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Application News

No. i283

Compact Tabletop Testing Machine

# Probe Tack Test of Adhesive Tape

Adhesive tapes and sheets are produced for many industrial fields and have a wide range of applications. Diverse types of adhesive tape are used every day, for example, in manufacturing smartphones, in constructing furniture in the housing and construction industries, and in bundling cables in the automotive industry. Particularly in the medical field, adhesive tapes are used in adhesive skin patches (transdermal patches) and materials for covering wounds. Transdermal patches are a minimally-invasive method for delivering drugs through the skin, and are a comparatively safe drug administration method, since administration can be stopped easily, simply by removing the patch. The characteristics of quick adhesion and high workability make the application of such products necessary in many fields.

The properties required in adhesives include its adhesive force when applied to an object, the durability of adhesion during use, the force necessary to remove the product, and the re-adhesion property in case the initial application is incorrect and it is necessary to reapply the product. As the methods of evaluation for these properties, the Japanese Pharmacopoeia 17th Edition provides several methods of adhesion testing, including peel adhesion testing, inclined ball tack testing, rolling ball tack testing, and probe tack testing. This article introduces an example of tests conforming to the probe tack test method, which enables testing of samples with small adhesive surface areas, such as adhesive plaster, using a Shimadzu EZTest™ compact tabletop testing machine.

C. Oya

## Introduction of Probe Tack Test Method

As described in the Japanese Pharmacopoeia 17th Edition (JP), the probe tack test method is a test method which "measures the force required for peeling a prescribed cylindrical probe after bringing the probe into contact with the adhesive side of a patch briefly". Table 1 and Table 2 show the operation procedures and the main test conditions described in the JP.

**Table 1 Operation Procedures**

| |
|---|
| 1. Attach the sample to the weight ring. |
| 2. Place the weight ring on the sample stage. |
| 3. Bring the probe into contact with the adhesive side of the sample. |
| 4. Maintain contact between the probe and the adhesive face for 1 s. |
| 5. Peel the probe vertically from the adhesive face. |
| 6. Measure the maximum load required for peeling. |

**Table 2 Main Test Conditions**

| | |
|---|---|
| Test contact rate | : 10 ± 0.01 mm/s |
| Contact holding time | : 1 ± 0.1 s |
| Probe diameter | : 5 mm |
| Probe surface roughness (Rq) | : 250 - 500 nm |
| Weight ring | : 19.6 g (approx.) (so that contact load = 0.98 ± 0.01 N/cm$^2$) |

## Measurement Conditions

Table 3 shows the measurement conditions, Fig. 1 shows an overview of the test operations, and Fig. 2 shows the condition of the test. Before each test, the contact faces of the probe and the weight ring were cleaned by wiping with ethanol. In the case of the adhesive plasters, the measurements were conducted in two steps: the first measurement was conducted on an unused plaster, while the second test was conducted on the same plaster after its application on skin.

**Table 3 Measurement Conditions**

| | |
|---|---|
| Instrument | : EZTest Compact Tabletop Testing Machine |
| Jig | : Probe tack test jig |
| Load cell | : 20 N |
| Software | : TRAPEZIUM™ X (control) |
| Number of tests | : n = 5 for each sample type |
| Samples | : Wet compress (2 types), adhesive plaster (2 types) |
| Conditions | : For adhesive plasters, the adhesive force of the new product (1st measurement) and the adhesive force when reapplied (2nd measurement) were measured |

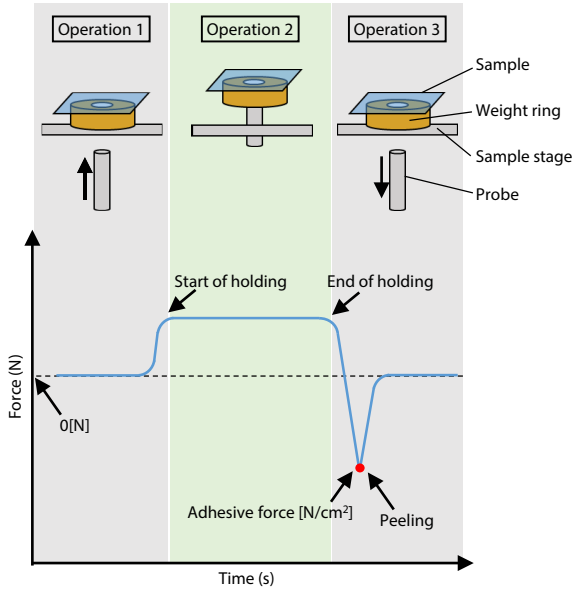


**Fig. 1 Overview of Test Operations**

Operation 1: The adhesive side of the sample is fixed on one side of a hollow weight ring. The weight ring is then placed on the sample stage, and the probe is raised from below, passing through the hole in the ring.

Operation 2: The probe adheres to the sample from the bottom. The weight ring and the sample are lifted from the sample stage and maintained at a specific height for a specific holding time.

Operation 3: The force required to peel the probe from the adhesive face is measured as adhesive force.

