



HIGH-SENSITIVITY 3-CELL GAS PERMEABILITY TESTER

High-Sensitivity 3-Cell Gas Permeability Tester - ToronGPT™ 3H

Vacuum Differential Pressure Gas Permeability Tester with Three Independent Chambers

ToronGPT™ 3H is a high sensitivity 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. Three independent chambers let QC and R&D labs run separate specimens at once, raising throughput without giving up accuracy. A measurement floor of $0.01 \text{ cm}^3/(\text{m}^2 \cdot 24\text{h} \cdot 0.1\text{MPa})$ suits everyday films and demanding high-barrier structures.

Beyond a single transmission figure, the ToronGPT™ 3H reports the permeability coefficient, diffusion coefficient, and solubility coefficient, giving material scientists a full picture of how a gas travels through a polymer. Water-bath temperature control holds each chamber at a stable set point across a 5°C to 95°C span, and an optional humidity generator adds controlled relative humidity for real-service barrier assessment. A 24-bit delta-sigma converter and embedded high-accuracy vacuum sensors resolve the small pressure changes that high-barrier films produce.

Operation runs through dedicated control software with a one-button workflow that carries each test through evacuation, permeation, and result without manual steps. Live data curves let operators watch pressure, temperature, and transmission develop in real time, while traceable reference-film calibration keeps results defensible for audits and certification work. The ToronGPT™ 3H (High-Sensitivity 3-Cell Gas Permeability Tester) serves packaging, pharmaceutical, food, electronics, and academic laboratories that need dependable barrier data.

APPLICATIONS

High-Sensitivity 3-Cell Gas Permeability Tester - ToronGPT™ 3H

Applications

The ToronGPT™ 3H supports gas barrier testing across industries where controlling oxygen, moisture, and gas permeation protects product quality and shelf life.

- **Food and Beverage Packaging:** verifies the oxygen and carbon dioxide barrier of films and laminates to protect flavor, freshness, and shelf life against oxidation.
- **Pharmaceutical and Medical Packaging:** assesses the barrier of blister films, foils, and pouches that protect moisture- and oxygen-sensitive drug products.
- **Flexible Packaging and Converting:** qualifies multilayer laminates, metallized films, and coated structures during development and batch quality control.
- **High-Barrier and Coated Films:** evaluates EVOH, PVDC, SiOx, and AlOx coatings where gas transmission is very low and high sensitivity matters.
- **Metal Foil and Aluminized Materials:** measures trace gas permeation through foil laminates and vacuum-metallized films used in demanding barrier applications.
- **Rubber, Tires, and Elastomers:** characterizes gas permeation through rubber sheeting and tire inner-liner compounds for material development.
- **Membrane and Filtration Research:** studies permeation and separation behavior of permeable membranes and polymer films under controlled conditions.
- **Electronics and Photovoltaic Encapsulation:** tests barrier films that shield sensitive electronic and PV components from oxygen and moisture ingress.
- **Academic and Materials Research:** quantifies permeability, diffusion, and solubility coefficients for polymer science and barrier-modeling studies.



Standards

The ToronGPT™ 3H 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

High-Sensitivity 3-Cell Gas Permeability Tester - ToronGPT™ 3H Key Features

The ToronGPT™ 3H pairs high-sensitivity measurement with automation and multi-sample throughput, targeting accurate and repeatable barrier data across a wide material range.

- **Vacuum Differential Pressure Method:** establishes a precise pressure gradient across the specimen for accurate gas transmission measurement on low- and high-barrier materials.
- **Three Independent Test Chambers:** run three specimens at once, each with its own data channel and temperature sensor, so labs process more samples per shift.
- **Wide Detection Range:** covers 0.01 to 190,000 cm³/(m²·24h·0.1MPa), handling ordinary films and demanding high-barrier structures on one platform.

- **24-Bit Delta-Sigma Data Acquisition:** resolves the small pressure changes produced by high-barrier films, supporting the instrument's high-sensitivity performance.
- **Embedded High-Accuracy Vacuum Sensors:** track lower-chamber pressure to 0.1 Pa for reliable and stable transmission calculations.
- **Water-Bath Temperature Control:** holds each chamber at a stable set point across a 5°C to 95°C span for repeatable, isothermal testing.
- **Permeation Coefficient Analysis:** reports permeability, diffusion, and solubility coefficients alongside transmission rate for deeper material characterization.
- **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.
- **One-Button Automated Workflow:** a single command runs the complete sequence from evacuation through shutdown, cutting operator effort and test-to-test variability.
- **Real-Time Data Curves:** on-screen plots of pressure, temperature, and transmission let operators judge test progress and stability at a glance.
- **Traceable Reference-Film Calibration:** calibration against certified reference films keeps results defensible for QC release and certification audits.
- **Configurable Differential Pressure:** standard operation to 0.1 MPa, with optional 1.0 MPa and 4.0 MPa ranges for specialized high-pressure permeation studies.
- **Multi-Gas Capability:** tests oxygen, nitrogen, carbon dioxide, helium, and other gases, with flammable or toxic gas configurations available on request.
- **Laboratory Data Management Integration:** connects to lab data management software for centralized records, review, and reporting.
- **Multiple Test Modes:** selectable modes adapt the instrument to different materials, gases, and sensitivity requirements.

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 the 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 a single test cell can characterize all three properties. As gas accumulates 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.

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. Film thickness and the applied pressure differential then yield the permeability coefficient, while the transient time-lag portion of the curve resolves the diffusion and solubility coefficients. Water-bath temperature control keeps each chamber isothermal, and the 24-bit delta-sigma converter resolves the very small pressure changes that high-barrier films generate, which supports the tester's high-sensitivity performance.

TECHNICAL SPECIFICATIONS

High-Sensitivity 3-Cell Gas Permeability Tester - ToronGPT™ 3H Technical Specifications

Parameter	Specification
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Measurement Range	0.01 to 190,000 cm ³ /(m ² ·24h·0.1MPa) (standard)
Resolution	0.001 cm ³ /(m ² ·24h·0.1MPa)
Test Chambers	3, 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 ²
Test Gases	O ₂ , N ₂ , CO ₂ , He, and others (flammable or toxic gases such as H ₂ , CH ₄ , H ₂ S, C ₂ H ₂ , C ₂ H ₄ available on request and must be specified in advance)
Differential Pressure	-0.1 MPa to 0.1 MPa (standard); 1.0 MPa, 4.0 MPa (optional)
Gas Interface	Ø8 mm
Dimensions	730 mm (L) × 510 mm (W) × 360 mm (H)
Voltage	AC 220 V, 50 Hz (110V is also available)
Net Weight	63 kg

Standard Delivery

Item	Description
Main Unit	Three-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
Vacuum Pump Control Module	Manages vacuum pump operation
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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