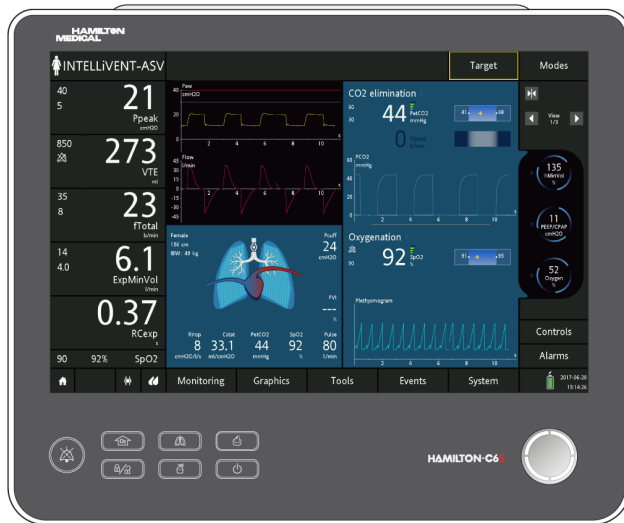




INTELLiVENT-ASV

Operator's Manual

HAMILTON-C6

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Operator's Manual

INTELLiVENT-ASV

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About this guide

This guide describes the features and functions of INTELLiVENT-ASV for HAMILTON-C6, and is designed for use with the following documentation:

- Your ventilator *Operator's Manual*
- *Pulse oximetry Instructions for use* for your ventilator
- *INTELLiVENT-ASV Quick Guide*

Conventions used in this guide

In this manual:

- Button and tab names are shown in a **bold** font.
- The notation *XX > XX* shows the sequence of buttons/tabs to touch to open the associated window.
For example, the text *Open the System > Settings window* means touch the **System** button, then touch the **Settings** tab.
- The graphics shown in this manual may not exactly match what you see in your environment.
- Pressure is indicated in cmH₂O, length in cm, and temperature in degrees Celsius (°C). The units of measure for pressure and length are configurable.
- PI and PVI are only available only with a Masimo SET[†] pulse oximeter.

Safety messages are displayed as follows:

WARNING

A WARNING alerts the user to the possibility of injury, death, or other serious adverse reactions associated with the use or misuse of the device.

CAUTION

A CAUTION alerts the user to the possibility of a problem with the device associated with its use or misuse, such as device malfunction, device failure, damage to the device, or damage to other property.

NOTICE

A NOTICE emphasizes information of particular importance.

In tables, safety messages are indicated as follows:

WARNING!

CAUTION!

NOTICE!

In our manuals, we refer to *active* and *passive* patients.

- An *active* patient is one who is making inspiratory efforts.
Active breathing is identified as the occurrence of at least five (5) consecutive spontaneous breaths. Spontaneous breaths are those for which inspiration is both patient triggered and patient cycled.
In addition to spontaneous breaths as described, an active patient must also meet the requirements described in Section 1.7.3.

- A *passive* patient is one who is not making inspiratory efforts. Passive breathing is identified as the occurrence of at least five (5) consecutive mandatory breaths. In general, mandatory breaths are those for which inspiration is either machine triggered or machine cycled. In INTELLiVENT-ASV, mandatory inspirations are both machine triggered and machine cycled. In addition to mandatory breaths as described, a passive patient must also meet the requirements described in Section 1.7.3.

1

INTELLiVENT-ASV

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1.1 Overview

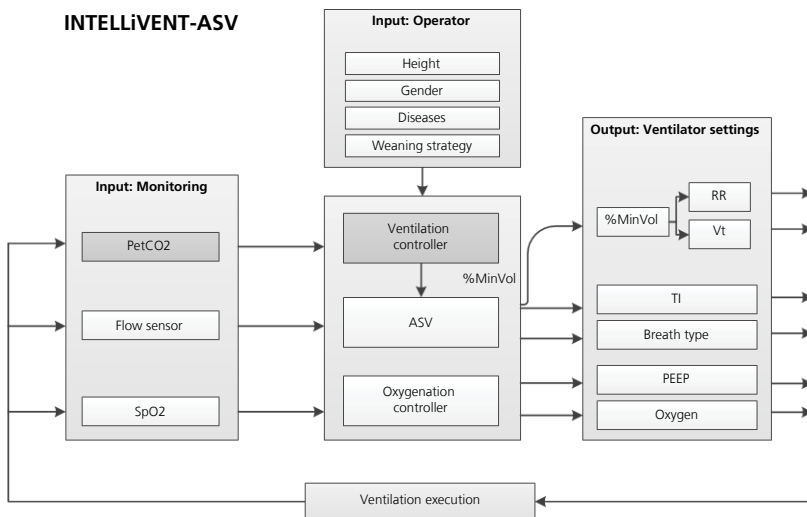
INTELLiVENT-ASV is an advanced ventilation mode, based on the proven Adaptive Support Ventilation (ASV) mode, to automatically regulate CO₂ elimination and oxygenation for both passive and active patients, based on both physiologic data from the patient and clinician-set targets.

With this mode, the clinician sets targets for PetCO₂ and SpO₂ for the patient. INTELLiVENT-ASV then automates

management of the controls for CO₂ elimination (%MinVol), and oxygenation (PEEP and Oxygen) based on these targets and on the physiologic input from the patient (PetCO₂ and 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.

Figure 1-1. INTELLiVENT-ASV workflow



For detailed information about how INTELLiVENT-ASV regulates these parameters, see:

- Section 1.7, Management of minute volume
- Section 1.8, Management of PEEP and Oxygen
- For details on the ASV mode, see your ventilator *Operator's Manual*

When enabled, INTELLiVENT-ASV offers automated recruitment maneuvers and can also help promote early weaning using Quick Wean.

Before using INTELLiVENT-ASV, be sure to review the indications and contraindications for use, as well as all safety-related messages.

1.2 Indications and contraindications for use

Indications for use

NOTICE

- Use the INTELLiVENT-ASV for adult and pediatric patients only.
- Use INTELLiVENT-ASV for intubated patients only.
- Be sure you are familiar with the use of the CO₂ and SpO₂ sensors. See your ventilator *Operator's Manual*, the *Pulse Oximetry Instructions for Use*, and documentation provided with the sensors.

INTELLiVENT-ASV is designed for use with all adult and pediatric patients weighing 7 kg or more. It is not available for neonatal applications. INTELLiVENT-ASV can be used in the hospital and during primary and secondary transport.

Contraindications for use

WARNING

Do *not* use the INTELLiVENT-ASV automatic PEEP/Oxygen adjustment if dyshemoglobin is expected or clearly evidenced, or if the difference between SaO₂ and SpO₂ is greater than 5%¹.

CAUTION

Do *NOT* use SpO₂ measurement and automated PEEP/Oxygen adjustments with patients having intravenous dyes.

Do NOT use INTELLiVENT-ASV if:

- The patient weight is under 7 kg
- There is airway leakage
- The INTELLiVENT-ASV target ranges for PetCO₂ and SpO₂ cannot be set according to your hospital protocol or to the patient's condition

¹ You can compensate for differences between SaO₂/SpO₂ and PaCO₂/PetCO₂ up to set limits. For details, see information about Target shift.

1.3 Preparing for ventilation with INTELLiVENT-ASV

 **WARNING**

- Additional ventilator-independent patient monitoring (for example, bedside vital monitoring or a blood gas analyzer) must be used during INTELLiVENT-ASV ventilation. Check PaCO₂ against displayed PetCO₂, and SaO₂ against SpO₂.
- The physician is responsible for final decisions.

Preparing for ventilation with INTELLiVENT-ASV comprises the following steps.

Table 1-1. Preparing for ventilation with INTELLiVENT-ASV, overview

To ...	See ...
Set up and enable the CO ₂ and SpO ₂ sensors	• Ventilator <i>Operator's Manual</i> • Pulse oximetry documentation • CO₂ documentation
Prepare the ventilator for operation, including performing the preoperational check	<i>Ventilator Operator's Manual</i>
Connect the patient	<i>Ventilator Operator's Manual</i>
Specify and confirm INTELLiVENT-ASV settings	Section 1.4
Start ventilation and monitor the patient	<i>Ventilator Operator's Manual</i>

1.4 Specifying INTELLiVENT-ASV settings

Once the ventilator is prepared for use and all tests are successfully completed, you are ready to set up INTELLiVENT-ASV for use.

You use the INTELLiVENT-ASV Settings window to specify patient data and automation choices, in addition to other options.

Navigating the window differs depending on whether you are setting up INTELLiVENT-ASV for the first time for the current patient or you are adjusting settings during active INTELLiVENT-ASV ventilation.

- When you first select the INTELLiVENT-ASV mode, you are guided through the setup process to enter patient information and adjust the INTELLiVENT-ASV settings as required for the patient.

The setup process then prompts you to fine-tune any control settings, and review and adjust alarm limits. You are prompted to confirm the settings on each window.
- When displayed:
 - Touching the **Back** button returns you to the previously displayed window.
 - Touching the **X** or **Cancel** buttons, or doing nothing for 1 minute, closes the INTELLiVENT-ASV Settings window and returns you to the previously selected mode.
- During active ventilation, you can access the INTELLiVENT-ASV Settings window at any time to make further adjustments. All of the tabs in the window are available and function the same way as during initial setup, except

that there are no **Back/Cancel/Continue/Confirm** buttons. Changes are applied as soon as you make them.

You can also adjust control settings and alarm limits at any time, same as with any other ventilation mode.

Specifying INTELLiVENT-ASV settings comprises the following steps.

Table 1-2. Specifying INTELLiVENT-ASV settings

	See...
Verify the patient settings in the Standby window.	Section 1.4.1
Select the INTELLiVENT-ASV mode.	Section 1.4.2
Select ventilation and oxygenation automation options.	Section 1.4.3
Select the patient condition, if needed.	Section 1.4.4
Select Quick Wean/SBT options.	Section 1.4.5
Specify additional settings (minimum Oxygen limit, upper and lower PEEP limits, and auto-recruitment).	Section 1.4.6
Review and adjust control settings.	Section 1.4.7
Review and adjust alarm limits.	Section 1.4.8
Adjust settings during active ventilation, if needed.	Section 1.4.9

1.4.1 Specifying patient data

NOTICE

When coming from Standby and **Last patient** is selected, the last-used settings are active, including patient height and gender, alarm limits, and control settings.

To specify patient data

- ▶ In the Standby window, choose the correct patient group, gender, and height.
If needed, you can adjust these settings during ventilation in the Controls > Patient window.

Be sure this data is accurate. It is used to calculate the patient's IBW, which is used by the INTELLiVENT-ASV controllers to regulate ventilation parameters.

You can fine-tune the settings at a later time, if needed.

For additional information, see the ventilator *Operator's Manual*.

1.4.1.1 Notes about exiting Standby

When starting ventilation from standby with a new patient selected and activating INTELLiVENT-ASV, the controllers (%Min-Vol, PEEP, and Oxygen) are set to default settings.

If you select **Last Patient** in the Standby window and start ventilating the patient, the system assumes the same settings that were in place before entering standby.

1.4.2 Selecting the INTELLiVENT-ASV mode

INTELLiVENT-ASV is an option in the ventilator Modes window.

To select the INTELLiVENT-ASV mode

1. Do either of the following:
 - Touch the mode name at the top left of the display.
 - Touch the **Modes** button at the top right of the display.
2. Touch the **INTELLiVENT-ASV** button.
3. Touch **Confirm**.

The INTELLiVENT-ASV Settings window (Figure 1-2) opens, displaying the **Auto** tab.

You can now select INTELLiVENT-ASV options.