(a)

(b)

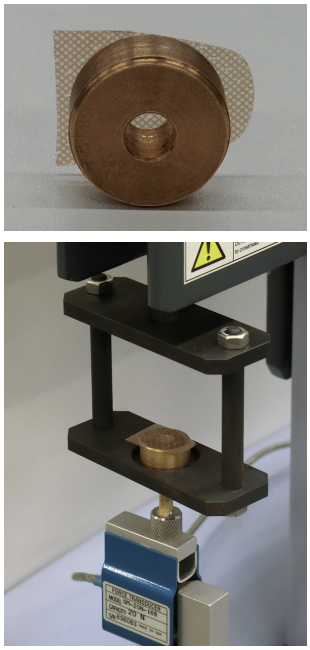

**Fig. 2 Condition of Test**
**(a) Weight Ring and Adhesive Plaster,**
**(b) Probe Tack Test Jig**

## Measurement Results

Table 4 shows the measurement results (average, n = 5), and Fig. 3 shows an example of the force-time graph. The measured peeling forces were different for wet compresses A and B. In particular, the adhesive force of wet compress A was stronger than that of B. In case of both adhesive plasters A and B, the adhesive force of the new plasters (1st measurement) was approximately 3 to 9 times larger than that when the plasters were reapplied (2nd measurement), showing that the decrease of adhesive force due to reapplication could be quantified accurately.

When the sample material was soft (wet compress B), loading could not be applied accurately because the weight ring could not be separated from the sample stage due to stretching of the sample around the contact surface. Therefore, the measurements were carried out after setting the movement of the probe so as to adequately push up the sample and weight ring.

## Conclusion

A probe tack test, which is one method of adhesion measurement, was conducted. The probe tack test makes it possible to measure the adhesive force of samples with small contact surface areas, and is used in evaluations of the mechanical properties of medical supplies such as the wet compresses and adhesive plasters used in this test. The Shimadzu EZTest compact tabletop testing machine used in this test can also be used with other adhesion measurement methods by exchanging the jig. For example, it is also possible to conduct the 90-degree and 180-degree peel test with this instrument. Since the adhesion force required in adhesive tapes or sheets (also after reapplication) differs depending on the intended application, it is necessary to evaluate such properties in order to select a product which fit the purpose of use.

**Table 4 Measurement Results (Average Values)**

| | Adhesive force [N/cm²]* | | 1st-2nd measurement force ratio [-] |
|---|---|---|---|
| | 1st measurement | 2nd measurement | |
| Wet compress A | 6.62 | - | - |
| Wet compress B | 0.81 | - | - |
| Adhesive plaster A | 8.15 | 2.85 | 2.9 |
| Adhesive plaster B | 7.08 | 0.81 | 8.7 |

* Adhesive force [N/cm²] = Minimum force [N] ÷ Surface area [cm²] of probe ($\varphi$5 mm)

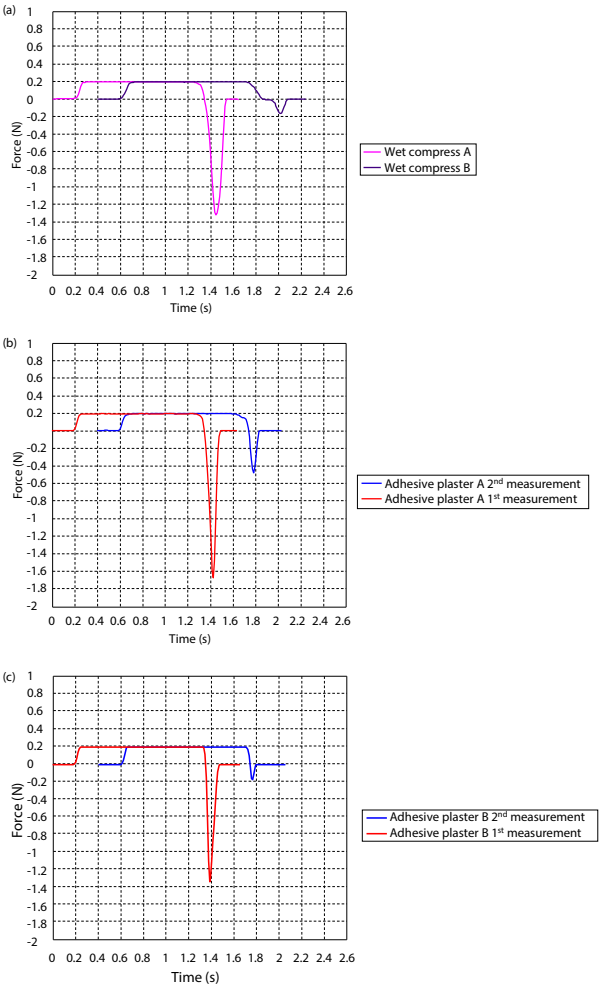


**Fig. 3 Force–Time Graphs**
**(a) Wet Compresses A, B,**
**(b) Adhesive Plaster A,**
**(c) Adhesive Plaster B**



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