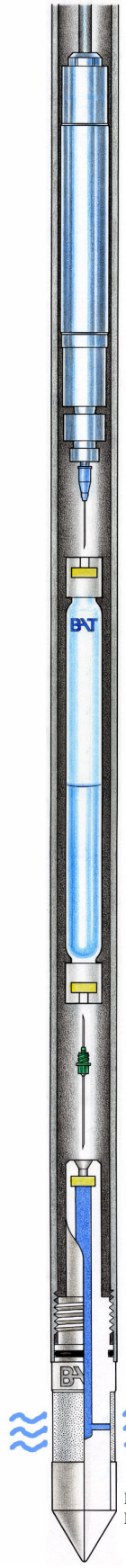
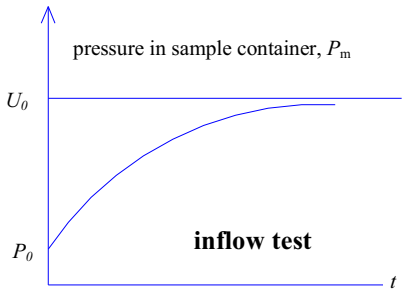
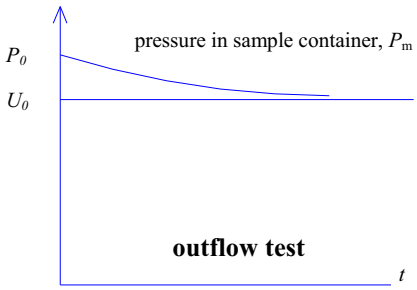
# System description




**System layout (in- or outflow test)**

The BAT Permeameter is used for in-situ measurement of soil permeability. The method used for evaluation of the coefficient of permeability $k$ is of the type "falling head"-test. Depending on the groundwater situation, unsaturated or saturated zone, the test can either be done as an inflow or outflow test. Volume changes in the system are calculated based on measured pressure changes and by using Boyle´s law.




## Calculation of the coefficient of permeability , *k*

The calculation of the out- or inflow volume in the sample container is made by using Boyle´s law as follows:

$$P_0 V_0 = PV$$ N.B. $P$ represents absolute pressure (1)

(After completion of the test, the actual out- or inflow volume can also be measured. The quality of the test can thus be checked by comparing the measured and calculated volumes).

The permeability coefficient, $k$, is calculated using the following equation:
(Bengtsson, P-E, 1984; Torstensson & Petsonk, 1986)

$$k = \frac{P_0 V_0}{F \cdot t \cdot 10^3}\left(\frac{1}{U_0 P_0} - \frac{1}{U_0 P_m} + \frac{1}{U_0^2}\ln\left(\frac{P_0 - U_0}{P_0} \times \frac{P_m}{P_m - U_0}\right)\right) \quad (2)$$

in which:

| | | |
|---|---|---|
| $k$ | coefficient of permeability | [m/s] |
| $P_0$ | initial system pressure | [m $H_2O$] |
| $V_0$ | initial system volume of air | [ml] |
| $F$ | form factor of filter | [mm] |
| $t$ | time for the test | [s] |
| $U_0$ | pore pressure at equilibrium | [m $H_2O$] |
| $P_m$ | system pressure at time $t$ | [m $H_2O$] |
| $V_t$ | system volume of air at time $t$ | [ml] |

The equation for the form factor $F$ of the filter element is as follows:

$$F = \frac{2\pi l}{\ln\left(\frac{l}{d} + \sqrt{1 + \left(\frac{l}{d}\right)^2}\right)}$$ where $l$ = length of filter [mm], $d$ = diameter of filter [mm] (3)

For the BAT MKIII Filter Tip shown to the left the form factor is $F = 230$ mm. ($l = 35$mm, $d = 31{,}5$mm)

## Time for stabilization - time of testing

The $k$-value can be computed at any time.

The BAT system makes use of only small volume changes. Thus the test can be carried out quickly.

Typical stabilization times, $t_{stab}$, as a function of the $k$-value are summarised below.

$k \approx 10^{-7}$ m/s ; $t_{stab} \approx 1$ minute
$k \approx 10^{-8}$ m/s ; $t_{stab} \approx 10$ minutes
$k \approx 10^{-9}$ m/s ; $t_{stab} \approx 1$ hour
$k \approx 10^{-10}$ m/s ; $t_{stab} \approx 10$ hours