

LAERDAL BAG VALVE MASK



“Kiss by the Hôtel de Ville” by Robert Doisneau, Gelatin silver print, Life Magazine, 1950

“The marvels of daily life are exciting; no movie director can arrange the unexpected that you find in the street...Life is short. Forgive quickly. Kiss slowly” (Robert Doisneau, 1912-1994).

Robert Doisneau was one of France’s greatest photographers of the mid 20th century. His most famous photograph is “Kiss by the Hôtel de Ville”. It appeared in Life Magazine in 1950 and immediately struck a cord the world over. It provided a stark contrast to the recent grim memories of the Second World War. It seemed to project an image of a second chance at a new and better life for the world. A new life that would be ushered in by the first post war generation, both ignorant and innocent of the horrors of the war just ended. The grim memories of death were momentarily forgotten and replaced with a vision of life. It was the “kiss of life”.

The “marvels of daily life” in the ED, can also be exciting, especially in the event of sudden cardio-respiratory arrest in one of our patients. We must be ever ready for this possibility. Should this event occur we must immediately provide our own medical “kiss of life” in the form of our BLS protocol, if the patient is to have any possibility of a “second chance for life”. In the medical setting, however, it is advisable to provide our patient’s second chance via the use of a Laerdal bag, in distinction to the rather more direct method depicted by Doisneau’s “Kiss by the Hôtel de Ville”.

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Introduction

- The Laerdal Bag-Valve-Mask device is a non-rebreathing ventilation device.
- It is mandatory equipment in all areas where resuscitation or sedation or anaesthesia may be required.

Indications

Indications include:

- Ventilation in BLS procedures.
- Ventilation or assisted ventilation in sedated or anesthetized patients.
- Provision of supplemental oxygen.

Components

The Laerdal Bag Valve mask unit comes in 3 sizes and each consists of 3 basic parts, the face mask unit, the self-refilling ventilating bag and the reservoir bag, as shown below.



Above to below, the Adult, Child and Infant Laerdal Bag-Valve-Mask ventilation devices, (Northern Hospital)

A. Inspiratory valve. B. Expiratory valve. C. Pressure relief valve. D. Self-refilling ventilator bag. E. Oxygen port. F. Emergency air entrainment valve. G. Reservoir bag. H. Pressure relief valve for reservoir bag. I. Face mask.

Sizes

The Laerdal Bag Valve mask System comes in 3 sizes with characteristics that are shown in the table below:

SIZE	Weight/ Age	Ventilation Bag Capacity	Oxygen Reservoir Bag Capacity	Pressure Relief Valve (45 cm water)
Adult	> 30 kgms or > 10 years	1,600 mls	2,600 mls	No
Child	7-30 kgms or 6 months to 10 years	500 mls	2,600 mls	Yes
Infant	< 7 kgms or < 6 months	240 mls	600 mls	Yes

Oxygen Concentration Delivery Capabilities

1. Spontaneously breathing patients:

Most spontaneously ventilating patients can be provided with 100% oxygen, providing:

- Oxygen flow rates exceed the patient's minute volume, (adjust wall oxygen to the maximum 15 litres per minute to help ensure this).
- The reservoir exceeds the patient's tidal volume.
- There are no leaks within the system.

2. Ventilated patients:

It can be a 100% oxygen delivery system, (see also Oxygen Therapy Guidelines), for ventilated patients under certain conditions that will depend on:

- Attachment of the reservoir bag.
- The tidal volume delivered.
- The breath rate provided.
- The wall oxygen flow rate provided.

100 % oxygen may be provided by:

Adult Bag:	Reservoir bag + 500 ml tidal volume + Respiratory rate of 12 + Wall oxygen flow rate of 15 liters per minute.
Children's Bag:	Reservoir bag + 250 ml tidal volume + Respiratory rate of 20 + Wall oxygen flow rate of 10 liters per minute.
Infant's Bag:	Reservoir bag + 40 ml tidal volume + Respiratory rate of 30 + Wall oxygen flow rate of 4 liters per minute.

See also tables in Appendix 1 below.

