

# AUTOMATIC 6-CELL GAS PERMEABILITY TESTER



# Automatic 6-Cell Gas Permeability Tester - ToronGPT™ 6A

## Fully Automatic Vacuum Differential Pressure Gas Permeability Tester

ToronGPT™ 6A is an automatic gas permeability tester that measures the gas transmission rate (GTR) of plastic films, laminated films, metal foils, and high-barrier packaging materials. The system uses the vacuum differential pressure method to determine how readily oxygen, nitrogen, carbon dioxide, and other gases move through a barrier. Six independent chambers test six specimens at the same time, doubling throughput over three-cell systems for busy QC and contract labs. A detection range starting at  $0.01 \text{ cm}^3/(\text{m}^2 \cdot 24\text{h} \cdot 0.1\text{MPa})$  covers common films through demanding high-barrier structures.

One-button operation carries each run automatically, evacuation through result, with automatic start, stop, and save so operators can load six samples and step away. Intelligent test control matches the measurement to each specimen's barrier level without manual parameter setup. The vacuum system and water-bath temperature control work together to hold stable conditions across all six chambers during long unattended runs.

An overlay display plots the transmission, temperature, and pressure curves of all six specimens together, which makes batch comparison and outlier spotting straightforward. Traceable reference-film calibration keeps results defensible for audits and certification, and an optional humidity generator adds controlled relative humidity for real-service testing. The ToronGPT™ 6A (Automatic 6-Cell Gas Permeability Tester) serves high-volume packaging, pharmaceutical, food, and materials laboratories.

## APPLICATIONS

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## Automatic 6-Cell Gas Permeability Tester - ToronGPT™ 6A Applications

The ToronGPT™ 6A suits laboratories that test many barrier samples per day and need consistent, hands-off gas permeation data.

- **High-Volume Packaging QC:** parallel testing of films and laminates for plants and contract labs that release large sample batches every shift.
- **Flexible Packaging and Converting:** routine and R&D screening of multilayer laminates, metallized films, and coated structures at scale.
- **Pharmaceutical and Medical Packaging:** barrier verification of blister films, foils, and pouches that protect moisture- and oxygen-sensitive drug products.
- **Food and Beverage Packaging:** confirms the oxygen and carbon dioxide barrier of films and laminates that protect flavor, freshness, and shelf life.
- **Metal Foil and High-Barrier Materials:** measures low gas permeation through foil laminates, aluminized films, and coated high-barrier structures.
- **Plastic Film and Sheet Production:** incoming and outgoing QC of PE, PP, PET, and coated films against defined barrier targets.
- **Rubber, Tires, and Elastomers:** characterizes gas permeation through rubber sheeting and tire inner-liner compounds for material development.
- **Membrane and Materials Research:** studies permeation, diffusion, and solubility behavior of permeable membranes and polymer films across many specimens.
- **Electronics and Photovoltaic Encapsulation:** barrier screening of films that shield sensitive electronic and PV assemblies from oxygen and moisture ingress.



# Standards

The ToronGPT™ 6A is designed to align with internationally recognized test methods for gas transmission rate measurement by the differential pressure method.

- ASTM D1434 - Standard Test Method for Determining Gas Permeability Characteristics of Plastic Film and Sheeting
- ISO 15105-1 - Plastics: Film and Sheeting: Determination of Gas-Transmission Rate: Part 1: Differential-Pressure Methods
- ISO 2556 - Plastics: Determination of the Gas Transmission Rate of Films and Thin Sheets Under Atmospheric Pressure: Manometric Method
- JIS K 7126-1 - Plastics: Film and Sheeting: Determination of Gas-Transmission Rate: Part 1: Differential-Pressure Method

## FEATURES

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### Automatic 6-Cell Gas Permeability Tester - ToronGPT™ 6A Key Features

The ToronGPT™ 6A pairs full automation with six-sample throughput, targeting high-volume, hands-off barrier testing.

- **Six Independent Test Chambers:** run six specimens at once, each with its own data channel and temperature sensor, for high daily throughput.
- **One-Button Fully Automatic Testing:** a single command runs the complete sequence and stops on its own, cutting operator effort and test-to-test variability.
- **Automatic Start, Stop, and Save:** the instrument sequences and records each run without supervision, supporting overnight and unattended testing.
- **Intelligent Test Control:** adaptive test logic matches the measurement to each specimen's barrier level without manual parameter setup.

