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Application News

Precision Universal Testing Machine AGX™-V

# Tensile Test of Plastics with Automatic Extensometer

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## User Benefits

- Compliance with ISO 527 (JIS K 7161) regulation
- Significant test time reduction

## ■ Introduction

Plastic materials have excellent formability and versatility, and are widely employed as structural/functional material in several fields ranging from aircraft parts to electronic components.

During the design/quality control phase, the measurement of the material mechanical properties is essential to ensure high reliability and safety of the products. The typical material properties are the tensile strength and the elastic modulus, both evaluated with a tensile test. Such tests must be conducted following the guidelines of regulations (national or international) in order to guarantee a high repeatability and reliability of the measurements.

When tensile tests are conducted for quality control, numerous tests must be repeated every day and a reduction of the test time is key to optimize the inspection process. Effective methods to reduce the test time include the employment of extensometers capable of setting the arm position and grip the specimen automatically, such as the SIE-560SA. In this work, the precision universal testing machine AGX-10kNVD and the automatic extensometer SIE-560SA were employed to test 3 varieties of plastic materials (PVC, PP, PC) according to the ISO 527 (JIS K 7161) standard.

## ■ Test Method

The tests have been conducted following the guidelines of the ISO 527 (JIS K 7161) regulation. The shape and size of the specimens are shown in Fig. 1. The tests speed has been set to 1 mm/min for a strain below 0.3% and 50 mm/min when the strain reached the value of 0.3%. The strain interval for the calculation of the Elastic modulus $E_t$ was 0.05%~0.25% (Fig. 2).

The tensile strength $\sigma_m$ is defined as the highest stress recorded during the test. Accordingly, in the case that the tested material exhibits a clear yielding point, the tensile strength $\sigma_m$ becomes the stress in correspondence of the yielding strain, $\sigma_y$.

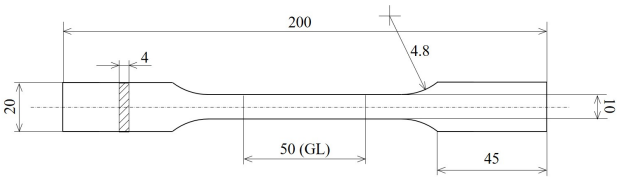


Fig. 1 Specimen Shape and Size

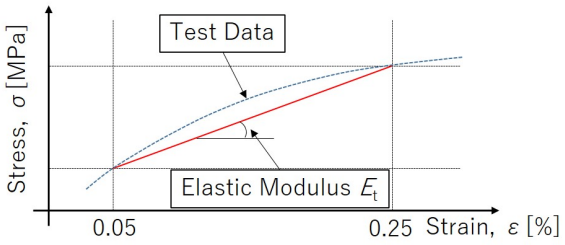


Fig. 2 Elastic Modulus $E_t$ Calculation

## ■ Test Equipment

The tests have been conducted using a 10 kN universal precision testing machine AGX-10kNVD and the measurement of the strain was performed with the automatic extensometer SIE-560SA. The main features of the SIE-560SA are listed below

- Automatic position adjustment and closing/removal of the arms.
- Measurement of the strain until rupture of the specimen.
- Strain measurement accuracy suitable for tests according to ISO 527 (JIS K 7161) regulation (the higher between ±1μm or 0.5% of the measured stain).


Fig. 3 Test Equipment

For this test, 5kN pneumatic flat grips were employed. The opening/closing of these grips is air driven and drastically facilitate the specimen setup, further contributing to the reduction of the test time. The details of the test equipment are summarized in Table 1. A schematic view of the test is shown in Fig. 4.