Advantages of the Bag Valve Mask System

1. Provides advantages over unaided "mouth to mouth" techniques, including:
 - The allowance for a more efficient means of ventilation, especially when used in combination with an oral airway.
 - A reduction in the risk of transmission of infectious disease.
 - Even when not connected to supplemental oxygen, the provision of a greater FiO₂, (21% oxygen of ambient air as opposed to approximately 16% oxygen that will be provided by expired air resuscitation techniques)
 - Provision of a more "aesthetic" means of ventilation.
2. May be used for a spontaneously breathing patient or to ventilate a non-breathing patient.
3. Self inflating ventilation bag:
 - If the oxygen supply fails a patient can still be ventilated on 21% oxygen, (room air).
4. It is a low pressure, low resistance system.
5. It is a non-rebreathing device that ensures that no CO₂ builds up within the system.
6. An oxygen tubing connection port located on the ventilation intake valve allows for the provision of supplemental oxygen. The oxygen from this port is directed into the reservoir and ventilation bags.
7. Provision of a reservoir bag allowing delivery of near 100% oxygen in most situations.
8. The 3 size ranges ensures the device can be used on patients of any age.
9. Connections:
 - Parts are inter-connectable between the 3 sizes.
 - The mouth piece valve can connect to any size face mask of the Laerdal system or to the universal adaptor of any endotracheal tube.

10. Excessive **reservoir bag** filling leading to excessive pressures within the reservoir bag are prevented by a relief valve to the atmosphere, located at the outlet membrane of the reservoir valve unit, (marked H above).

Note this is not a relief valve for the ventilating bag, (gas is prevented from flowing from the ventilating bag into the reservoir by a separate valve).

11. When the oxygen supply is insufficient, adequate ventilation volume is ensured by entrainment of ambient air through the intake membrane of the reservoir valve unit, (located on the opposite side to the outlet membrane of the reservoir valve unit).
12. If the reservoir bag remains flat throughout the whole ventilation cycle, this acts as a visual sign that no supplemental oxygen is being provided.
13. The **child** and **infant** devices are provided with a high pressure relief valve on the upper mouth piece. If bag ventilation meets with a pulmonary resistance of 45 cm of water within the **ventilating bag** this valve will open to reduce the risk of stomach distension. When open a hissing sound will be heard.

When higher inspiration pressures are necessary the operator can keep the pressure regulator closed with the tip of the index finger while still squeezing the bag.

14. A PEEP valve can be fitted to the expiratory valve of the mouth piece.

Disadvantages of the Valve Bag Mask System

1. Open system:
 - Being an open system there is a reliance on higher oxygen flow rates to deliver the higher concentrations of oxygen and as the patient's minute volume increases the more atmospheric air will be entrained into the system and thus reduce the overall FiO_2 .
2. Stomach Inflation:
 - This can occur with manual ventilation in particular in cases of airway obstruction, increased airway resistance or reduced pulmonary compliance.
3. The units are somewhat bulky and disconnections may occur.

Appendix 1

Feasible oxygen concentration *

ADULT: Ventilation bag volume: 1600 ml
Reservoir bag volume: 2600 ml

O ₂ -flow lpm	Tidal vol. (ml) x bag cycling rate per min. O ₂ -concentrations (%) using reservoir (Without reservoir in brackets.)					
	500x12	500x24	750x12	750x24	1000x12	1000x24
3	56 (37)	39 (32)	47 (33)	34 (29)	41 (32)	30 (28)
5	81 (52)	52 (38)	62 (41)	42 (33)	52 (39)	38 (31)
10	100 (73)	84 (48)	100 (56)	65 (42)	84 (55)	53 (39)
12	100 (84)	97 (53)	100 (61)	74 (45)	94 (60)	59 (42)
15	100 (89)	100 (59)	100 (69)	86 (48)	100 (69)	66 (44)

CHILD: Ventilation bag volume: 500 ml
Reservoir bag volume: 2600 ml

O ₂ -flow lpm	Tidal vol. (ml) x bag cycling rate per min. 250 x 20 100 x 30			
	O ₂ -concentrations (%)			
	w/ reservoir	wo/ reservoir	w/ reservoir	wo/ reservoir
10	100	75	100	90

INFANT: Ventilation bag volume: 240 ml
Reservoir bag volume: 600 ml

O ₂ -flow lpm	Tidal vol. (ml) x bag cycling rate per min. 40 x 30 20 x 40			
	O ₂ -concentrations (%)			
	w/ reservoir	wo/ reservoir	w/ reservoir	wo/ reservoir
4	98	89	98	98

* Oxygen concentrations were measured in the Laerdal test laboratory, using a Polarographic Oxygen Analyser (Ventronics mod. 5575), a Michigan Instruments Vent Aid TTL test lung, a Gould Pneumotachograph, and a Gould ES 1000 recorder. Compliance and resistance of test lung were in accordance with drafted ASTM standards.

References

1. Laerdal Silicone Resuscitators Manual 1984

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