1.4.3 Selecting ventilation/ oxygenation automation options

NOTICE

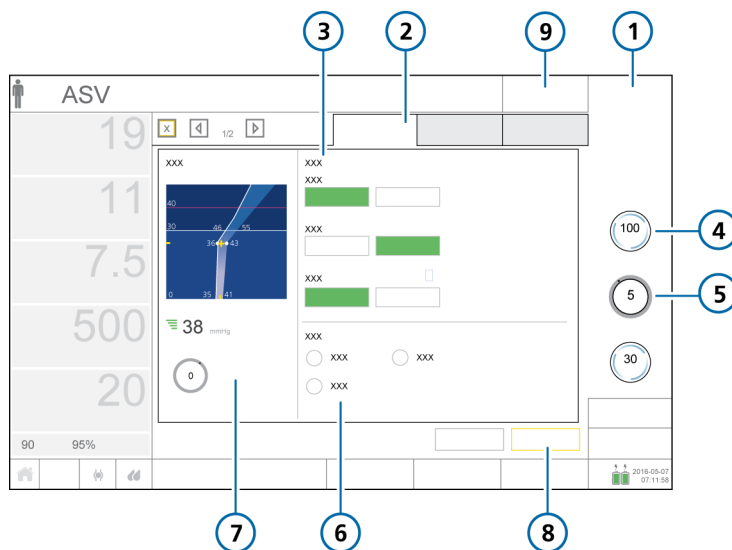
- Automated management of *all* controls is disabled if the patient weighs < 7 kg.
- Automated management of %MinVol is disabled when the CO2 sensor is disabled.
- Automated management of PEEP is disabled when:
 - Either the **Chronic Hypercapnia** or **Brain Injury** patient condition is selected. If **Chronic Hypercapnia** and **ARDS** are *both* selected, PEEP management can be automated.
 - The SpO2 sensor is disabled

- Automated management of **Oxygen** is disabled when:
 - The SpO2 sensor is disabled
 - The O2 cell is disabled

Use the INTELLiVENT-ASV Settings > Auto window to specify:

- Whether adjustments of one or more of the following controls should be performed automatically by the device or manually by the clinician: %MinVol, PEEP, and **Oxygen**
Sections 1.7 and 1.8 in this guide provide detailed information about how INTELLiVENT-ASV regulates these controls automatically.
- A patient condition (**ARDS**, **Chronic Hypercapnia**, or **Brain injury**)
- Shift the **PetCO2** and/or **SpO2** target zones, if needed

Figure 1-2. INTELLiVENT-ASV Settings window, Auto tab



- | | | | |
|---|--|---|--|
| 1 | Modes button | 6 | Patient condition options |
| 2 | Auto tab | 7 | Map panel showing either a Ventilation map (labeled CO ₂ elimination) in view 1 or an Oxygenation map in view 2 |
| 3 | Controller settings: Automatic, Manual buttons for %MinVol, PEEP, Oxygen | 8 | Cancel/Continue buttons (if displayed) |
| 4 | Automated management indicator and parameter value | 9 | Target button (to access the INTELLiVENT-ASV Settings window) |
| 5 | Manual management indicator and parameter value | | |

To set automation options for INTELLiVENT-ASV

- ✓ If you just selected the INTELLiVENT-ASV mode and are going through the initial setup process, start with step 2.
1. To open the INTELLiVENT-ASV Settings window, touch the **Target** button at the top right of the display, or touch an automated controller.

The Settings window opens, with the **Auto** tab selected, where you define automation settings and any applicable patient condition.

2. For each of the controls, %MinVol, PEEP, and Oxygen, choose whether management is performed by the device or by the operator:

- Touch **Automatic** to have INTELLiVENT-ASV regulate the control.

When you select **Automatic** for a given control, the appropriate map is displayed on the left: setting %MinVol to **Automatic** displays the ventilation map, and setting PEEP or **Oxygen** to **Automatic** displays the Oxygenation PEEP/SpO2 map.

- When **Oxygen** is set to **Automatic**, you can set an absolute lower limit that the controller will not fall below.

When PEEP is set to **Automatic**, you can set absolute upper and lower limits for the controller. You set these limits in the INTELLiVENT-ASV Settings > More window.

- When set to **Manual**, the device makes no adjustments to the control; it is operator controlled. This is the default setting.

3. Review the control settings on the right and, if desired, make any adjustments.
4. Continue to *Selecting patient conditions* if your patient has chronic hypercapnia, ARDS, or a brain injury.
If you are not setting any patient condition, continue to the next step.
5. If displayed, touch **Continue** to accept the settings and proceed to the next step.

1.4.4 Selecting patient conditions

The patient condition options affect some default CO2 elimination and oxygenation startup values and target settings. During initialization, settings are dynamically updated in real-time as you change the patient condition, and are reflected in the control values shown on the right side of the display as well as in the target zone of the associated Ventilation or Oxygenation map.

To specify patient conditions

- ✓ If you just selected the INTELLiVENT-ASV mode and are going through the initial setup process, start with step 2.

1. To open the INTELLiVENT-ASV Settings window, touch the **Target** button at the top right of the display, or touch an automated controller.

The Settings window opens, with the **Auto** tab selected.

2. Before proceeding, be sure to read the safety information related to selecting patient conditions, in Section 1.4.10.1.
3. *Only* if the patient has any special conditions, select one or more of the following entries: **ARDS**, **Chronic Hypercapnia**, **Brain injury**.

Selecting an entry changes the startup settings and targets for ventilation and/or oxygenation, and may affect whether regulation of PEEP can be automated. See Table 1-5.

The Maps panel (Section 1.5.1) on the left shows the CO2 elimination and oxygenation targets based on the patient condition selections you make.

4. Carefully review the PetCO₂ target range shown in the Ventilation map, and the SpO₂ target range shown in the Oxygenation map.

If needed, make adjustments using the **Target Shift** control (Section 1.4.10.3).

5. Review the control settings on the right and, if desired, make any adjustments.
6. Set automation options, as needed, if you haven't already done so.

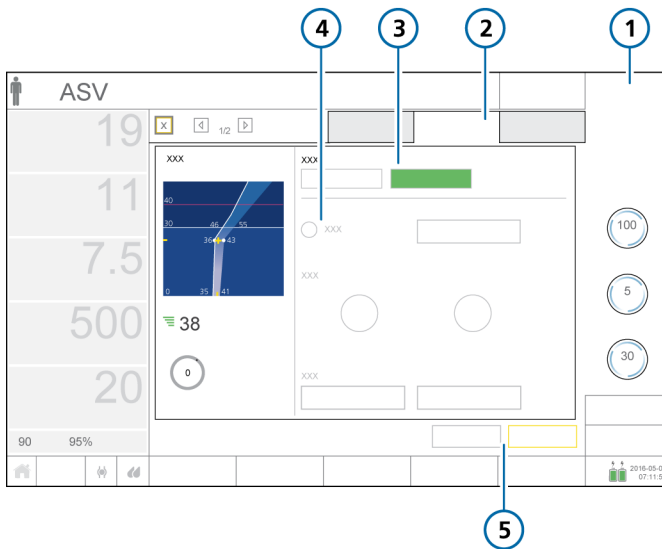
7. If displayed, touch **Continue** to accept the settings and proceed to the next step.

1.4.5 Selecting Quick Wean and SBT options

Quick Wean is not available if the patient condition selected in INTELLiVENT-ASV is **Brain injury**.

Use the INTELLiVENT-ASV Settings > Quick Wean window to specify Quick Wean and spontaneous breathing trial (SBT) settings, if desired.

Figure 1-3. INTELLiVENT-ASV Settings window, Quick Wean tab



- | | | | |
|---|--------------------|---|--|
| 1 | Modes button | 4 | Automatic SBT checkbox (unavailable when Quick Wean is disabled) |
| 2 | Quick Wean | 5 | Back/Continue buttons (if displayed) |
| 3 | Disabled (default) | | |

To enable/disable Quick Wean and automated SBTs

- ✓ If you just selected the INTELLiVENT-ASV mode and are going through the initial setup process, start with step 3.
- 1. To open the INTELLiVENT-ASV Settings window, touch the **Target** button at the top right of the display, or touch an automated controller.
The Settings window opens, with the **Auto** tab selected.
- 2. To display Quick Wean/SBT options, touch the **Quick Wean** tab (Figure 1-3).
- 3. Select whether to enable Quick Wean.
By default, Quick Wean is disabled.
To enable Quick Wean, touch the **Automatic** button. The target range of acceptable CO2 values is permanently shifted up to +5 mmHg to the right, depending on pressure, while Quick Wean is enabled. For details, see Chapter 2.
In addition, the Automatic SBT checkbox becomes available.
- 4. To enable automated SBTs and specify options, see Section 2.3.
Otherwise, continue to the next step.
- 5. If displayed, touch **Continue** to accept the settings and proceed to the next step.

1.4.6 Specifying additional settings

The INTELLiVENT-ASV Settings > More window provides access to additional INTELLiVENT-ASV options:

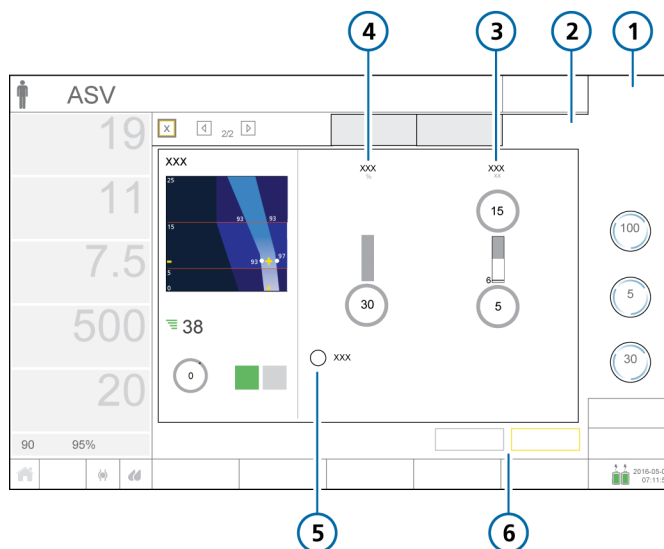
- Set the minimum **Oxygen** level (between 21% and 30%)
- Set an upper and/or lower PEEP limit
- Enable/disable auto-recruitment

The Oxygenation map is automatically displayed when you open the More window.

Table 1-3. More tab settings

Setting	Description
Oxygen limit	When the Oxygen control is set to Automatic , you can set an absolute lower limit that the Oxygen controller cannot fall below. The limit can be set between 21% and 30%. See Section 1.4.10.4.
PEEP limit control	When the PEEP control is set to Automatic , you can set an absolute upper limit that the PEEP controller cannot exceed, as well as an absolute lower limit that it cannot fall below. The minimum difference allowed between the low and high limit is 2 cmH2O. See Section 1.4.10.5.
Auto-recruitment	When the PEEP control is set to Automatic , you can enable automatic recruitment. For details, see Section 1.4.10.2. To enable auto-recruitment, touch the checkbox to select it. When auto-recruitment is enabled, the text auto-recruitment is displayed on the Oxygenation map and horizon (views 1 and 2). By default, auto-recruitment is disabled.

Figure 1-4. INTELLiVENT-ASV Settings window, More tab



- | | | | |
|---|--------------------|---|-------------------------------------|
| 1 | Modes button | 4 | Oxygen limit |
| 2 | More | 5 | Auto-recruitment |
| 3 | PEEP limit control | 6 | Back/Confirm buttons (if displayed) |

To set minimum oxygen limit, PEEP limit, and auto-recruitment options

- ✓ If you just selected the INTELLiVENT-ASV mode and are going through the initial setup process, start with step 3.
1. To open the INTELLiVENT-ASV Settings window, touch the **Target** button at the top right of the display, or touch an automated controller.
The Settings window opens, with the **Auto** tab selected.
 2. Touch the **More** tab (Figure 1-4).
 3. Set options as specified in Table 1-3.
 4. If displayed, touch **Confirm** to accept the settings and proceed to the next step, reviewing and adjusting control settings.