Table 1 Details of the Test Equipment

| | |
|---|---|
| Testing Machine | : AGX-10kNVD |
| Load Cell | : 10 kN |
| Grips | : Pneumatic Type Flat Grips |
| Grip face | : Single Side File Teeth |
| Software | : TRAPEZIUM™X-V (Single) |

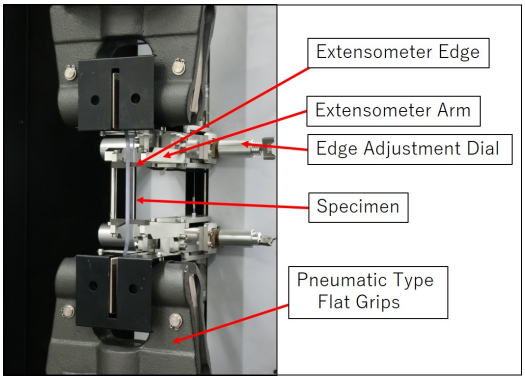


Fig. 4 Schematic View of the Test

## ■ Test Results

The relationship between stress and strain graph is represented in Fig. 5. Each material exhibited a clear yield point, and therefore the tensile strength $\sigma_m$ has been evaluated as the yield stress $\sigma_y$. The detection of the yield strength is conducted automatically with the software TRAPEZIUMX-V. The test results are shown in Table 2.

Table 2 Test Results

| Specimen<br>- | Tensile Strength $\sigma_m$<br>MPa | Elastic Modulus $E_t$<br>GPa |
|---|---|---|
| PVC1 | 74.69 | 3.15 |
| PVC2 | 75.29 | 3.12 |
| PC1 | 63.02 | 2.22 |
| PC2 | 62.98 | 2.25 |
| PP1 | 32.35 | 1.59 |
| PP2 | 32.39 | 1.57 |

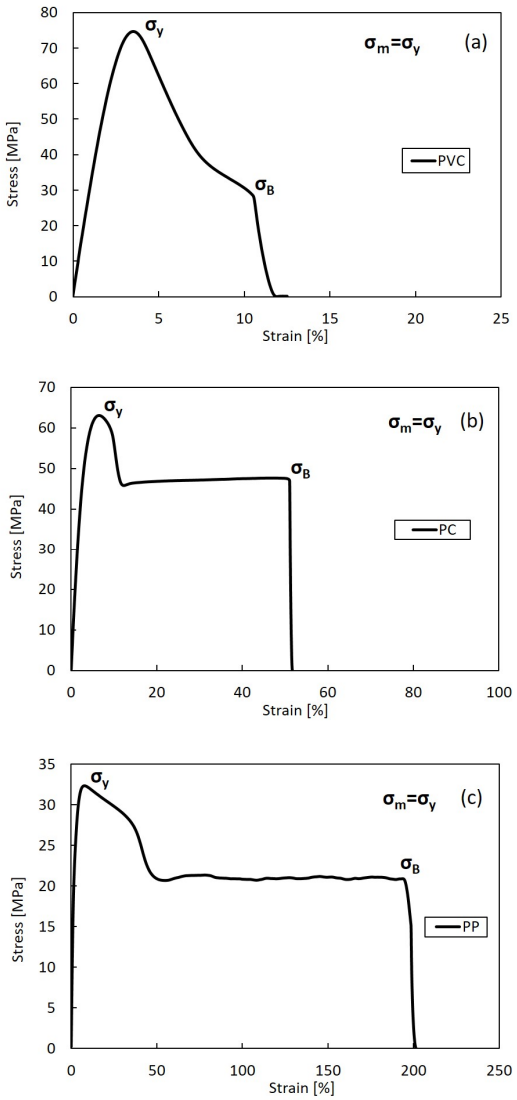


Fig. 5 Stress-Strain Graphs (a. PVC, b. PC, c. PP)

## ■ Conclusion

The tensile strength and the elastic modulus of three types of plastic materials were measured by using a precision universal testing machine AGX-10kNVD and an automatic extensometer SIE-560SA. By using the SIE-560SA and a pneumatic type grip, a significant test time reduction can be achieved allowing to conduct highly efficient measurements. In addition, the high precision of the SIE-560SA makes it suitable for tests compliant with the ISO 570 (JIS K 7161) regulation.



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