluation methods for the permeability of fabrics to air and their heat-retaining property. Among these, the JIS and ISO methods include a total of 6 test methods for tensile strength. There are 4 JIS methods, method A (strip method), method B (grab method), method C (wet strip method), and method D (wet grab method), and 2 ISO methods, method E (strip method) and method F (grab method).

This article introduces an example of a tensile test of fabric specimens by method A (strip method).

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Measurement System

Table 1 shows the composition of the test system. A Shimadzu AGS-X table-top type universal testing instrument and pneumatic flat grips were used in this measurement. Because file-like grip teeth damage the threads and may cause the sample to rupture in the holder, a flat grip face without file teeth and wave-type grip face (R5) were used in the grip teeth.

Table 2 shows the test conditions. The sample preparation methods used in method A are the raveled strip method, which is applicable to woven fabrics, and the cut strip method, which is used with knitted fabrics and certain special woven fabrics. In the raveled strip method, as shown in Fig. 1, a sample having the specified width is prepared by raveling out approximately the same number of threads from both sides of the target width after the sample is cut, while in the cut strip method, the sample is simply cut to the specified width. The loading patterns used in the tensile test are the constant rate of traverse pattern, in which the test is conducted at a constant speed regardless of the distance between the grips, and the constant rate of specimen extension pattern, in which the speed is adjusted depending on the distance between the grips so as to maintain a constant rate of elongation.

Fig. 2 shows a view of the test. In this experiment, the strength of 4 types of samples prepared by the raveled strip method was evaluated using the constant rate of traverse pattern. In sampling the materials, samples were cut in the warp (length) direction and weft (width) direction, as defined by the longer direction of the fabric.

Table 1 **Composition of Test System**

Testing machine	AGS-X
Load cell	5 kN
Grip	5 kN pneumatic flat grip
Grip face	Flat grip face, wave grip face (Flat, Wave R5)
Software	TRAPEZIUM™ X (single)

Table 2 **Test Conditions**

Test speed	150 mm/min (constant rate of traverse)
Pretension	Not set
Specimen	Raveled strip method
Specimens after width adjustment	W 50 mm × L 300 mm (①, ②) W 30 mm × L 200 mm (③, ④)
Sample type	① Gingham fabric ② Cotton/linen fabric ③ Satin fabric ④ Sheeting fabric
No. of tests	n = 3

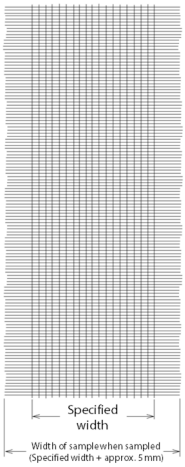

Fig. 1 **Schematic Diagram of Raveled Strip Method Sample**

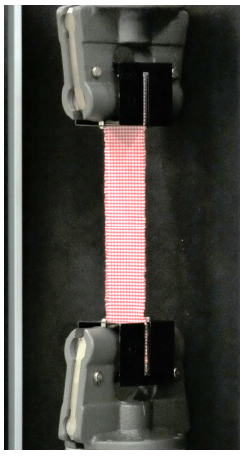

Fig. 2 **View of Test**

Test Results

Fig. 3 shows the test results. JIS L 1096 states that "specimens which rupture within 10 mm from the grip or which rupture in an abnormal manner shall be excluded from the test results." With these specimens, it was possible to conduct the test without rupture near the grips because the flat/wave (R5) grip faces were used. Table 3 shows a summary of the test results. In this test, it was found that differences in strength between the warp and weft directions existed in all of the specimens. The manner of rupture also differed depending on the type of test material and direction. In two of the specimens (② weft, ④ warp), the test force decreased in steps as the threads broke one by one after reaching the maximum test force. In one specimen (③ weft), rupture occurred when the threads gradually broke before the maximum test force, and in another (② warp), rupture occurred instantaneously after the maximum test force was achieved.