1.4.7 Adjusting control settings

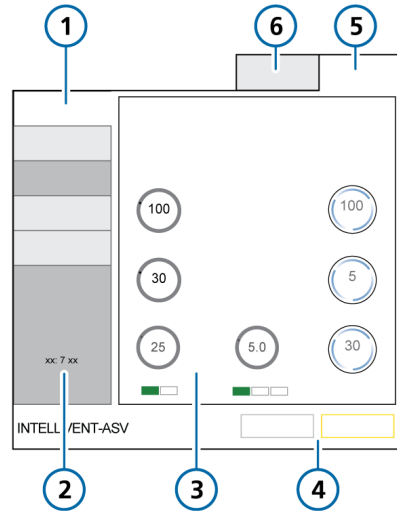
As with other modes, you can adjust parameter settings for INTELLiVENT-ASV. The controls are the same as in ASV.

During initial setup of INTELLiVENT-ASV, the Controls > Basic window opens automatically after you touch **Confirm** in the INTELLiVENT-ASV Settings > More window.

To adjust INTELLiVENT-ASV control settings

- ✓ If you just selected the INTELLiVENT-ASV mode and are going through the initial setup process, start with step 2.
- 1. To open the Controls window, touch the **Controls** button at the bottom right of the display.
The contents of the **Basic** tab are displayed by default.
- 2. Adjust any settings as needed.
- 3. Touch the **More** tab to enable or disable **Sigh**, as needed.
- 4. Touch the **TRC** tab to adjust any settings as needed.
For details on tube resistance compensation, see your ventilator *Operator's Manual*.
- 5. Touch the **Patient** tab to review patient data (height, gender), to ensure the correct **IBW** is calculated.
You can also access the Patient window by touching the patient icon at the top left of the display.
For details, see your ventilator *Operator's Manual*.
- 6. If displayed, touch **Confirm** to accept the settings and proceed to the next step, reviewing and adjusting alarm limits.

Figure 1-5. INTELLiVENT-ASV Controls window, Basic tab



- | | |
|--|---|
| 1 Basic | 4 Cancel/Confirm buttons (if displayed) |
| 2 Current minute volume | 5 Modes |
| 3 Control settings: P-ramp, Pasvlimit, ETS, Trigger, %MinVol, PEEP, Oxygen | 6 Target |

1.4.8 Adjusting alarm limits

⚠ WARNING

- Set all alarms to clinically acceptable values, especially **Pressure**, **ExpMinVol**, **SpO2**, and **PetCO2**.
- To prevent patient injury, periodically review all alarm settings.

NOTICE

You can suppress the physiological PetCO₂ and SpO₂ alarms for 2 minutes by pressing the Audio Pause key, in the same manner as other alarms on the ventilator. For details, see the chapter, *Responding to alarms*, in your ventilator *Operator's Manual*.

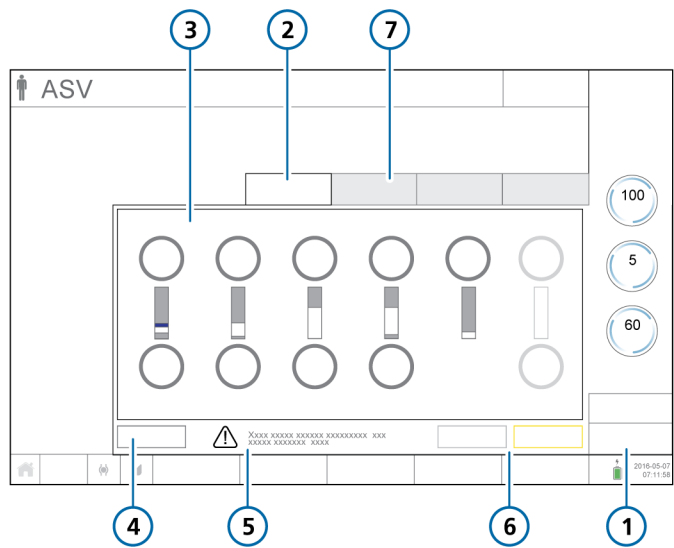
As with other modes, you can adjust alarm limits for INTELLiVENT-ASV. The Limits 1 window contains the general alarm settings, as well as the Oxygen level

notification control. The Limits 2 window contains the PetCO₂- and SpO₂-related alarm settings.

For additional information:

- For details about Oxygen level notification, see Section 1.4.10.6.
- For troubleshooting, see Section 1.6.
- For detailed information about alarms, including default settings and ranges, see your ventilator *Operator's Manual* and the *Pulse Oximetry Instructions for Use*.

Figure 1-6. Setting alarm limits



- | | | | |
|---|----------------------|---|--------------------------------------|
| 1 | Alarms | 5 | Safety notice |
| 2 | Limits 1 | 6 | Back/Continue buttons (if displayed) |
| 3 | Alarm limit controls | 7 | Limits 2 |
| 4 | Auto button | | |

To adjust INTELLiVENT-ASV alarm limits

- ✓ If you just selected the INTELLiVENT-ASV mode and are going through the initial setup process, start with step 2.
- 1. To open the Alarms window, touch the **Alarms** button at the bottom right of the display.
The contents of the **Limits 1** tab are displayed by default.
- 2. Adjust any limits as needed.
- 3. Touch the **Limits 2** tab to review and adjust additional alarm limits.
- 4. To set alarm limits automatically, touch the **Auto** button.
Selecting **Auto** automatically sets alarm limits around the current monitoring parameter values, except for the following alarm limits: **Apnea**, **Vt**, **SpO2**, **Pulse**, and **PI**. These alarm limits remain unchanged, and must be set manually to the desired level.
- 5. If displayed, touch **Confirm** to accept the settings and proceed to the next step.

INTELLiVENT-ASV setup is now complete.

1.4.9 Adjusting settings during active ventilation

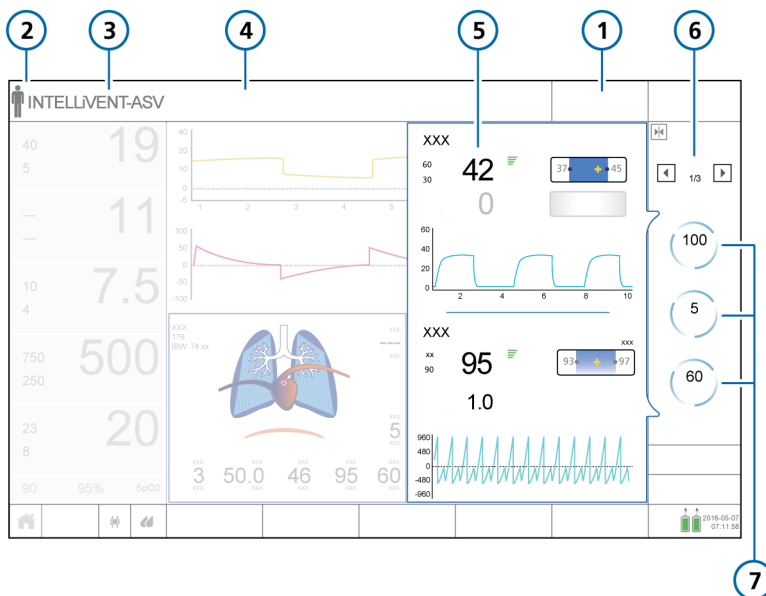
During active ventilation, you can adjust INTELLiVENT-ASV settings at any time.

You can also review the Ventilation/Oxygenation maps and horizons, guides, plethysmogram, capnogram, and Quick Wean-related views (when enabled).

All of the tabs in the INTELLiVENT-ASV Settings window are available and function the same way as during initial setup, except that there are no **Cancel/Back**, **Continue/Confirm** buttons. Changes are applied as soon as you make them.

You can also adjust control settings and alarm limits at any time, same as with any other ventilation mode. For details, refer to your ventilator *Operator's Manual*.

Figure 1-7. Active ventilation with INTELLiVENT-ASV



- | | | | |
|---|--|---|--|
| 1 | Touch Target to open the INTELLiVENT-ASV Settings window | 5 | Ventilation and Oxygenation horizons, with capnogram and plethysmogram |
| 2 | Touch the patient icon to open the Patient window | 6 | View navigation buttons and number |
| 3 | Touch the mode name or the Mode button to open the Modes window | 7 | Controls managed by INTELLiVENT-ASV |
| 4 | Alarm message bar | | |

To display the INTELLiVENT-ASV Settings window

- At any time during ventilation with INTELLiVENT-ASV, touch the **Target** button at the top right of the display, or touch one of the automated controllers.
The INTELLiVENT-ASV Settings window opens, with the **Auto** tab selected (Figure 1-2).
- Make changes as desired on any of the tabs.
- To review or change control settings, touch the **Controls** button and make changes as needed.
- To review or change alarm settings, touch the **Alarms** button and make changes as needed.

1.4.10 About INTELLiVENT-ASV settings

The following sections provide details about the following features:

Settings	See ...
Patient conditions	Section 1.4.10.1
Auto-recruitment maneuvers	Section 1.4.10.2
Target shift	Section 1.4.10.3
PEEP limit	Section 1.4.10.5
Oxygen limit	Section 1.4.10.4
Oxygen level notification (Oxygen msg %)	Section 1.4.10.6

1.4.10.1 About patient conditions

CAUTION

- *Select the Chronic Hypercapnia and/or ARDS patient condition only if the patient has one of these conditions; in case of doubt, do NOT select either of these options.*
- *Always select Brain injury if you are sure that the patient has this condition. If the patient suffers from a brain injury but the Brain injury option is not selected, increased CO₂ levels and high cranial pressure might result. Carefully monitor intracranial pressure when available.*
- *If Brain Injury is selected but the patient is to be ventilated normally, the patient will be slightly hyperventilated and increased peak pressures might occur.*

NOTICE

- If **Brain injury** is selected, the ventilation controller (%MinVol) regulates in accordance with the measured **PetCO₂** signal even if the patient is breathing spontaneously.
- The **Brain injury** target range has the highest priority of all patient conditions.
- If either the **Chronic Hypercapnia** or **Brain injury** patient condition is selected, management of PEEP cannot be automated; you must manually set the desired PEEP level. If **Chronic Hypercapnia** and **ARDS** are *both* selected, PEEP management can be automated.

Patient conditions are used in INTELLiVENT-ASV to determine:

- Startup settings to use for %MinVol, PEEP, and Oxygen
- Whether PEEP can be automated or must be manually controlled
- PetCO₂ and SpO₂ target ranges
- %MinVol for active patients, based on fSpont or PetCO₂ (if Brain Injury selected)

For details about selecting patient conditions, see Section 1.4.4.

Table 1-4 lists the patient conditions available in the INTELLiVENT-ASV Settings window. For patients with mixed conditions, you can select more than one option.

Table 1-4. Patient conditions in INTELLiVENT-ASV

Patient condition	Description
Normal patient	No condition selected
ARDS	Acute respiratory distress syndrome, which presents as an acute, severe injury to most segments of the lung
Chronic Hypercapnia	For patients with chronically high arterial CO ₂ values, usually as a result of obstruction in airways due to chronic bronchitis, emphysema, or both
Mixed (ARDS and Chronic Hypercapnia)	For patients with both listed conditions
Brain Injury	Patients with brain injuries with whom it is critical to maintain CO ₂ under strict control to keep intracranial pressures at safe levels, and to keep oxygenation within a normal range

Table 1-5 provides an overview of the values set for startup and during ventilation. Startup values all depend on the selected patient condition(s).

In all cases, Quick Wean and auto-recruitment are disabled at startup.

Table 1-5. Patient conditions and startup values for ventilation

Patient condition	Ventilation	Oxygenation	
	%MinVol startup value (%)	Oxygen startup value (%)	PEEP startup value (cmH ₂ O) ²
Normal	100	60	5
ARDS	120	100	8
Chronic Hypercapnia	100	60	Manually controlled
ARDS + Chronic Hypercapnia	120	100	8
Brain Injury	100	60	Manually controlled

² Control of settings not explicitly marked as *Manual* can be automated.

1.4.10.2 Automatic recruitment maneuvers

CAUTION

Check for pneumothorax and potential susceptibility to pneumothorax before ventilating the patient. Automatic PEEP adjustment during recruitment maneuvers can lead to an increase in ventilation pressure levels.

