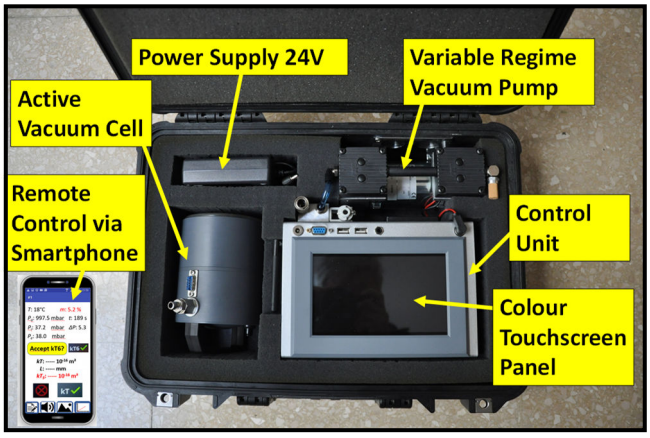
Measures the Air-Permeability of Cover Concrete

5th Generation

PermeaTORR ACTIVE CELL+

Standardized in Switzerland, Japan and Argentina

- **Fast (2 - 6 minutes)**
- **Repeatable and Reliable**
- **Non-Destructive**
- **Apt for Lab and Jobsite**
- **Fully Automatic + Remote Control via Smartphone**
- **Compact and Light**



Why measure the Air-Permeability of the Cover Concrete?

As the defence barrier against penetration of aggressive species (CO_2, Cl^-, SO_4^{2-}, etc.), the permeability of the cover concrete has a decisive impact on the durability of concrete structures. Concrete composition, type of formwork, concreting and curing practices are the main factors influencing the quality of the cover concrete; hence the need to measure it on the end-product, the finished structure.

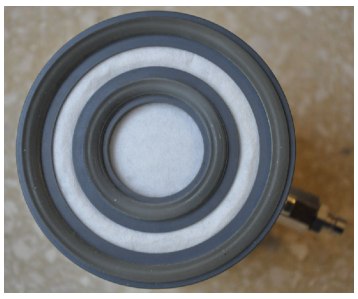
Swiss Standard SIA 262:2013 – "Concrete Construction" states: "The impermeability of the cover concrete shall be checked by means of permeability tests (e.g., air permeability measurements) on the structure or on core samples taken from the structure".

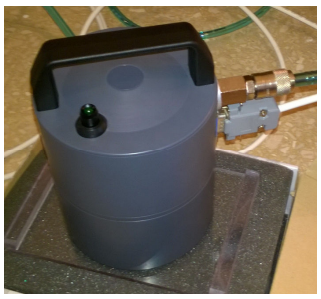
The *PermeaTORR AC*™ is an instrument designed precisely to serve that purpose: i.e., to measure the permeability to air of the cover concrete on site, in a fast, repeatable, reliable and non-destructive manner. The results of the Swiss Standard method correlate well with other durability-related tests, such as "Rapid Chloride Permeability" (ASTM C1202), Capillary Suction (ASTM C1585), Water Penetration under Pressure (EN 12390-8), Carbonation, Permeability to O_2 (Cembureau and S. African OPI), etc. Air-permeability upper limits have been proposed by Swiss Standard SIA 261/1:2019 (see our webpage) for moderate to severe exposure conditions.

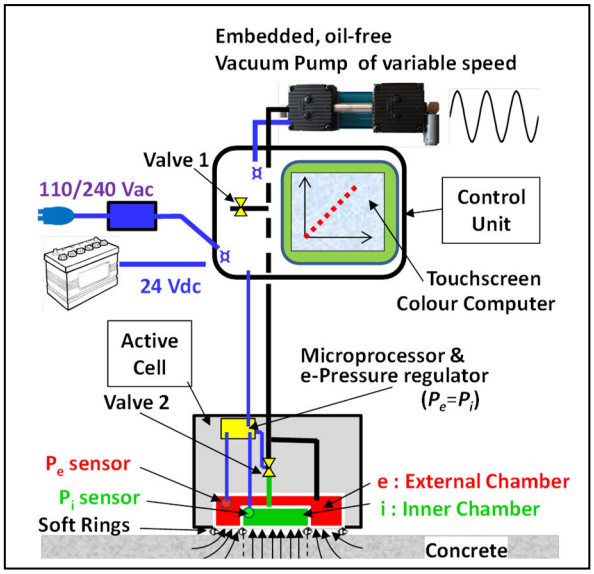
The method is also applicable to other porous materials such as rock, stone, clay products, ceramics, wood, etc.

