

### INTELLiVENT®-ASV®

HAMILTON-C6 Quick Guide



This Quick Guide is based on evaluations by clinicians within and outside Hamilton Medical and is intended to serve as an example. This Quick Guide does not replace either the official *INTELLIVENT-ASV Operator's Manual* or the clinical judgment of a physician. This Quick Guide should not – on its own – be used for clinical decision making. The information in this guide applies to adult and pediatric patients.

The use of INTELLiVENT-ASV requires a good understanding of mechanical ventilation. Understanding the working principles of Adaptive Support Ventilation (ASV) is also helpful.

This guide is for INTELLiVENT-ASV on the HAMILTON-C6 ventilator. Other device Quick Guides may be available on MyHamilton: https://www.hamilton-medical.com/Services/ MyHamilton. Note that illustrations in this Quick Guide may look different from your device display.

We provide free and open e-learning modules on the basics of mechanical ventilation, and on Hamilton Medical products and features. The modules target operators and users of mechanical ventilators in a critical care setting. Register now at http://college.hamilton-medical.com/

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1. INTELLiVENT-ASV basics



INTELLiVENT-ASV is based on the proven Adaptive Support Ventilation (ASV), which simplifies ventilation by

- 1 Eliminating separate modes for *passive* and *active* patients
- 2 Reducing the number of controls relevant for CO2 elimination to %MinVoI
- 3 Adding direct access to controls relevant for oxygenation (PEEP/CPAP and Oxygen)
- 4 With INTELLiVENT-ASV, the clinician sets targets for PetCO2 and SpO2 for the patient
- 5 INTELLIVENT-ASV automates the controls for CO2 elimination (%MinVol) and oxygenation (PEEP/CPAP and Oxygen) based on the set targets and on physiologic input from the patient (PetCO2, SpO2)

INTELLiVENT-ASV continuously monitors patient conditions, and automatically and safely adjusts parameters to keep the patient within target ranges, with minimal clinician interaction, from intubation until extubation. INTELLiVENT-ASV also provides tools to promote early, automated weaning (Quick Wean).

# Preparing and calibrating for ventilation Enabling and calibrating sensors



Before starting INTELLiVENT-ASV, you must:

- 1 Enable the oxygen, CO2, and SpO2 sensors (System > Sensors window).
- Perform any required calibrations (System > Tests & calib window).

For details about calibrating the components, see your ventilator *Operator's Manual*.

#### System > Sensors > On/Off window

- 1 System
- 2 Sensors
- 3 On/Off
- 4 Sensor options (O2, CO2, SpO2)

# Preparing for ventilation with INTELLiVENT-ASV 3.1 Set up

During setup, pay attention to the following:

- Place the CO2 and flow sensor/airway adapter assembly at the proximal (patient) end of the airway circuit as shown.
- **Position the airway adapter assembly in a vertical**, not a horizontal, position. This helps keep patient secretions from pooling in the sensors. If pooling occurs, remove the airway adapter from the circuit, rinse with water, and reconnect it to the circuit.
- Check that everything is properly connected by verifying the presence of a proper CO2 waveform (capnogram) on the ventilator display.



# Preparing for ventilation with INTELLiVENT-ASV Startup



#### **Getting started**

1 Review the patient height and sex, and adjust if needed.

Be sure this data is accurate. It is used to calculate the patient's ideal body weight (IBW), which is used by the INTELLIVENT-ASV controllers to regulate ventilation parameters. This information can also be adjusted during ventilation in the Controls > Patient window.

2 Touch the **Modes** button at the top of the display.

The Modes window opens.