Automatic recruitment is a strategy for re-expanding collapsed lung tissue, and then maintaining higher PEEP to prevent subsequent "de-recruitment". To recruit collapsed lung tissue, sufficient pressure must be imposed to exceed the critical opening pressure of the affected lung.

Automatic recruitment in INTELLiVENT-ASV, called *auto-recruitment*, is an optional function designed to reopen collapsed lung units in severely hypoxemic patients, such as those with ARDS.

The ventilator automatically performs a recruitment maneuver when a second consecutive PEEP increase is required *and* the following conditions are met:

- PEEP controller is set to **Automatic**
- Auto-recruitment is enabled
- The patient is *not* breathing spontaneously; that is, the patient is passive
- Monitored SpO2 is below the target range (that is, the patient is hypoxemic)
- The ventilator has made two consecutive PEEP increases, according to the automated PEEP regulation rules
- The set maximum PEEP has not been reached

When these conditions are met, the ventilator performs a recruitment maneuver. PEEP is increased to 40 cmH2O and held for 20 seconds; PEEP is then decreased to the appropriate setting according to the automated PEEP regulation rules.

Auto-recruitment maneuvers occur after two consecutive automatic increases of PEEP of 1 cmH2O. This means the recruitment maneuver cycle occurs no more often than once every 12 minutes. As soon as a recruitment maneuver is performed, the device generates a **Recruitment maneuver in progress** message.

Note that use of the P/V Tool also counts as a recruitment maneuver.

By default, auto-recruitment is disabled, and must be manually enabled for use.

To enable or disable auto-recruitment

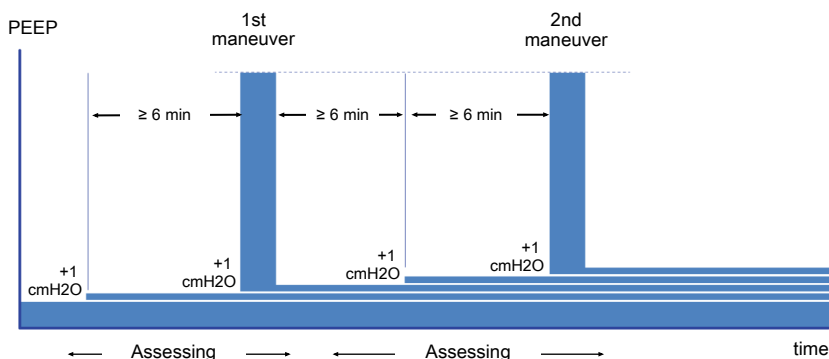
- ▶ In the INTELLiVENT-ASV Settings > More window, touch the **Auto-recruitment** checkbox. See Figure 1-4.

When auto-recruitment is enabled, the text **auto-recruitment** is displayed on the Oxygenation maps and horizon.

Important:

- During the recruitment maneuver, all patient alarms are suppressed.
- The maneuver is canceled if a flow sensor failure or any pneumatic disconnection is detected.
- No recruitment maneuver takes place if any of the following occurs:
 - PEEP is manually changed
 - The patient is active

Figure 1-8. Recruitment maneuver cycle



1.4.10.3 Target shift

CAUTION

- Regularly check the patient after specifying a $P_{et}CO_2$ or SpO_2 target shift to verify that the range is still appropriate for the current patient condition.
- Changing the target range and NOT monitoring the patient's progress can increase risk of hyper- or hypoventilation or hyper- or hypoxemia.

INTELLiVENT-ASV uses PetCO₂ and SpO₂ as monitoring inputs for regulation of ventilation and oxygenation, and works to keep the patient within the target range for these values.

These target ranges are shown in the Ventilation and Oxygenation maps and horizons. INTELLiVENT-ASV adjusts ventilation and oxygenation controls to bring the patient to the middle of the set range.

In general, PetCO₂ and SpO₂ values represent a reliable index of CO₂ partial pressure in the arterial blood (PaCO₂) and partial pressure of dissolved oxygen in the arterial

blood (PaO₂), respectively (measured using blood gas analysis (BGA)). To get the most accurate approximation of PaCO₂, the second highest PetCO₂ value out of 8 breaths is used.

Under normal conditions, PaCO_2 is approximately 3-5 mmHg higher than PetCO_2 — the difference between the values is referred to as the *$\text{PaCO}_2\text{-PetCO}_2$ gradient*. Under special clinical conditions (such as shunt), the $\text{PaCO}_2\text{-PetCO}_2$ gradient can increase, requiring adjustment of the ventilation targets.

The **Target Shift** control allows you to move the PetCO₂ and SpO₂ target ranges to the left (lower values) or to the right (higher values), within the limits defined in Tables 1-6 and 1-7. INTELLiVENT-ASV always tries to bring patient values to the middle of the specified range.

When determining the appropriate PetCO₂ target range for your patient, keep the following considerations in mind (described in more detail with examples):

- Is the displayed PetCO₂ target range appropriate for your patient?
- Is the PaCO₂-PetCO₂ gradient outside of the physiologic normal range?

Is the displayed PetCO₂ target range appropriate for your patient?

Check whether one of the patient conditions applies to your patient. If so, select the condition. If the range is still inadequate for your patient, use the **Target Shift** control to adjust the target range as needed to set the appropriate limits.

Example

If INTELLiVENT-ASV sets the PetCO₂ target range to 40–50 mmHg and:

- The ideal PetCO₂ target for the patient is 50 mmHg, consider setting the Target Shift to +5 to move the target range 5 mmHg to the right, to 45–55 mmHg.
- The ideal PetCO₂ target for the patient is 30 mmHg, consider setting the Target Shift to -15 to move the target range 15 mmHg to the left, to 25–35 mmHg.

Is the PaCO₂-PetCO₂ gradient outside of the physiologic normal range?

If the difference between the two is greater than 3-5 mmHg, consider adjusting the PetCO₂ target range to achieve the desired PaCO₂ value.

Example

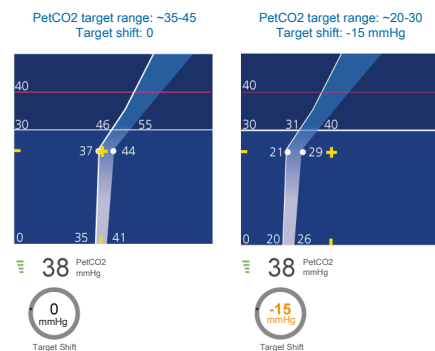
Assume the following patient conditions apply:

Measured PetCO₂ = 38 mmHg³
PaCO₂ from the BGA = 60 mmHg
Target PaCO₂ = 40-50 mmHg

The PaCO₂-PetCO₂ gradient at 17 mmHg⁴ is well outside the normal range.

In this case, consider setting the Target Shift to -15⁵ to move the PetCO₂ target range 15 mmHg to the left, for a target range between 20 and 30 mmHg.

Figure 1-9. Target shift example



INTELLiVENT-ASV makes adjustments to try to get the patient's PetCO₂ values to the middle of the target range, which in this case should result in PaCO₂ values within the desired 40 to 50 mmHg target PaCO₂.

You can adjust the SpO₂ target range in the same manner.

³ PetCO₂ is in the middle of the target range.

⁴ 60 - 38 - 5 = 17

⁵ 60 (current PaCO₂ from BGA) - 45 (middle of target PaCO₂ range) = 15 shift to the left

Table 1-6. PetCO₂ target shift limits

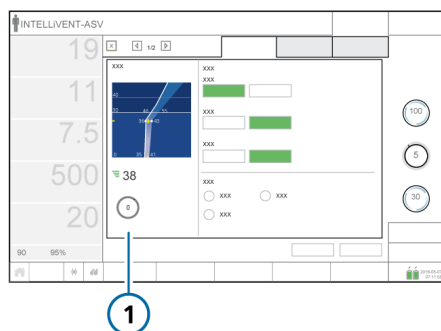
PetCO ₂ target shift limits	
All patient conditions	-20 mmHg to 10 mmHg

Table 1-7. SpO₂ target shift limits based on patient condition

SpO ₂ target shift limits ⁶	
Normal	-5% to +4%
ARDS	-2% to +4%
Chronic Hypercapnia	-2% to +5%
Mixed (Chronic Hypercapnia + ARDS)	-2% to +5%
Brain Injury	-2% to +2%

The **Target Shift** control is located in the Ventilation and Oxygenation map panel on the left side of the INTELLiVENT-ASV Settings window.

Figure 1-10. Target Shift control (1)



To shift the target zone to the left or to the right

1. To open the INTELLiVENT-ASV Settings window, touch the **Target** button or an automated controller.
2. Display the appropriate map: Ventilation (PetCO₂ target range) or Oxygenation (SpO₂ target range) using the View arrows in the INTELLiVENT-ASV Settings window.
3. Touch the **Target Shift** control and adjust the target range limits; then accept the value.
 - Setting the value to a positive number shifts the target range to the right, targeting a higher PetCO₂ or SpO₂.
 - Setting the value to a negative number shifts the target range to the left, targeting a lower PetCO₂ or SpO₂.
 - To shift the PetCO₂ target range to a value beyond ± 5 mmHg, set the value now to +5 or -5, as needed.
4. To shift the PetCO₂ target range beyond ± 5 mmHg, touch the **Target Shift** control again and set the value as desired; then accept the value.

The change is applied immediately and is visible in the associated Ventilation or Oxygenation map. During ventilation, the applied target shift is displayed on the associated map.

The PetCO₂ **Target Shift** value and text is displayed in different colors depending on the setting.

⁶ If a change in patient condition would cause the existing limit to be exceeded, the target shift is automatically reduced to comply with the new conditions.

Table 1-8. Target shift display

Target Shift control	Text color and description
	Black text. Target shift is 0; there is no change to the target range values.
	Yellow text. Target shift is between ± 1 and ± 5 .
	Orange text. Target shift is greater than ± 5 .

1.4.10.4 Minimum Oxygen limit

When the **Oxygen** controller is set to **Auto-matic**, you can set an absolute lower limit for Oxygen; Oxygen will not fall below this limit.

To set the minimum Oxygen limit

- ▶ In the INTELLiVENT-ASV Settings > More window, set the limit to any value between 21% and 30%.

The default setting is 30%.

1.4.10.5 PEEP limit

When the PEEP controller is set to **Auto-matic**, the PEEP limit control allows you to define an absolute high limit that the PEEP controller cannot exceed. If enabled, you can also specify an absolute low limit for PEEP; PEEP will not fall below this limit, listed in Table 1-9.

Note that the minimum difference between the low and high limit is 2 cmH2O.

Table 1-9. PEEP limit control settings

PEEP limit control range (cmH2O)	Default (cmH2O)
Low: 5 to 22	Low: 5
High: 7 to 24	High: 15

If the patient condition **Chronic Hypercapnia** or **Brain injury** is selected, you set PEEP manually.

To set PEEP limits

- ▶ In the INTELLiVENT-ASV Settings > More window, set the desired high and/or low PEEP limits. See Figure 1-4.

1.4.10.6 Oxygen level notification

When the **Oxygen** controller is set to **Auto-matic**, you can specify an oxygen level that, when exceeded, generates a medium-priority alarm message that is displayed in the message bar.

The Oxygen message control is only a notification tool; it *does not* affect the percentage of delivered oxygen.

This threshold is set using the **Oxygen msg** control in the Alarms > Limits 2 window. See Section 1.4.8.

1.5 Monitoring INTELLiVENT-ASV

CAUTION

Check the patient's condition periodically to assess readiness for weaning.

NOTICE

- If the **PetCO₂** signal is NOT reliable, the automated **%MinVol** controller freezes after 30 seconds. See Section 1.7.4.
- If the **SpO₂** signal is NOT reliable, the automated **PEEP** and **Oxygen** controls freeze after 30 seconds. See Section 1.8.4.

INTELLiVENT-ASV provides easy access to numerical and graphical monitoring data. Data is shown on the main display in the Monitoring window, in the various graphic panels (trends, Dynamic Lung, Vent Status, plethysmogram, capnogram), and in the INTELLiVENT-ASV-specific windows, including the Ventilation/Oxygenation maps and horizon graphs.