How is the Air-Permeability *kT* measured?

A vacuum is created, by the pump, inside the 2-chamber **Active Cell**, which is sealed onto the concrete surface by means of a pair of concentric soft rings, creating two separate chambers.







When sufficient vacuum has been reached, Electro-Valve 2 is closed and the pneumatic system of the inner, measurement chamber (green in the diagram), is isolated from the pump.

The air at atmospheric pressure, present in the pores of the concrete underneath, flows through the cover concrete into the inner chamber, raising its pressure P_i. The rate of increase of pressure P_i is directly linked to the coefficient of air-permeability of the cover concrete.

An electronic pressure regulator maintains the pressure of the external chamber permanently balanced with that of the inner chamber (P_e=P_i). Thus, a controlled unidirectional flow into the inner chamber is ensured and the coefficient of permeability to air *kT* (m^2) can be calculated through suitable modelling.

PermeaTORR's Background

The *PermeaTORR AC+* is the last-generation version of the well-proven "Torrent" test method, covered by Swiss Standard SIA 262/1-E, that has been successfully applied worldwide for some 30 years. Over 430 international published documents dealing with the test method are a testimony of its popularity. Our instruments (ca. 200) are used satisfactorily in various countries of Africa, America, Asia and Europe. It has been standardized also in Japan (NDIS 3436-2:2020) and Argentina (IRAM 1892:2022).

What is new with the *PermeaTORR AC+* (Active Cell)?

1. Valve operation, pressure measurement and balancing happen inside the **Active Cell**, leading to higher accuracy in *kT* owing to:
   - Instrument's constant independent of hose length (5 m long)
   - Higher accuracy by measuring and balancing pressures at the source
   - Compact, less leaks → lower and more stable Calibration values
2. Embedded, oil-free mini vacuum pump, of variable regime, yielding better reproducibility, robustness and longevity to the instrument
3. Safe operation at 24 Vdc/3Adc, from power supply or suitable battery
4. Compact (fits in strong carrying case weighing 10 kg, pump included)
5. The operation and different functionalities are controlled via a touch-screen computer that also displays the results; color screen adds clarity to the displayed information.
6. Optional remote control via smartphone (just one operator needed)
7. Data input digital, oral and/or pictorial (photos)
8. Over 1000 measurements can be stored in the memory and easily downloaded to an external memory device (via USB port)
9. Safe operation of Active Cell, avoiding falls and damage
10. Software can be easily updated

Permeability Class		kT (10^{-16} m²)
PK0	Negligible	< 0.001
PK1	Very Low	0.001 - 0.01
PK2	Low	0.01 - 0.1
PK3	Moderate	0.1 - 1.0
PK4	High	1.0 - 10
PK5	Very High	10 - 100
PK6	Ultra High	> 100

Classes PK1-PK4 equivalent to ASTM C1202

Application Examples

The pictures below show field applications of the *PermeaTORR*: as quality control and service life prediction tool in the construction of new structures and for condition assessment of architectural heritage buildings. It is intensively used also in the laboratory.

What else is required?

Electricity (110-240 V) or a suitable battery (e.g., Suaoki S270).

The *PermeaTORR AC* measures the coefficient of air-permeability *kT* under the existing moisture conditions. As the moisture content of the cover concrete affects *kT*, Swiss Standard SIA 262/1-E:2019 specifies that the moisture content of the concrete surface should not exceed 5.5%, measured with an impedance-based moisture meter after ASTM F2659 (Recommended instrument: CMEXPERT II, manufactured by Tramex).

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