**3** Touch **INTELLiVENT-ASV**, then touch **Continue**. The INTELLiVENT-ASV Settings window opens.

# 4. INTELLiVENT-ASV initial setup4.1 Settings

1			$\bigcirc$		
Ÿ	Automatic adjustments		Y	Quick Wean	
	%MinVol			Automatic	Disabled
	Automatic	Manual			
	PEEP/CPAP Automatic	Manual		Automatic SBT	SBT settings
	Oxygen Automatic	Manual		Oxygen limit	5 PEEP limit control cmH20
2	)				15
Ĩ	Patient conditions				6
	ARDS	Brain injury		30	5
	Chronic Hypercapnia			6 Auto-recruitment	

- 1 *Automatic adjustments.* Set the %MinVol, PEEP, and Oxygen controllers to Manual or Automatic, as appropriate.
- 2 Patient conditions:
  - Normal lungs: Do not select anything
  - ARDS: Initial settings are adjusted
  - Chronic Hypercapnia / Brain injury: Initial settings, including default target range are adjusted, automated PEEP adjustment is deactivated
- 3 Quick Wean. Activate Quick Wean and automated SBTs, as appropriate
- 4 Oxygen limit. Define the lower limit for the Oxygen controller (21% to 30%\*)
- 5 *PEEP limit control.* Define high and low limits that the PEEP controller cannot exceed or go below
- 6 Auto-recruitment. Enable/disable as needed

<sup>\*</sup> Not available in all markets.

# 4. INTELLiVENT-ASV initial setup4.2 Checking the target range



#### Check and adjust targets as appropriate for the patient's condition

INTELLIVENT-ASV continuously monitors patient conditions, and automatically and safely adjusts parameters to keep the patient within target ranges.

INTELLIVENT-ASV uses PetCO2 and SpO2 as monitoring inputs for regulation of ventilation and oxygenation. These parameter values are used to track PaCO2 and SaO2, respectively.

Target shift refers to:

- 1 Readjustment of the PetCO2 target range to keep the measured PetCO2 value in accordance with a measured PaCO2 value from a blood gas analysis (BGA). This is referred to as the PaCO2-PetCO2 gradient.
- 2 Readjustment of the SpO2 target range to keep the measured SpO2 value in accordance with a measured PaO2 value from a BGA.

# 4. INTELLiVENT-ASV initial setup4.3 Controls



In the Controls window, check the following default settings:

- Pressure ramp (P-ramp)
- Pasvlimit
- Cycle (expiratory trigger sensitivity (ETS) or IntelliSync+\*)
   With IntelliSync+, the ventilator monitors incoming sensor signals from the patient and reacts dynamically to initiate inspiration and expiration in real-time.
- Trigger (flow, pressure, or IntelliSync+\*)

With IntelliSync+, the ventilator monitors incoming sensor signals from the patient and, using a comprehensive set of algorithms, analyzes this data and dynamically adjusts the setting in real-time to address changing patient or system conditions.

If required, adjust one or more values depending on the patient's condition or as indicated by your protocol, as with conventional ventilation. Otherwise, use the default values.

For more details about control settings, see the INTELLiVENT-ASV Operator's Manual.

<sup>\*</sup> If the IntelliSync+ option is available and installed.

# 4. INTELLiVENT-ASV initial setup4.4 Alarms



#### **WARNING**

When using INTELLiVENT-ASV, you must have additional ventilator-independent patient monitoring in place.

Set your alarm limits for ventilation and monitoring parameters as in conventional ventilation.

Set alarm limits in the Alarms > Limits 1 and Limits 2 windows.

### The following alarms are particularly important for INTELLiVENT-ASV:

#### **High Pressure**

The maximum pressure delivered in INTELLiVENT-ASV (Pasvlimit) is 10 cmH2O below the high Pressure alarm limit.

Pasvlimit limits the pressure delivered for the breath. Exceeding the high pressure limit immediately terminates the breath.

#### Oxygen msg

When the Oxygen controller is set to Automatic, you can specify an oxygen level that, when exceeded, generates a medium-priority alarm message. The Oxygen msg control is only a notification tool; it does not affect the percentage of delivered oxygen.

#### SpO2

If either limit is reached, an alarm is generated. The SpO2 alarm setting is independent of the SpO2 target range settings.

#### PetCO2

If either limit is reached, a medium-priority alarm is generated. The PetCO2 alarm setting is independent of PetCO2 target range settings.