Note that trend graphs for **PetCO₂**- and **SpO₂**-related parameters, as well as for the ventilation and oxygenation controller settings are also available. For details, see Section 1.5.7.

The following sections provide details about the Ventilation and Oxygenation maps and horizon graphs. For details about the Quick Wean-related views, see Chapter 2.

For details about other ventilator graphics and displays (for example, the Dynamic Lung, Vent Status panel, waveforms, and the Monitoring window), see your ventilator *Operator's Manual*.

1.5.1 About the INTELLiVENT-ASV windows and views

INTELLiVENT-ASV provides a graphical overview of CO₂ elimination (ventilation) and oxygenation, as well as other INTELLiVENT-related data on the main display in specialized windows.

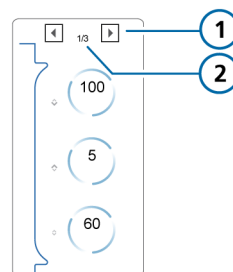
Most of these windows are displayed as a series of views that you can cycle through during ventilation.

To display view windows

- Touch the left or right view navigation button to cycle through the views.

The view number is displayed between the buttons.

Figure 1-11. Displaying INTELLiVENT-ASV views



- 1 View navigation buttons 2 View number

The following table describes the INTELLiVENT-ASV windows, as well as where they are displayed.

Table 1-10. INTELLiVENT-ASV views, overview

View	Description	See ...
Ventilation map	Shows the current patient PetCO₂ value and target range in relation to Ppeak, together with the set limits. The map is shown: • In the INTELLiVENT-ASV Settings window, in view 1 • During active ventilation in view 2	Section 1.5.2 For details about the rules used to regulate CO₂ elimination, see Section 1.7.
Ventilation horizon	For a passive patient, shows a zoom into the map at the current PetCO₂ value and target range. For an active patient, the spontaneous breathing rate is displayed (fSpont). The horizon is shown during active ventilation in view 1.	Section 1.5.3
Oxygenation maps	Two maps are available: • The PEEP/SpO₂ view shows the current patient SpO₂ value and the target range in relation to PEEP, together with the set limits. • The FiO₂/PEEP view shows the patient's current combination of Oxygen/PEEP values, together with the set limits. The selected map is shown: • In the INTELLiVENT-ASV Settings window, in view 2 • During active ventilation in view 2	Section 1.5.4 For details about the rules used to regulate oxygenation, see Section 1.8.
Oxygenation horizon	Shows a zoom into the map at the current SpO₂ value and target range. The horizon is shown during active ventilation in view 1.	Section 1.5.5

View	Description	See ...
Plethysmogram	Provides a real-time waveform that represents the pulsating blood volume. A plethysmogram is shown: • During active ventilation in views 1 and 3 • As a waveform on the main display, if selected	Section 1.5.6
Capnogram	Provides a real-time CO ₂ waveform. A capnogram is shown: • During active ventilation in views 1 and 3 • As a waveform on the main display, if selected	Section 1.5.6
Quick Wean related		
Quick Wean, Quick Wean & SBT status	Shows the status for SBT- and weaning-related parameters.	Section 2.4.4.1
SBT history	The SBT history panel is shown during active ventilation in view 3.	Section 2.4.4.2

1.5.2 About the Ventilation (CO₂ elimination) map

The INTELLiVENT-ASV ventilation controller monitors end-tidal CO₂ (PetCO₂), and uses this data to adjust %MinVol to regulate CO₂ elimination, according to the detailed rules and conditions described in Section 1.7.

The INTELLiVENT-ASV ventilation controller uses a predefined end-tidal CO₂ target schema with peak pressure (P_{peak}) on the y-axis and PetCO₂ on the x-axis. Peak pressure is the sum of PEEP and the inspiratory pressure set by the controller.

This schema is called the *Ventilation* map. In the map, the yellow cross is the patient symbol denoting the patient's current measured PetCO₂ value at the current peak pressure. The boomerang shaped

area of the graph is the target range, which denotes a range of values at a given peak pressure.

1.5.2.1 Reviewing the Ventilation map

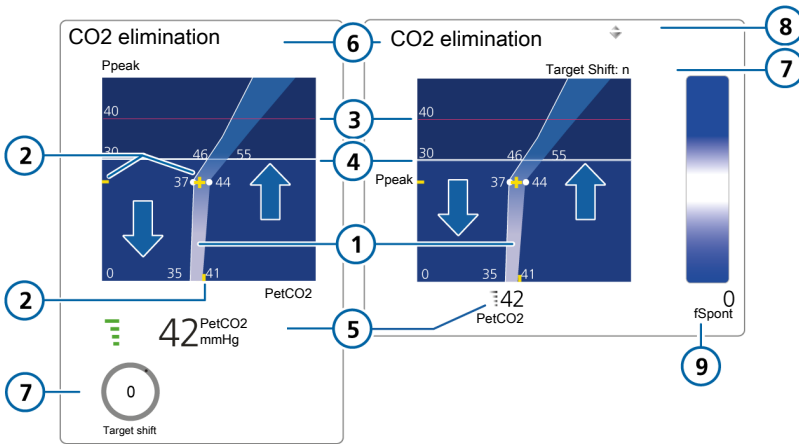
NOTICE

The maximum P_{peak} value that can be shown on the Ventilation map is 50 cmH₂O, so in some cases, the map may not show the patient symbol. INTELLiVENT-ASV is running, however.

The Ventilation map is available in two locations:

- INTELLiVENT-ASV Settings window, in view 1
- During active ventilation with INTELLiVENT-ASV, in view 2

Figure 1-12. Ventilation map, INTELLiVENT-ASV Settings window (left), main display during active ventilation (right)



- | | |
|--|--|
| 1 Target zone | 6 Map title: CO2 elimination |
| 2 Yellow patient symbol (cross) and current patient values | 7 Target Shift. When set, the map in view 2 shows the setting (<i>Target Shift: n > or Target Shift: < n</i>) |
| 3 High pressure alarm limit | 8 When %MinVol is increasing (^) or decreasing (v), the appropriate indicator appears. When the arrows are the same size, %MinVol is in target zone. |
| 4 Pressure limitation: Pasvlimit | 9 For active patient: target range and current fSpont value |
| 5 Current measured PetCO2 value and quality index | |



The blue arrows are for clarification purposes only; they do not appear on the display. Up arrow: Increase zone (PetCO2 too high, increase %MinVol); Down arrow: Decrease zone (PetCO2 too low, decrease %MinVol).

To display the Ventilation map in the INTELLiVENT-ASV Settings window

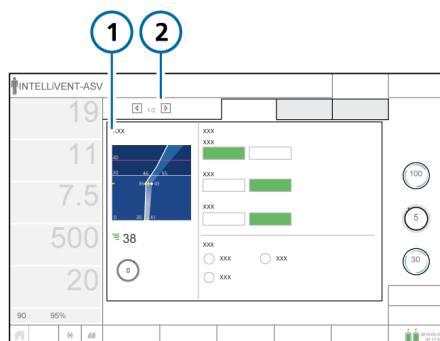
1. To open the INTELLiVENT-ASV Settings window, touch the **Target** button at the top right of the display, or touch an automated controller.

The Settings window opens, with the **Auto** tab selected.

2. If the Ventilation (CO₂ elimination) map is not already displayed, touch the left view navigation arrow at the top left of the window to display view 1.

The panel shows the Ventilation map, measured PetCO₂ value, and the **Target Shift** control.

Figure 1-13. Ventilation map, INTELLiVENT-ASV Settings window



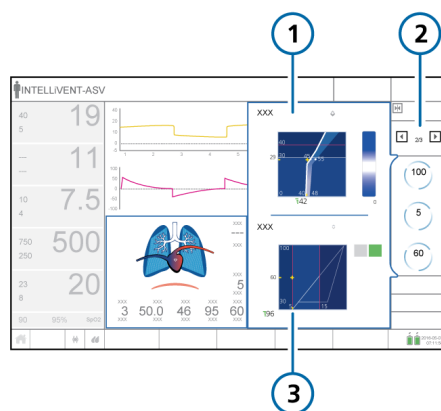
- 1 Ventilation map
- 2 View arrows and current view number

To display the Ventilation map while INTELLiVENT-ASV is running

- If it is not already displayed, touch the view navigation arrows at the right of the display or swipe right on the display until view 2 is displayed.

View 2 shows the Ventilation map and measured PetCO₂ value.

Figure 1-14. Ventilation map, in main display during active ventilation

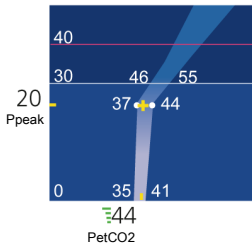


- 1 Ventilation map
- 2 View arrows and current view number
- 3 Oxygenation map

1.5.2.2 About the PetCO₂ target zone

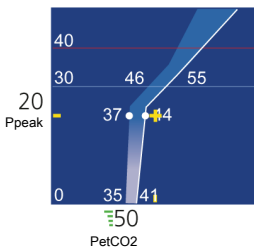
At a very basic level, the ventilation controller attempts to keep the patient in the target zone as described here.

The Ventilation map provides examples of each situation: PetCO₂ is within, above, or below the target zone.



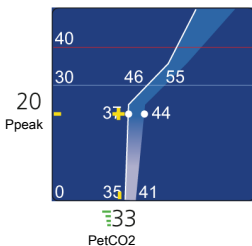
Patient symbol within the PetCO₂ target zone

When the patient symbol is within the target zone, the %MinVol is fine tuned to get the patient to the middle of the target range.



Patient symbol above the PetCO₂ target zone

When the patient symbol is to the right of the target zone (in the increase zone, PetCO₂ is too high), the %MinVol setting increases.



Patient symbol below the PetCO₂ target zone

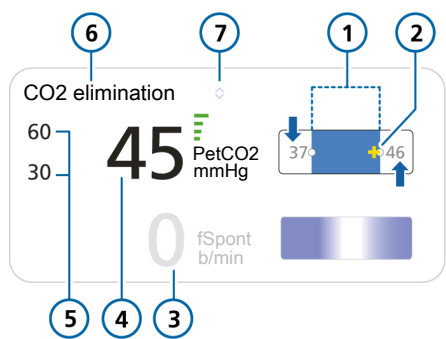
When the patient symbol is to the left of the target zone (in the decrease zone, PetCO₂ is too low), the %MinVol setting decreases.

1.5.3 About the Ventilation horizon

For a passive patient, the Ventilation horizon shows a simplified view of the same data as the Ventilation map, together with the upper and lower PetCO2 alarm limits.

When the patient is active, the horizon shows spontaneous breathing activity (fSpont).

Figure 1-15. Ventilation horizon, passive patient

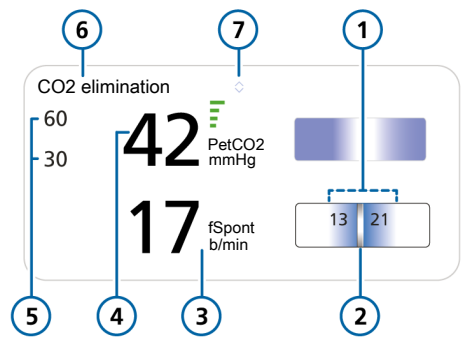


- | | | | |
|---|---|---|--|
| 1 | Target zone, showing upper and lower boundaries | 5 | Upper and lower PetCO2 alarm limits |
| 2 | Patient symbol (yellow) showing current value | 6 | Horizon title: CO2 elimination |
| 3 | fSpont value (0) | 7 | When %MinVol is increasing (^) or decreasing (v), the appropriate indicator appears. When the arrows are the same size, %MinVol is in the target zone. |
| 4 | Current measured PetCO2 value and quality index | | |



The blue arrows are for clarification purposes only; they do not appear on the display. Up arrow: Increase zone (PetCO2 too high, increase %MinVol); Down arrow: Decrease zone (PetCO2 too low, decrease %MinVol).