- **Vacuum Differential Pressure Method:** establishes a precise pressure gradient across each specimen for accurate gas transmission measurement.
- **Wide Detection Range:** covers 0.01 to 190,000 cm<sup>3</sup>/(m<sup>2</sup>·24h·0.1MPa), handling ordinary films and demanding high-barrier structures on one platform.
- **Embedded High-Accuracy Vacuum Sensors:** track lower-chamber pressure to 0.1 Pa for reliable and stable transmission calculations.
- **Water-Bath Temperature Control:** holds all six chambers at a stable set point across a 5°C to 95°C span for repeatable, isothermal testing.
- **Overlay Curve Display:** plots transmission, temperature, and pressure curves for all six specimens together for fast batch comparison and outlier detection.
- **Permeation Coefficient Analysis:** reports permeability, diffusion, and solubility coefficients alongside transmission rate for deeper material characterization.
- **24-Bit Delta-Sigma Data Acquisition:** high-resolution conversion delivers clean, stable readings across the measurement range.
- **Optional Humidity Control:** an add-on humidity generator applies controlled relative humidity to reproduce real service conditions during barrier testing.
- **Built-In Ambient Monitoring:** an internal temperature and humidity sensor logs room conditions with every test for better traceability.
- **Multiple Test Modes:** selectable modes adapt the instrument to different materials, gases, and throughput needs.
- **Traceable Reference-Film Calibration:** calibration against certified reference films keeps results defensible for QC release and certification audits.
- **Laboratory Data Management Integration:** connects to lab data management software for centralized records, review, and reporting.

## THEORY & METHOD

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# Theory and Method

The differential pressure method, also called the manometric method, measures gas transmission by holding a controlled pressure gradient across a film. The specimen divides each test cell into an upper chamber and a lower chamber. The instrument evacuates the whole gas circuit, then admits test gas to the upper chamber at a set pressure while the lower chamber starts near vacuum. This difference in pressure becomes the driving force that pushes gas through the material.

Gas transport follows the solution-diffusion model. Molecules dissolve into the upstream face of the film, diffuse through the polymer matrix, and desorb at the downstream face. The permeability coefficient (P) equals the product of the diffusion coefficient (D) and the solubility coefficient (S), so each cell can characterize all three properties. As gas collects in the sealed lower chamber, pressure there rises in proportion to the amount that has permeated, and a high-accuracy vacuum sensor tracks that rise over time.

Six cells run this measurement in parallel, each with its own sensors and data channel, so the instrument reports six independent results from a single loading. The system computes gas transmission rate from the steady-state slope of lower-chamber pressure against time, using the known test area, chamber volume, and temperature, then derives the permeability, diffusion, and solubility coefficients from film thickness and the transient time-lag. Water-bath temperature control keeps every chamber isothermal, and overlaid curves let operators compare all six specimens on one plot.

## TECHNICAL SPECIFICATIONS

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### Automatic 6-Cell Gas Permeability Tester - ToronGPT™ 6A Technical Specifications

| Parameter | Specification |
|-----------|---------------|
|-----------|---------------|

|                       |                                                                                    |
|-----------------------|------------------------------------------------------------------------------------|
| Measurement Range     | 0.01 to 190,000 cm <sup>3</sup> /(m <sup>2</sup> ·24h·0.1MPa) (standard)           |
| Resolution            | 0.001 cm <sup>3</sup> /(m <sup>2</sup> ·24h·0.1MPa)                                |
| Test Chambers         | 6, independent                                                                     |
| Vacuum Accuracy       | 0.1 Pa                                                                             |
| Temperature Range     | 5°C to 95°C                                                                        |
| Temperature Accuracy  | ±0.1°C                                                                             |
| Humidity Range        | 0% RH; 35% to 90% RH; 100% RH (optional)                                           |
| Humidity Accuracy     | ±1% RH (optional)                                                                  |
| Sample Thickness      | ≤ 3 mm                                                                             |
| Sample Size           | ≥ 150 mm × 94 mm                                                                   |
| Test Area             | 48 cm <sup>2</sup>                                                                 |
| Test Gases            | O <sub>2</sub> , N <sub>2</sub> , CO <sub>2</sub> , He, and others (user-supplied) |
| Differential Pressure | -0.1 MPa to 0.1 MPa                                                                |
| Gas Interface         | Ø8 mm                                                                              |
| Dimensions            | 650 mm (L) × 700 mm (W) × 420 mm (H)                                               |
| Voltage               | AC 220 V, 50 Hz (110V is also available)                                           |
| Net Weight            | 96 kg                                                                              |

## Standard Delivery

| Item | Description |
|------|-------------|
|------|-------------|

|                        |                                                      |
|------------------------|------------------------------------------------------|
| Main Unit              | Six-chamber gas permeability test instrument         |
| Computer               | Dedicated control PC                                 |
| Control Software       | Instrument operation and data-analysis software      |
| Temperature Controller | Water-bath temperature control unit                  |
| Vacuum Pump            | Evacuates the gas circuit before testing             |
| Tank Regulator         | Regulates supply pressure from the test-gas cylinder |
| PCIe Acquisition Card  | Data acquisition interface for the control PC        |
| Communication Cable    | Connects the instrument to the control PC            |
| Sample Cutter          | Prepares specimens to the required test size         |
| Vacuum Grease          | Seals the specimen at the chamber interface          |

## Optional Accessories

| Item                              | Description                                        |
|-----------------------------------|----------------------------------------------------|
| Humidity Generator                | Adds controlled relative-humidity testing          |
| Reference Film                    | Certified film for traceable calibration           |
| Vacuum Grease                     | Additional sealing grease for specimen mounting    |
| Sample Cutter                     | Additional specimen-preparation cutter             |
| Laboratory Data Management System | Centralized data management and reporting software |



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