#### Tidal volume (Vt)

When the delivered Vt is > 1.5 times the set Vt high alarm limit, an **Inspiratory volume limitation** alarm is generated. In this case, the device aborts the breath and reduces the pressure to the **PEEP** level.

## INTELLiVENT-ASV views and indicators CO2 elimination and oxygenation maps



#### **CO2** elimination map

- 1 High pressure alarm limit
- 2 Pressure limitation: Pasvlimit
- 3 Yellow patient symbol (cross): Shows the current measured PetCO2 value at current Ppeak
- 4 Target zone
- 5 When %MinVol is increasing (^) or decreasing (v), the appropriate indicator appears above the map. When the arrows are the same size, %MinVol is in the target zone.



#### Oxygenation map: (PEEP/SpO2 view)

- 1 Upper PEEP limit
- 2 Yellow patient symbol (cross): Shows the current measured SpO2 value and current PEEP
- 3 Dark blue emergency zone
- 4 Lower PEEP limit
- 5 Target zone
- 6 When PEEP or Oxygen is increasing (^) or decreasing (v), the appropriate indicator appears above the map. When the arrows are the same size, SpO2 is in the target zone.

## INTELLIVENT-ASV views and indicators Oxygenation map and controls



#### Oxygenation map: (FiO2/ PEEP view)

- 1 Lower PEEP limit
- 2 Upper PEEP limit
- 3 Yellow patient symbol (cross): Shows current Oxygen (FiO2) and PEEP values
- 4 Lower Oxygen limit
- 5 When PEEP or Oxygen is increasing (^) or decreasing (v), the appropriate indicator appears above the map. When the arrows are the same size, SpO2 is in the target zone.

For details, see section 6.3 and the INTELLiVENT-ASV Operator's Manual.



#### Solid gray circle (manual management)

Indicates that the operator must manually manage the control and change the settings as needed.



#### Blue circle rotating to the right (automatic management)

Indicates that INTELLiVENT-ASV is managing the patient and treatment has been increased. A faster rotation provides a visual indication of ongoing or recent changes.



#### Blue circle rotating to the left (automatic management)

Indicates that INTELLiVENT-ASV is managing the patient and treatment has been decreased. A faster rotation provides a visual indication of ongoing or recent changes.



#### Red circle (no automatic management)

No appropriate signal is available. Controller is in a frozen state. Check the position and connection of the sensor to ensure optimal signal quality.



#### Green circle and timer

Oxygen enrichment in progress.

## 6. Working principles of INTELLiVENT-ASV6.1 Management of %MinVol based on PetCO2

Ventilation horizon: passive patient



#### Target of the Ventilation controller (passive patient)

Keep the *passive* patient in the middle of the target range for PetCO2.

- The patient condition is defined as *passive* when *any* of the following occur:
  - The ventilator delivers five (5) consecutive mechanical breaths without the patient triggering a breath
  - PetCO2 is invalid or exceeds the upper limit by at least 3 mmHg (0.4 kPa)
  - The Brain injury patient condition is chosen
- Management is based on PetCO2.
- The ventilation controller adjusts %MinVoI by up to a maximum of 1% on a breath-by-breath basis to reach the target PetCO2.
- When the patient's PetCO2 is within the target range, %MinVoI is fine-tuned to get the patient to the middle of the target range.
- When the patient's PetCO2 is too high (to the right of the target zone), the %MinVol setting increases.
- When the patient's PetCO2 is too low (to the left of the target zone), the %MinVol setting decreases.
- For details about sensor quality and the controller, see page 43.

6. Working principles of INTELLiVENT-ASV6.2 Management of %MinVol based on fSpont

Ventilation horizon: active patient



#### Target of the Ventilation controller (active patient)

Keep the *active* patient in the target range for spontaneous respiratory rate (fSpont) and keep PetCO2 below the upper limit.