Figure 1-16. Ventilation horizon, active patient

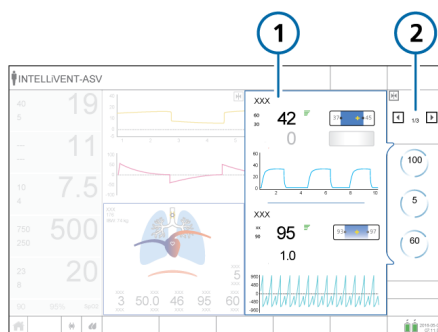


- | | | | |
|---|---|---|--|
| 1 | Spontaneous breathing target zone, showing upper and lower boundaries | 5 | Upper and lower PetCO2 alarm limits |
| 2 | Patient symbol (floater) showing current value | 6 | Horizon title: CO2 elimination |
| 3 | Current measured fSpont value | 7 | When %MinVol is increasing (^) or decreasing (v), the appropriate indicator appears. When the arrows are the same size, %MinVol is in the target zone. |
| 4 | Current measured PetCO2 value and quality index | | |

The appropriate Ventilation horizon (for active or passive patient) is shown on the main display during active ventilation, in view 1.

For details about the rules governing automated %MinVol adjustments, see Section 1.7.

Figure 1-17. Ventilation horizon, during active ventilation



- 1 Ventilation horizon
- 2 View arrows and current view number

1.5.4 About the Oxygenation maps

The INTELLiVENT-ASV oxygenation controller monitors SpO₂, and uses this data to adjust PEEP and Oxygen to regulate oxygenation, according to the detailed rules and conditions described in Section 1.8.

We use the term *treatment* to refer to the joint effect of PEEP and Oxygen:

- *Increasing treatment* refers to changes to PEEP and/or Oxygen that cause SpO₂ to increase. The controller makes these changes based on ARDSnet guidelines.
- *Decreasing treatment* refers to changes in these control values that cause SpO₂ to decrease. The controller makes these changes based on the Open Lung concept.

The INTELLiVENT-ASV oxygenation controller uses two predefined schemas, referred to as the *Oxygenation maps*.

The *PEEP/SpO₂ target* schema shows PEEP on the y-axis and SpO₂ on the x-axis. The yellow cross is the patient symbol denoting the patient's current measured SpO₂ value at the current PEEP. The boomerang shaped area of the graph is the target zone, which denotes a range of SpO₂ values at a given PEEP.

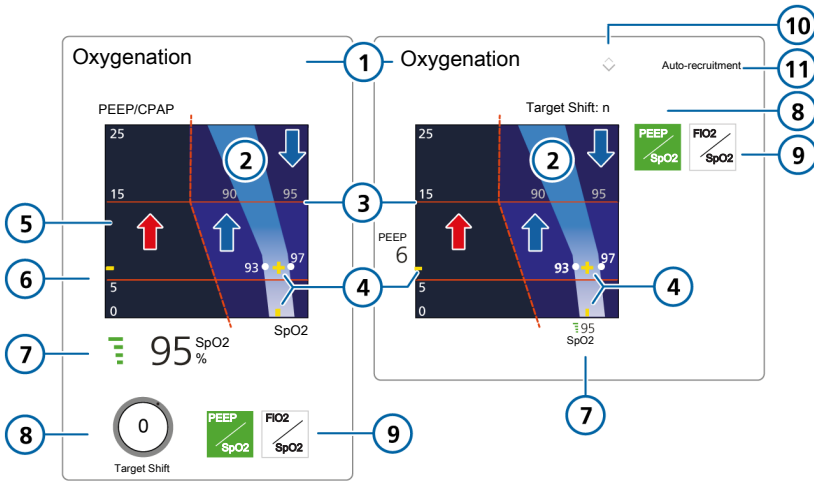
The *FiO₂/PEEP* schema shows Oxygen on the y-axis and PEEP on the x-axis. The yellow cross is the patient symbol denoting the patient's current measured combination of Oxygen/PEEP values. The triangular PEEP/Oxygen curve shows the target treatment levels, depending on whether treatment remains unchanged, increases, or decreases.

1.5.4.1 Reviewing the Oxygenation maps

The Oxygenation maps (PEEP/SpO₂ and FiO₂/PEEP) are available in two locations:

- INTELLiVENT-ASV Settings window, in view 2
- During active ventilation with INTELLiVENT-ASV, on the main display in view 2

Figure 1-18. Oxygenation map, PEEP/SpO₂, in INTELLiVENT-ASV Settings window (left), main display during active ventilation (right)

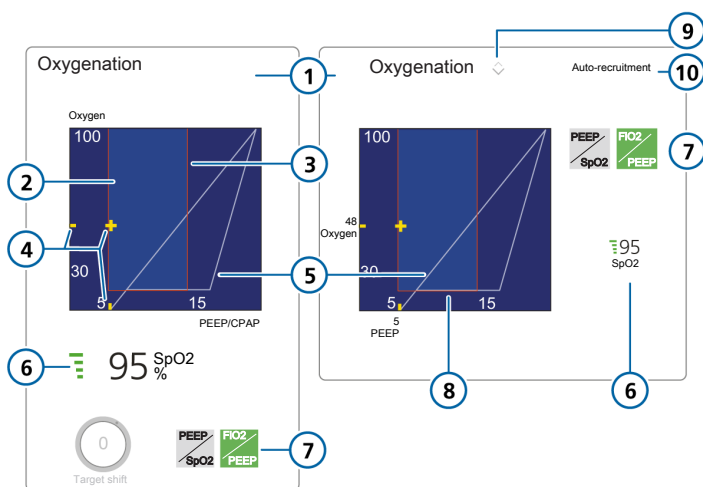


- | | |
|--|---|
| 1 Map title: Oxygenation | 7 Current measured SpO ₂ value and quality index |
| 2 Target zone | 8 Target Shift. When set, the map in the main display shows the setting (<i>Target Shift: n</i> > or <i>Target Shift: < n</i>) |
| 3 Upper PEEP limit | 9 Oxygenation map selection button: PEEP/SpO ₂ |
| 4 Yellow patient symbol (cross) and current patient values | 10 When PEEP or Oxygen is increasing (^) or decreasing (v), the appropriate indicator appears. When the arrows are the same size, SpO ₂ is in target zone. |
| 5 Dark blue emergency zone | 11 When auto-recruitment is enabled, text is displayed on the map |
| 6 Lower PEEP limit | |



The red/blue arrows and dotted line are for clarification purposes only; they do not appear on the display. Blue up arrow: Increase treatment zone. Blue down arrow: Decrease treatment zone. Red arrow: Emergency increase zone (dark blue area), Oxygen set to 100%.

Figure 1-19. Oxygenation map, FiO2/PEEP, in INTELLiVENT-ASV Settings window (left), main display during active ventilation (right)

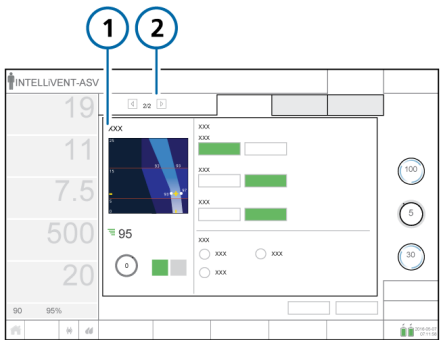


- | | |
|--|--|
| 1 Map title: Oxygenation | 6 Current measured SpO2 value and quality index |
| 2 Lower PEEP limit | 7 Oxygenation map selection button: FiO2/PEEP |
| 3 Upper PEEP limit | 8 Lower Oxygen limit |
| 4 Yellow patient symbol (cross) and current patient values | 9 When PEEP or Oxygen is increasing (^) or decreasing (v), the appropriate indicator appears. When the arrows are the same size, SpO2 is in target zone. |
| 5 PEEP/Oxygen curve | 10 When auto-recruitment is enabled, text is displayed on the map |

To display the Oxygenation map in the INTELLiVENT-ASV Settings window

1. To open the INTELLiVENT-ASV Settings window, touch the **Target** button at the top right of the display, or touch an automated controller.
The Settings window opens, with the **Auto** tab selected.
2. If the Oxygenation panel is not already displayed, touch the right view navigation arrow at the top left of the window to display View 2.
The panel shows the PEEP/SpO2 Oxygenation map, measured SpO2 value, and the **Target Shift** control.
3. To display the FiO2/PEEP map, touch the **FiO2/PEEP** button.

Figure 1-20. Oxygenation map, INTELLiVENT-ASV Settings window



- 1 Oxygenation map
- 2 View arrows and current view number

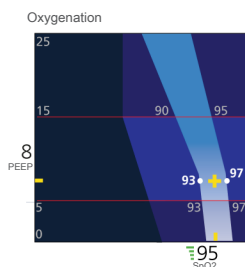
To display the Oxygenation maps while INTELLiVENT-ASV is running

1. If it is not already displayed, touch the view navigation arrows at the right of the display until view 2 is displayed.
View 2 shows the Oxygenation map and the measured SpO2 value. See Figure 1-14.
2. To display the FiO2/PEEP map, touch the **FiO2/PEEP** button.
To display the PEEP/SpO2 map, touch the **PEEP/SpO2** button.

1.5.4.2 About the SpO2 target zone

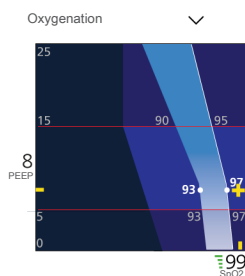
At a very basic level, the oxygenation controller attempts to keep the patient in the target zone as described here.

The PEEP/SpO2 (left) and FiO2/PEEP (right) maps below provide examples of each situation: SpO2 is within, above, or below the target zone.



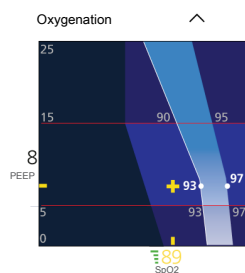
Patient symbol within the SpO2 target zone

When the patient symbol is within the target zone, **Oxygen** is fine tuned to get the patient to the middle of the target range.



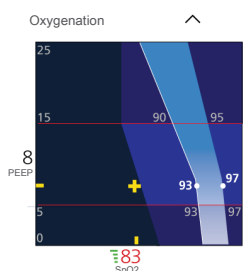
Patient symbol above the target zone

When the patient symbol is to the right of the target zone (in the *decrease zone*, indicating that the treatment is more than sufficient), the treatment is decreased. The down arrow above the map indicates a treatment decrease is occurring.



Patient symbol below the SpO2 target zone

When the patient symbol is to the left of the target zone (in the *increase zone*, indicating oxygenation is inadequate), the treatment is increased. The up arrow above the map indicates a treatment increase is occurring. As a result of being below the target zone, a medium-priority alarm is generated; the parameter is shown in the associated color.



Patient symbol below the SpO2 target zone, in the Emergency zone

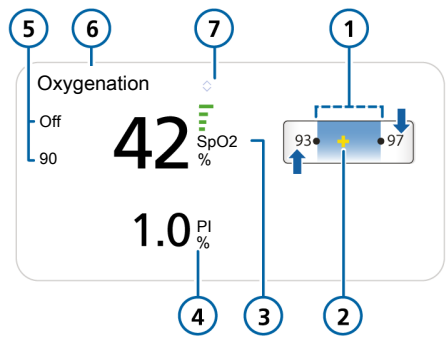
If the patient symbol is to the far left of the target zone in the dark blue *emergency zone* indicating hypoxemia, **Oxygen** is immediately increased to 100%. The up arrow above the map indicates a treatment increase is occurring. As a result of being below the target zone, a high-priority alarm is generated; the parameter is shown in the associated color.

1.5.5 About the Oxygenation horizon

The Oxygenation horizon shows a simplified view of the same data as the SpO2/PEEP Oxygenation map, together with the

upper and lower *SpO2* alarm limits. With a Masimo SET *SpO2* sensor, the horizon also shows the measured perfusion index (*PI*).