Table 3 **Summary of Test Results (Average Value of n = 3)**

Specimen	Direction	Strength (N)	Elongation (%)
① Gingham fabric	Warp	445	22.5
	Weft	270	9.85
② Cotton/linen fabric	Warp	351	12.4
	Weft	271	20.9
③ Satin fabric	Warp	618	52.6
	Weft	604	69.6
④ Sheeting fabric	Warp	193	28.5
	Weft	96.0	6.87

Conclusion

In this experiment, a tensile test of various fabric specimens was conducted in accordance with JIS L 1096 using a Shimadzu table-top precision universal tester. In order to evaluate strength correctly in strength tests of fabrics, it is necessary to use appropriate grips and grip teeth. Although this article introduced an example in which flat and wave (R5) grip faces were used, we can propose various other grip teeth that are not described in this article, depending on the quality of the fabric.

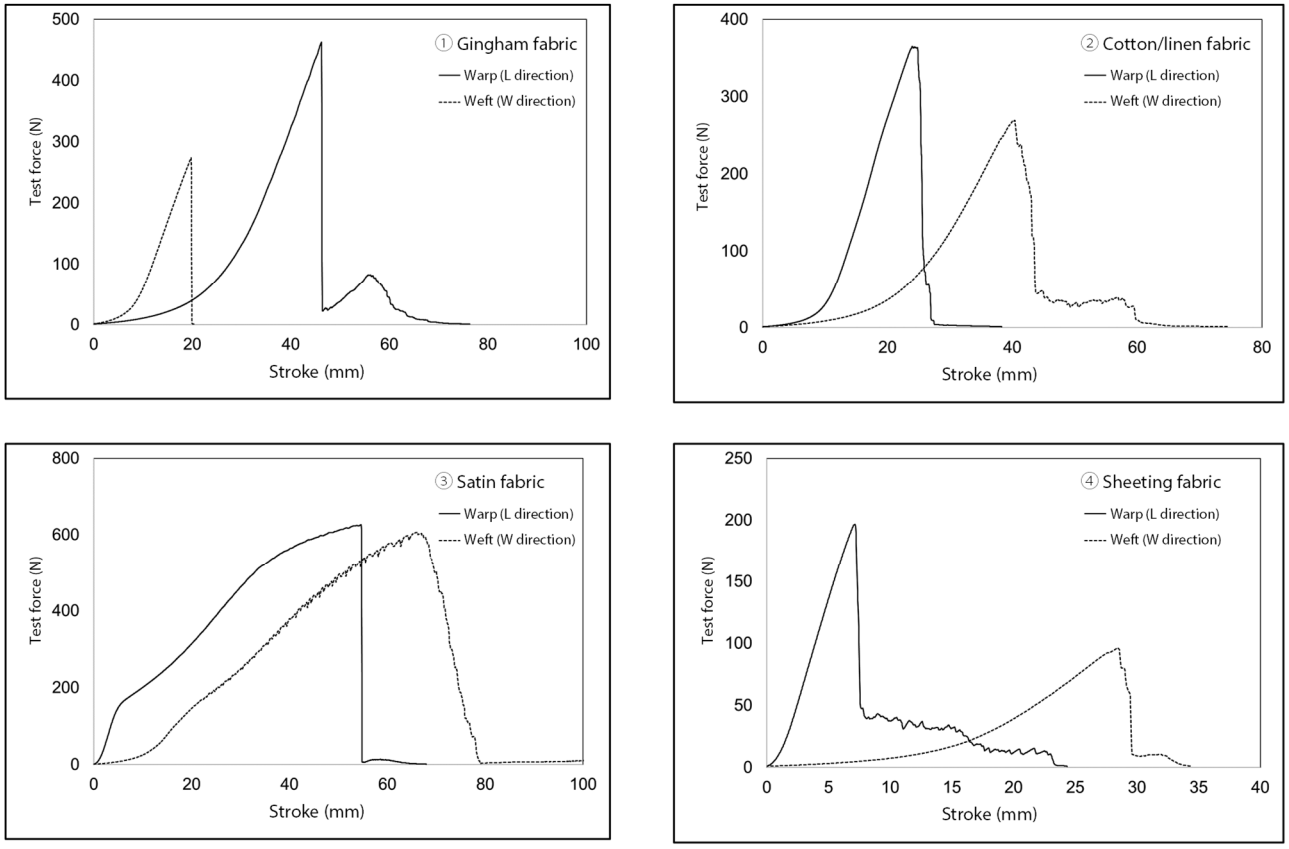

Fig. 3 **Test Results**

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