- The patient condition is defined as *active* when *ALL* of the following occur:
  - The patient takes five (5) consecutive spontaneous breaths
  - PetCO2 is valid and below or equal to the upper limit
  - Brain injury is not selected
- Management is based on Rate.
- The controller adjusts %MinVoI by up to a maximum of 1% on a breath-by-breath basis to reach the target Rate.
- When the patient's respiratory Rate value is within the target range, no change in %MinVol (except when Quick Wean is enabled).
- When the patient's respiratory Rate is above the upper limit (danger of patient fatigue), %MinVol increases.
- When the patient's respiratory Rate is below the lower limit, %MinVol decreases.
- For details about sensor quality and the controller, see page 43.

## 6. Working principles of INTELLiVENT-ASV6.3 Oxygenation management

#### **Oxygenation horizon**



#### Target of Oxygenation controller

- When the patient's SpO2 is within the target range, Oxygen is fine-tuned to get the patient to the middle of the target range.
- When the patient's SpO2 is too high (to the right of the target zone), oxygenation is decreased.
- When the patient's SpO2 is too low (to the left of the target zone), oxygenation is increased.
- If the patient's SpO2 is very low (to the far left of the target zone) in the *emergency zone* indicating hypoxemia, Oxygen is immediately increased to 100%.
- For details about oxygenation rules, see page 42.
- For details about sensor quality and the controller, see page 43.

<sup>\*</sup> Treatment = PEEP and/or Oxygen

6. Working principles of INTELLiVENT-ASV 6.4 Oxygenation management



#### **Decreasing treatment: Open Lung**

#### Target

Keep the patient in the target range for SpO2. Adjust the PEEP/Oxygen combination according to evidence-based protocols.

#### **Oxygenation controller rules**

- Depending on patient conditions and the actual combination of PEEP and Oxygen on the PEEP/Oxygen curve, the PEEP/Oxygen controllers decide whether PEEP, Oxygen, or both are increased or decreased.
- The PEEP/Oxygen controllers adjust PEEP and/or Oxygen in proportion to the difference between actual SpO2 and the target.
- The relationship between PEEP and Oxygen is based on the ARDSnet guidance for increasing treatment (1) and the Open Lung concept for decreasing treatment (2). See the *INTELLiVENT-ASV Operator's Manual* for details.
- The Oxygen controller adjusts **Oxygen** between 21%<sup>\*</sup> and 100%.
- The PEEP controller operates between 5 and 24 cmH2O (when not limited by the PEEP limit setting).

<sup>\*</sup> The lower limit depends on the Oxygen limit control setting. A setting of 21% may not be supported in all markets; in this case, the lower limit is 30%.

## 6. Working principles of INTELLiVENT-ASV6.5 Auto-recruitment maneuver



#### Target

Re-expand collapsed lung tissue and then maintain higher PEEP to prevent subsequent "de-recruitment" in passive patients.

- Auto-recruitment is only performed when ALL of the following conditions are met:
  - The patient is passive
  - PEEP management is set to Automatic
  - Auto-recruitment is enabled
  - SpO2 is below the target range

#### **Controller rules**

- The auto-recruitment maneuver in INTELLiVENT-ASV consists of 20 seconds of sustained inflation with a pressure level of 40 cmH2O.
- Recruitment maneuvers occur after two consecutive automatic increases of PEEP of 1 cmH2O every 6 minutes. This means that the recruitment maneuver cycle occurs at a maximum every 12 minutes (see illustration). A notification message appears on the display as soon as a recruitment maneuver is performed.

### 7. Adjusting INTELLiVENT-ASV during ventilation



While INTELLiVENT-ASV is running, the ventilator automatically adjusts the control settings for ventilation (%MinVol) and oxygenation (PEEP and/or Oxygen).

At any time during ventilation with INTELLiVENT-ASV, you can check and/or modify settings by touching the **Target**, **Controls**, or **Alarms** buttons.

As the patient conditions change, be sure to regularly monitor the patient and ventilation settings.