Figure 1-21. Oxygenation horizon



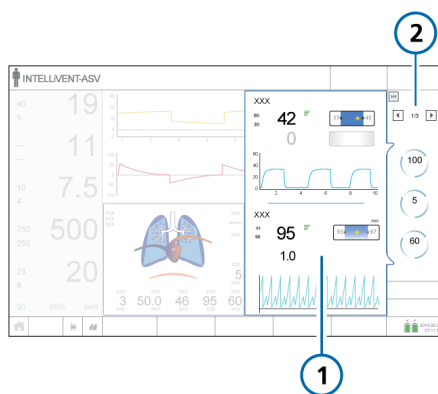
- | | | | |
|---|---|---|---|
| 1 | Target zone, showing upper and lower boundaries | 5 | Upper and lower <i>SpO2</i> alarm limits |
| 2 | Yellow patient symbol (cross) showing current patient value | 6 | Horizon title: Oxygenation |
| 3 | Current <i>SpO2</i> value and quality index | 7 | When <i>PEEP</i> or <i>Oxygen</i> is increasing (^) or decreasing (v), the appropriate indicator appears. When the arrows are the same size, <i>SpO2</i> is in the target zone. |
| 4 | Current <i>PI</i> value (<i>Masimo SpO2</i> sensor only) | | |



The blue arrows are for clarification purposes only; they do not appear on the display. Up arrow: Increase treatment zone; Down arrow: Decrease treatment zone.

The Oxygenation horizon is shown on the main display during active ventilation in view 1.

Figure 1-22. Oxygenation horizon during active ventilation



- | | |
|-----------------------|---------------------------------------|
| 1 Oxygenation horizon | 2 View arrows and current view number |
|-----------------------|---------------------------------------|

1.5.6 About the plethysmogram and capnogram

A CO₂ capnogram and SpO₂ plethysmogram are available as part of the INTELLiVENT-ASV standard views. You can also display them as individual waveforms, in the same manner as other waveforms on the main display.

The time scale displayed is the same as for other waveforms. See your ventilator *Operator's Manual* for details.

About the capnogram

A capnogram is a waveform that represents CO₂ levels throughout a breath cycle.

During active ventilation with INTELLiVENT-ASV, the capnogram is displayed together with the Ventilation horizon, as well as with the SBT history window. For details about selecting the capnogram as a waveform on the ventilator main display, see your ventilator *Operator's Manual*.

About the plethysmogram

A plethysmogram is a waveform that represents the pulsating blood volume; it is generated by the pulse oximeter.

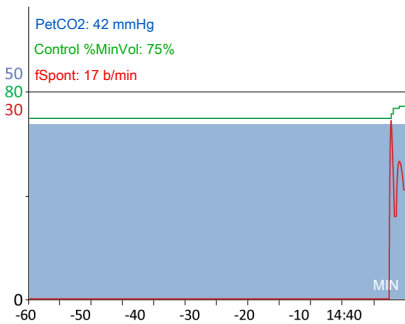
During active ventilation with INTELLiVENT-ASV, the plethysmogram is displayed together with the Oxygenation horizon, as well as with the SBT history window. For details about selecting the plethysmogram as a waveform on the ventilator main display, see the *Pulse Oximetry Instructions for Use*.

1.5.7 About trends

In addition to the trend data available for monitored parameters, you can also trend the actions of the ventilation and oxygenation controllers when using INTELLiVENT-ASV. The same time periods are available as for other parameters, namely, 1-, 6-, 12-, 24-, or 72-h trends. Each parameter is represented by a different color, as indicated in the graph legend.⁷

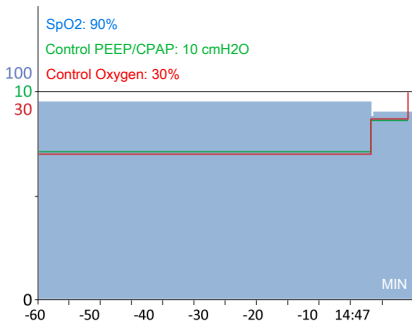
⁷ Note that the graphs provided here do not represent actual data, they just illustrate how the different parameters are represented.

Ventilation controller trend graph



The Ventilation controller trend graph provides data for the following parameters: PetCO2, Control %MinVol, and fSpont.

Oxygenation controller trend graph

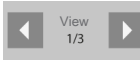


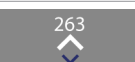
The Oxygenation controller trend graph provides data for the following parameters: SpO2, Control PEEP/CPAP, and Control Oxygen.

1.5.8 INTELLiVENT-ASV symbols

The following table describes important symbols and controls used with INTELLiVENT-ASV.

Table 1-11. INTELLiVENT-ASV-related symbols and controls

Symbol	Color	Description
	White	View selection. In the INTELLiVENT-ASV Settings window, two views are available; the view navigation arrows change the view between the Ventilation (view 1) and Oxygenation (view 2) panels. During active ventilation, three views are available; the view navigation arrows change the view between those described in Section 1.5.1.
	Yellow	Patient symbol. Indicates the current condition of the patient in the graph.
	Gray (or blue) (4 bars), Red (1 bar), Orange (2 bars)	Quality index showing unreliable signal quality. Sensor values are not usable or sensor not enabled or connected. When this occurs, the related controller freezes and an alarm is generated indicating the automatic management is turned OFF.
	Green (3 or 4 bars)	Quality index showing stable acceptable signal quality. The data from the sensor is highly stable and reliable.
	White	Measured PetCO₂ sensor value and quality index.
	PetCO ₂ horizon is greyed out; fSpont horizon is active	When the PetCO₂ horizon is greyed out, the patient is breathing spontaneously. The fSpont horizon is active. When the fSpont horizon is greyed out, the patient meets the passive criteria. The PetCO₂ horizon above it is active.
	White	The fSpont measurement is displayed when spontaneous breathing is detected by the flow sensor and used as physiologic input.

Symbol	Color	Description
	Red	Critical SpO2 value. SpO2 is below the set lower alarm limit.
	Black or white	Dashes indicate that no sensor value can be detected.
	White	Increase arrow, next to the horizon name and to the left of the automated controllers. Indicates that treatment must be increased.
	White	Decrease arrow, next to the horizon name and to the left of the automated controllers. Indicates that treatment must be decreased.
	Blue	Value is stable, in range. Displayed next to the horizon name and to the left of the automated controllers.
	White	Time to increase. Counts down the time to the next increase of the control.
	White	Time to decrease. Counts down the time to the next decrease of the control.
	White	Recruitment symbol. Indicates that a recruitment maneuver will be performed after the next PEEP increase. Counts down the time to maneuver.
	White	Recruitment in progress. Message displayed, and count-down timer indicating duration of maneuver. Located close to the PEEP controller.
	Gray circle	Manual management. Indicates that the operator must manage the control.
	Blue circle rotating clockwise	Automatic management. Indicates that INTELLiVENT-ASV is managing the patient and treatment has been increased (comets moving clockwise). A faster rotation provides a visual indication of ongoing or recent changes.

Symbol	Color	Description
	Blue circle rotating counter-clockwise	Automatic management. Indicates that INTELLiVENT-ASV is managing the patient and treatment has been decreased (comets moving counter-clockwise). A faster rotation gives a visual indication of ongoing or recent changes.
	Red circle	No automatic management – controller is in a frozen state. A sensor value may be absent.
	Green circle	Oxygen enrichment in progress. For details, see your ventilator <i>Operator's Manual</i> .

1.6 Troubleshooting alarms

 CAUTION

You can suppress audible CO2 and SpO2 alarms for 2 minutes by pressing the Audio Pause key.

NOTICE

When the device is in Standby, all SpO2-related alarms are suppressed.

The following table provides troubleshooting information for alarms related to INTELLiVENT-ASV.

For information about working with alarms, including resetting them, see your ventilator *Operator’s Manual* and SpO2-related documentation.

For the following alarm types, see the listed documentation:

- *Quick Wean/SBT-related alarms*, see Section 2.8.
- *SpO2-related alarms*, see the *Pulse oximetry Instructions for use*.
- *PetCO2-related alarms*, see your ventilator *Operator’s Manual*.

Table 1-12. INTELLiVENT-ASV alarms, priority, and corrective actions

Alarm/Priority	Definition/Corrective action
FiO2 set to 100% due to low SpO2 <i>Medium priority.</i>	Oxygenation controller set Oxygen to 100% due to low SpO2 saturation. SpO2 is, or was, in the emergency zone. To resolve • Check patient condition. • Open and close the alarm buffer to reset the alarm (even if the alarm situation changes).
Oscillation Oxygen <i>Medium priority.</i>	Large variations in Oxygen in a short time period. To resolve • Check patient condition. • Set Oxygen to Manual.
Oscillation PEEP/CPAP <i>Medium priority.</i>	Large variations in PEEP in a short time period. To resolve • Check patient condition. • Set PEEP to Manual.
Oscillation %MinVol <i>Medium priority.</i>	Large variations in %MinVol in a short time period. To resolve • Check patient condition. • Set %MinVol to Manual.

Alarm/Priority	Definition/Corrective action
Oxygenation adjustment off <i>Medium priority.</i>	Oxygenation controller is frozen due to poor or absent SpO₂ signal. To resolve • Check pulse oximeter connections. • Set PEEP and/or Oxygen to Manual.
Oxygen controller at limit <i>Low priority.</i>	PEEP and/or Oxygen are at defined limit and cannot be increased. To resolve • Check patient condition. • Verify limit settings. • Set PEEP and/or Oxygen to Manual.
Oxygen control limit exceeded <i>Medium priority.</i>	Oxygen exceeds the limit defined by the Oxygen message alarm (Alarms window). To resolve • Check patient condition. • Open and close the alarm buffer to reset the alarm (even if the alarm situation changes).
Oxygen supply failed <i>Medium priority.</i>	Oxygen source flow lower than expected. To resolve • Check patient condition. • Check oxygen supply, change supply if necessary. • Check oxygen supply for leaks. • Provide alternative ventilation until issue is resolved.
Recruitment in progress <i>Low priority.</i>	Notification about ongoing recruitment maneuver. Check patient condition.
Ventilation adjustment OFF <i>Medium priority.</i>	Ventilation controller is frozen when any of the following conditions occurs for longer than 30 seconds: • Poor or absent CO₂ signal • fSpont > 60 b/min (> 40 kg IBW) • fSpont > 100 b/min (≤ 40 kg IBW) To resolve • Check patient condition. • Check CO₂ connections. • Set %MinVol to Manual.

Alarm/Priority	Definition/Corrective action
Ventilation controller at limit <i>Low priority.</i>	%MinVol is at defined limit (200%) and cannot be increased. To resolve • Check patient condition. • Set %MinVol to Manual.

1.7 Management of minute volume (%MinVol)

WARNING

Regularly inspect CO₂ adapters/sensors. Patient secretions and/or condensation in airway adapters can lead to an incorrect PetCO₂ reading.

CAUTION

Do NOT use the sidestream CO₂ sensor with automatic management of %MinVol.

Ventilation (%MinVol) management operates in two modes: Automatic and Manual.

Automatic minute volume management

When automated, the INTELLiVENT-ASV ventilation controller uses the following data to set the minute volume (%MinVol):

- The controller uses different inputs to control the target minute volume, depending on whether the patient is passive or active
 - **Passive patient.** The controller uses the measured end-tidal CO₂ partial pressure, PetCO₂, as described in Section 1.7.1.

- **Active patient.** The controller uses the difference between the targeted and actual respiratory rate, as described in Section 1.7.2.

For details on how the automated controller manages the transition between spontaneous breathing and passive activity, see Section 1.7.3.

- All ASV safety limits are active for prevention of Apnea, baro- and volutrauma, auto-PEEP, and dead-space ventilation, including the tidal volume (Vt) limit of 1.5 x (upper Vt alarm limit).
- The target PetCO₂ that is set depends on:
 - The patient's treatment level (peak inspiratory pressure)
 - Operator-set patient condition (Section 1.4.10.1)
 - Operator-set PetCO₂ target shift (Section 1.4.10.3)
 - Whether Quick Wean is enabled (Section 2.2)
- The acceptable spontaneous breathing rate is calculated using the information in Table 1-15.

