

Why use Patient Spirometry?

Patient Spirometry is an excellent tool for managing the patient's ventilation during anesthesia and critical care:

Measurement at the airway

- represents real patient values
- is not influenced by ventilator hoses or other breathing system components

Saved reference loops

- enable fast visual detection of changes
- help in adjusting optimal ventilator settings
- help in comparison of actual and previous ventilatory status

Modular flexibility

- can be used with a variety of ventilators
- enables flexible change of modules between patients

Integrated information

- ventilatory and hemodynamic information on a single screen provides a complete picture of the patient status

Comprehensive documentation

- graphical and numerical trends to evaluate of patient's history
- printed loops, trends and snapshots for easy reporting

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D-lite is a trademark of GE Healthcare Finland Oy.

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CAUTION: U.S. Federal law restricts this device to sale by or on the order of a licensed medical practitioner.

Consult the User's Guide of the monitor for detailed instructions.

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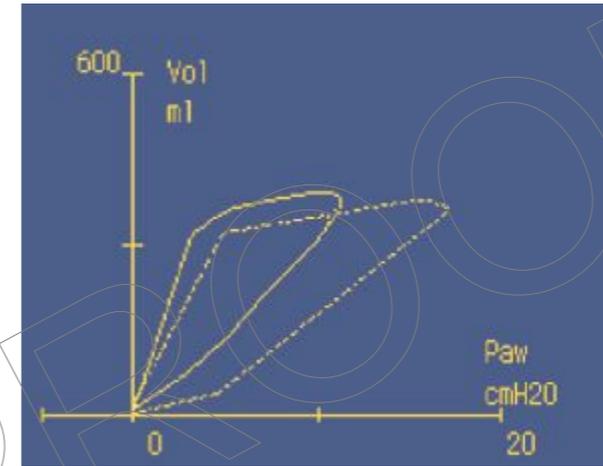
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Quick Guide



Patient Spirometry

What is Patient Spirometry?

Patient Spirometry measures airway pressures, flow, volumes, compliance and airway resistance breath-by-breath at the patient's airway. The dynamic interrelationships of pressure and volume or flow and volume are displayed as graphical loops.

In addition the inspired and expired gas concentrations are measured (CO₂, O₂ and anesthetic agents).



Pressure/Volume Loop

Flow/Volume Loop

All parameters are measured through a single, lightweight flow sensor and gas sampler, placed at the patient's airway. The "close to the patient" measurement is sensitive and continuous reflector of patient's ventilatory status, obtained independently of the ventilator used.

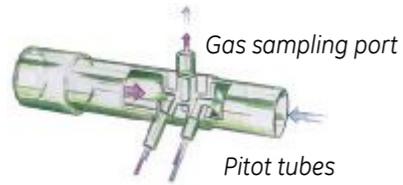


Spirometry split screen enables real-time monitoring of spirometry loops and numerical values, combined with hemodynamic information or real-time waveforms of airway pressure, flow and gases.



How is Patient Spirometry measured?

D-lite™ is an innovative, patented pressure and flow sensor.



Its two pitot tubes measure the pressure difference created by the gas flow. This pressure difference is used together with gas concentration information to calculate the flow. From the flow, both inspiratory and expiratory volumes are calculated.

Total positive end expiratory pressure (PEEP_{tot}) is the sum of externally applied PEEP (extrinsic PEEP, PEEP_e) and intrinsic PEEP (PEEP_i).

$$PEEP_{tot} = PEEP_i + PEEP_e$$

Dynamic PEEP_i is detected when the expiratory flow has not stopped before the next inspiration starts. Presence of PEEP_i indicates the air trapping situation in the lung, which may lead both in respiratory and hemodynamic side effects.

Compliance reflects the distensibility of the respiratory system. It is defined as a pressure difference required to expand the lung by a certain volume.

$$Compl = TV_{exp} / (P_{plat} - PEEP_{tot})$$

As continuous dynamic value it provides an easy tool to follow respiratory changes and to adjust ventilator settings.

Airway resistance (Raw) is calculated by using an equation, which gives an average system resistance between the lungs and the D-lite sensor over the total breathing cycle.

$$Paw(t) = Raw * V(t) + V(t) / Compl + PEEP_{tot}$$

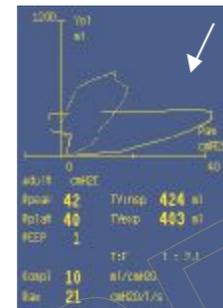
Clinical examples of Patient Spirometry



Leak in the airway

Leak in the airway is indicated by a loop remaining open at the end of expiration.

Leak in breathing system, in endotracheal tube or laryngeal mask, or even in the patient's lung may remain unnoticed without loop monitoring.



Obstruction in the airway

A loop moving towards the horizontal axis indicates airway obstruction that increases airway pressure without corresponding increase in tidal volume.

An obstruction caused by kinked tube, airway secretion or malposition of endotracheal tube can be immediately detected.

In Anesthesia



Monitoring of changes during laparoscopy

This figure illustrates the patient's ventilatory pattern before (1) and during CO₂ insuflation (2) in the laparoscopic operation.

A decrease in compliance and increase in airway pressure are clearly visible.



Spontaneous breathing efforts

This loop illustrates an initiation of a spontaneous breath during anesthesia.

In Critical Care



Intrinsic PEEP (autoPEEP)

Presence of intrinsic PEEP can be seen as a loop, where the flow is not reaching zero line and also as an increased PEEP_i value in the number field.

Intrinsic PEEP demonstrates air trapping situation which may lead to hyperinflation of the lung and increase the risk of the ventilation induced lung injury.



Best possible PEEP

This figure demonstrates effects of different PEEP settings on patient compliance. The saved loop (1) illustrates decreased compliance.

The situation is altered by increasing PEEP setting to 8 cmH₂O which clearly improves the lung compliance (2).