- 1 Re-evaluate patient condition
- 2 Reconsider activating Quick Wean
- 3 Reconsider activating automated SBTs
- 4 Reconsider the minimum Oxygen limit
- 5 Reconsider PEEP limits
- 6 Reconsider auto-recruitment
- 7 Adjust the PetCO2 target range (target shift) according to PaCO2 values from BGA\*
- 8 Adjust the SpO2 target range (target shift) according to PaO2 values from BGA\*

\* By checking the blood gas analysis (BGA), always keep in mind that respiratory drive is strongly linked to the metabolic status of the patient.

### Quick Wean and SBT (spontaneous breathing trial) Overview



Quick Wean is integrated with INTELLiVENT-ASV, and when activated, provides continuous dynamic monitoring and control of patient conditions to evaluate the patient's potential readiness for extubation, including the possibility of conducting fully controlled automated spontaneous breathing trials (SBT).

Quick Wean operates in three phases:

- Screening
- Observation
- Automated spontaneous breathing trial (SBT), if selected

While the default parameter values are all based on the currently available literature, if you prefer to use a different protocol, you can change the settings in the Quick Wean Configuration windows (see the *INTELLIVENT-ASV Operator's Manual*).

### Quick Wean and SBT (spontaneous breathing trial) Status window



#### Quick Wean & SBT Status window

When Quick Wean is enabled, the Quick Wean Status window is displayed by default.

- 1 The window title changes to *Quick Wean* & *SBT* when automated SBTs are enabled.
- 2 Text indicating the current status:
  - Verifying conditions
  - Conditions fullfilled/Starting SBT in x min
  - Conditions fulfilled/SBT will not start
  - SBT running
- 3 Timer
  - When an SBT is running, shows how long it has been in progress
  - Otherwise, shows how long the patient values have been within the target ranges
- 4 Green bars indicate value is within limits

### Quick Wean and SBT (spontaneous breathing trial) 8.3 Phase 1 – Screening

#### Target of phase 1 (Screening)

Quick Wean can be enabled at any time during ventilation.

#### **Controller rules**

- The PetCO2 range is shifted to the right by up to +5 mmHg (0.7 kPa), depending on pressure, to encourage and support spontaneous breathing efforts.
- When the patient is active and the patient's respiratory rate is below the upper limit of the target range<sup>\*</sup>, the device gradually reduces %MinVoI to no more than 70%.
- Quick Wean parameters are continuously monitored in the Quick Wean window.

#### **Patient monitoring**

- If the patient is passive, consider decreasing sedation.
- Monitor the Quick Wean parameters.

<sup>\*</sup> With active patients, INTELLIVENT-ASV calculates the fSpont target range. For calculation details, see page 25 and the INTELLIVENT-ASV Operator's Manual.

### Quick Wean and SBT (spontaneous breathing trial) Phase 2 – Observation

#### Target of phase 2 (Observation)

Establish whether the patient meets the Quick Wean conditions.

#### **Controller rules**

- So long as the patient remains active, the device continues to gradually reduce **%MinVol** to no more than 70%.
- Quick Wean monitors the configured *To start SBT* criteria.
- When the patient meets the criteria, the device starts recording the time the patient is in the weaning zone (if automated SBTs are disabled) or starts a countdown to the next automated SBT (if automated SBTs are enabled).
- Patient conditions for the *To start SBT* parameters must remain within the predefined ranges for the period of time specified in the **Time before starting SBT** parameter.\*

\* Note that any of the *To start SBT* parameters can be out of range for up to the time specified in the *Tolerance* time parameter without affecting the countdown.

## Quick Wean and SBT (spontaneous breathing trial) 8.5 Phase 3 – SBT

#### Target of phase 3 (SBT)

Establish whether the patient is able to breathe with minimal support.

#### **Controller rules**

 INTELLiVENT-ASV immediately decreases %MinVol and PEEP to the configured settings (by default, 25% and 5 cmH2O, respectively).



- During the SBT, the *To stop SBT* parameters are monitored (configurable).
- When an SBT is completed or stopped, the device returns **%MinVol** and **PEEP** to the values in place prior to the start of the SBT, and starts monitoring patient conditions against the *To start SBT* criteria again. The device also takes into account the time interval specified by the **Time between 2 SBTs** parameter.
- During each phase, an SBT status message is displayed (for example, SBT running, SBT fulfilled, and so on).

### 9. Spontaneous breathing trial (SBT) settings



- Enable Quick Wean by selecting **Automatic** in the Quick Wean section of the INTELLiVENT-ASV Settings window.
- 1 Select whether to enable automated SBTs (by default, disabled).
  - To enable automated SBTs, touch the Automatic SBT checkbox.
     A checkmark indicates the setting is enabled, and the SBT Settings button becomes available.
  - Touch **SBT Settings** to access the controls.
- 2 SBT controls:
  - Time before starting SBT: Defines the length of time before an SBT can start.
  - Time between 2 SBTs: The minimum length of time that must pass between two SBTs.
  - Psupport max/Rate: When the respiratory rate and pressure support are below the set values, SBT will start. If, during an SBT, either parameter is above the set value for longer than the time defined by the Tolerance time parameter, the SBT will stop.
- 3 SBT time range: Defines the hours between which an automated SBT can be started.
- 4 Manually start/stop SBT: An SBT can be started manually at any time as soon as the patient is active. An ongoing SBT can be manually stopped at any time.

### Appendix I: Oxygenation management

	Definition of action	Occurs when
Increase oxygen	Increases oxygen by 10% of current	Oxygen automatically managed
stepwise	Oxygen value every 30 seconds	<ul> <li>Increasing oxygen support</li> </ul>
Decrease oxygen	Decreases oxygen by 5% of current	Oxygen automatically managed
stepwise	Oxygen value every 60 seconds	Decreasing oxygen support
		<b>NOTICE.</b> If a lower limit is specified, <b>Oxygen</b> does <i>not</i> go below the lower limit.
Increase PEEP stepwise	Increases PEEP by 1 cmH2O every	PEEP automatically managed
	6 minutes	Increasing PEEP support
		<b>NOTICE.</b> If an upper limit is specified, PEEP does <i>not</i> exceed the limit.
Decrease PEEP stepwise	Decreases PEEP by 1 cmH2O every	PEEP automatically managed
	6 minutes	Decreasing PEEP support
		<b>NOTICE.</b> If a lower limit is specified, PEEP does <i>not</i> go below the lower limit.
Decrease PEEP stepwise	Exception: Decreases PEEP by 1 cmH2O	PEEP automatically managed
quickly	every <b>30 seconds</b>	• PEEP is above the upper PEEP limit (if it was manually set above the upper limit)

### Appendix II: Sensor signal quality

#### Sensor signal quality: Ventilation controller

When the PetCO2 signal is unavailable or of poor quality for more than 30 seconds:

- The signal quality indicator near the PetCO2 value shows gray, red, or orange bars
- The ventilation controller is frozen
- The Ventilation adjustment OFF (no PetCO2) alarm is generated

#### Sensor signal quality: Oxygenation controller

When the SpO2 signal is unavailable or of poor quality for more than 30 seconds:

- The signal quality indicator near the SpO2 value shows gray, red, or orange bars
- The PEEP and Oxygen controllers are frozen
- The Oxygenation adjustment OFF (no SpO2) alarm is generated

For additional details, see the INTELLiVENT-ASV Operator's Manual.

### Glossary

#### Parameter Definition

FiO2	Fraction of inspired oxygen
fSpont	Spontaneous breathing frequency
IBW	Ideal body weight, calculated from height and sex
MinVol	Minute volume. Based on the operator-set %MinVol, the ventilator calculates the target MinVol in l/min, then measures and displays it in the ASV target window.
%MinVol	Percentage of minute ventilation
PetCO2	End-tidal CO2 pressure
Pasvlimit	The maximum inspiratory pressure for INTELLIVENT-ASV is set using the Pasvlimit control in the Controls window. Changing the Pasvlimit value also changes the upper Pressure limit.
PEEP	Positive end-expiratory pressure; the constant pressure applied during the expiratory phase
Rate	Number of breaths per minute (b/min)
SBT	Spontaneous breathing trial

### Notes

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