The %MinVol limits that are in force during automatic minute volume management are listed in Table 1-13.

As soon as the upper limit for the automatic management of %MinVol is reached, a **Ventilation controller at limit** message is generated.

Table 1-13. %MinVol limits for automatic minute volume management

Minimum %MinVol	
PetCO ₂ available	70
PetCO ₂ not available	100 (automatic control suspended)
Maximum %MinVol	
PetCO ₂ available	200
PetCO ₂ not available	200 (automatic control suspended)

Manual minute volume management

In manual mode, you keep the CO₂ elimination within the target range by adjusting %MinVol, based on the PetCO₂ monitoring values and on clinical practice.

1.7.1 Management of %MinVol, passive patient

When the patient is passive, the ventilator adjusts the target minute ventilation based on the PetCO₂ value of the patient.

End-tidal CO₂ partial pressure (PetCO₂), available when the CO₂ sensor is connected, is the maximum partial pressure of CO₂ exhaled during a breath, just before the start of inspiration. This represents the final portion of air that was involved in the exchange of gases in the alveolar area, and is, generally, a reliable index of CO₂ partial pressure in the arterial blood.

Under normal conditions, PaCO₂ is approximately 3-5 mmHg higher than PetCO₂ — the difference between the val-

ues is referred to as the *PaCO₂-PetCO₂ gradient*. Under special clinical conditions (including ventilation/perfusion mismatch, such as shunt), the PaCO₂-PetCO₂ gradient can increase, requiring adjustment of the ventilation targets (using the **Target Shift** control). For details, see Section 1.4.10.3.

To get the most accurate approximation of PaCO₂, the second highest PetCO₂ value out of 8 breaths is used.

The PetCO₂ target range depends on:

- Operator-set patient condition (Section 1.4.10.1)
- Operator-set PetCO₂ target shift (Section 1.4.10.3)
- Current level of ventilator support (Ppeak)

Within these ranges, and based on the PetCO₂ response from the patient, %MinVol is adjusted as described in the following table.

Table 1-14. Automated management of %MinVol, passive patient

When these conditions apply ...	%MinVol change
PetCO ₂ is above the upper limit of acceptable values	%MinVol increase
PetCO ₂ is below the lower limit of acceptable values	%MinVol decrease
PetCO ₂ is within the target range	Minor %MinVol changes

When these conditions apply ...	%MinVol change
PetCO2 measurement is invalid or unreliable for at least 30 seconds	%MinVol control is frozen. The Ventilation adjustment OFF alarm is generated.

1.7.2 Management of %MinVol, active patient

When a patient is active, spontaneously triggering the breaths, the ventilator adjusts the target minute ventilation based on the spontaneous breathing rate of the patient.

The acceptable range for the spontaneous breathing rate is determined as follows:

Table 1-15. Spontaneous breathing rate range calculation

Lower limit of range	ASV target Rate + 2 When Quick Wean is enabled: ASV target Rate + 3
Upper limit of range	ASV target Rate + d d = %MinVol * k where k = 0.1 Quick Wean disabled k = 0.15 Quick Wean enabled

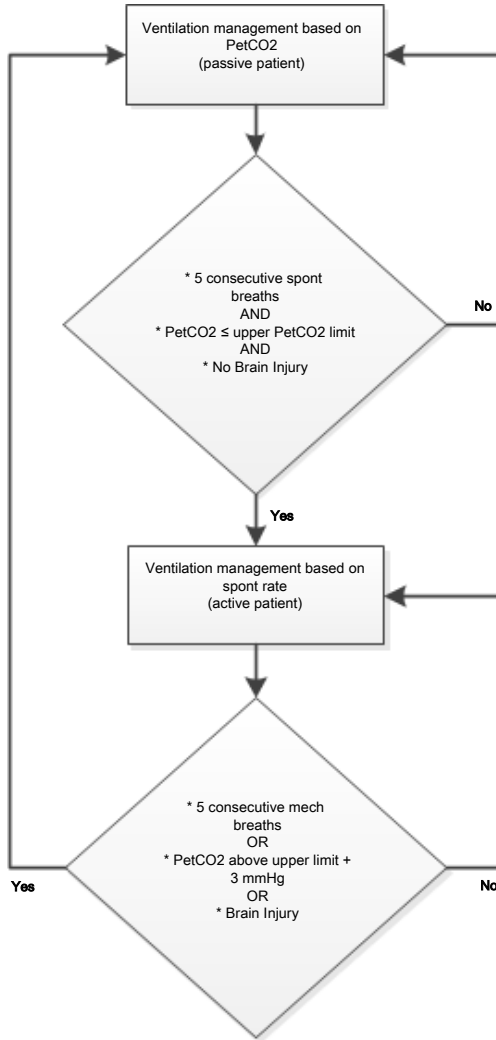
While the patient is active, the patient's spontaneous rate is detected by the flow sensor. The PetCO2 value is only used in the background for additional safety to avoid excessive values.

The rules listed in the following table apply to automated control of %MinVol for an active patient, and refer to the transition rules specified in Section 1.7.3.

Table 1-16. Automated management of %MinVol, active patient

When these conditions apply ...	%MinVol change
- The patient complies with the rules in Section 1.7.3 <i>and</i> - The patient's Rate is above the upper limit of the acceptable spontaneous rate (danger of patient fatigue)	%MinVol increase
- The patient complies with the rules in Section 1.7.3 <i>and</i> - The patient's Rate is below the lower limit of the acceptable spontaneous rate	%MinVol decrease
- The patient complies with the rules in Section 1.7.3 <i>and</i> - The patient's Rate value is within the target range	No change in %MinVol. If Quick Wean is enabled, see Section 2.4.1 for details.
The patient's PetCO₂ is invalid for more than 30 seconds	%MinVol control is frozen. The Ventilation adjustment OFF alarm is generated.
The patient's spontaneous rate is invalid (> 60 b/min (for patients > 40 kg IBW), > 100 b/min (for patients ≤ 40 kg IBW)) for more than 30 seconds	%MinVol control is frozen. The Ventilation adjustment OFF alarm is generated.

1.7.3 Rules for transitioning between active and passive states



Passive patient

For a passive patient, the controller starts adjusting the %MinVol based on PetCO₂ when ANY of the following are true:

- Five consecutive mechanical breaths occur *or*
- The PetCO₂ value exceeds the upper limit by at least 3 mmHg *or*
- The Brain Injury patient condition is selected

In this case, the %MinVol is adjusted on the PetCO₂ input.

When a reliable PetCO₂ measurement is not available (Table 1-18), the ventilation controller suspends automated management, and the %MinVol control is frozen. The Ventilation adjustment OFF alarm is generated.

Active patient

For an active patient, the ventilation controller starts adjusting the %MinVol based on the Rate when ALL of the following are true:

- Five consecutive patient-triggered breaths occur *and*
- The PetCO₂ value is below the upper limit *and*
- The Brain Injury patient condition is NOT selected

The controller continuously checks the passive patient rule (above) since it uses Rate as input criteria.

If the passive patient rule does not apply, the controller continues to adjust the %MinVol based on the spontaneous breathing rate of the patient.

If the patient's spontaneous rate is invalid⁸ for more than 30 seconds, the ventilation controller suspends automated management and the %MinVol control is frozen. The Ventilation adjustment OFF alarm is generated.

When a reliable PetCO₂ measurement is not available (Table 1-18), the ventilation controller suspends automated management, and the %MinVol control is frozen. The Ventilation adjustment OFF alarm is generated.

⁸ fSpont > 60 b/min (> 40 kg IBW) or fSpont > 100 b/min (≤ 40 kg IBW)

1.7.4 Important notes about ventilation management

When ventilating with INTELLiVENT-ASV, pay particular attention to important notes in the following areas:

Table 1-17. Important notes about ventilation management

For ...	See ...
Signal quality and ventilation	Section 1.7.4.1
Actions that temporarily halt automatic ventilation management	Section 1.7.4.2
PetCO2 is not available	Section 1.7.4.3
Disconnection or flow sensor failure resolved in 5 min or less	Section 1.7.4.4
Disconnection or flow sensor failure resolved in more than 5 min	Section 1.7.4.5
Returning to active ventilation from standby	Section 1.7.4.6

1.7.4.1 Signal quality and ventilation management

The following table summarizes INTELLiVENT-ASV operation depending on the quality of the PetCO2 signal.

Table 1-18. PetCO2 signal quality and automated ventilation management

Signal reliability and quality index	These conditions apply ...
PetCO2 signal is unavailable or of poor quality for more than 30 seconds Gray (or blue), red, or orange bars 	• The %MinVol control is a solid red circle; it is frozen. • The Ventilation adjustment OFF alarm is generated. • The minute volume adjustment works as it does in ASV, with a constant minute ventilation equal to the last valid automatic %MinVol setting. For details, see your ventilator <i>Operator's Manual</i>.
PetCO2 signal is available and reliable Green bars 	• The %MinVol control is a blue rotating circle. • The alarm is reset. • Automated ventilation management resumes.

1.7.4.2 Actions that temporarily halt automatic ventilation management

Automated ventilation management pauses during the following actions:

- ASV is not operating in normal mode (see your ventilator *Operator's Manual*)
- Disconnection
- Flow sensor calibration
- Tightness test
- Suctioning
- P/V Tool maneuver
- Inspiratory/expiratory hold maneuver
- Auto-recruitment

In some cases, the controller remains displayed with a blue rotating circle, and when the action is completed, it resumes automated management with the last-used setting.

1.7.4.3 PetCO₂ is not available

When a quality PetCO₂ measurement is not available (for example, the sensor is disabled or the signal quality is poor), the minute volume adjustment works the same as with ASV, with a constant minute ventilation (%MinVol) setting equal to the last valid automatic %MinVol value (frozen state).

- The ventilation controller display changes from blue to red.
- The alarm, Ventilation adjustment OFF, is generated. INTELLiVENT-ASV works like ASV with constant minute ventilation.

If this occurs when %MinVol is between 70% and 99%, the %MinVol is set to 100 and ventilation continues with %MinVol at 100% once a valid PetCO₂ measurement is again available.

When PetCO₂ is again available, the alarm is cleared and the minute volume adjustment switches back to fully automatic mode.

- The controller changes from red to a blue rotating circle again.
- %MinVol is adjusted automatically.

1.7.4.4 Disconnection or flow sensor failure resolved in 5 minutes or less

When a disconnection or flow sensor failure situation is resolved in 5 minutes or less, the device:

- The %MinVol management adjustment pauses for 10 breaths.
- The ASV adjustment (P_{insp} and ASV target rate) pauses for 4 breaths after reconnection.
- If the adjustment is in its initialization phase, it remains there for at least 3 more breaths.

For details, see your ventilator *Operator's Manual*.

1.7.4.5 Disconnection or flow sensor failure resolved in more than 5 minutes

When a disconnection or flow sensor failure is resolved in more than 5 minutes:

- The ventilation controller adjustment pauses for 2 minutes.
- The ASV adjustment re-initializes. If the adjustment is in its initialization phase, it remains there for at least 3 more breaths.

1.7.4.6 Starting active ventilation from Standby

When starting ventilation with a new patient selected and INTELLiVENT-ASV activated, the %MinVol adjustment initializes with the default settings.

If **Last Patient** was selected, the system assumes the patient settings, in addition to the %MinVol values from the last patient.

In the event the **PetCO₂** quality index is below 50, the %MinVol control changes from a blue rotating circle to a red non-pulsing circle. Ventilation management does not start.

When the **PetCO₂** quality index is above 50, ventilation management starts in automatic mode. The %MinVol control is a blue rotating circle.

1.8 Management of PEEP and Oxygen

As INTELLiVENT-ASV relies on the measurements provided by the SpO₂ sensor, be sure to carefully review the safety messages provided in this guide, as well as those provided in the *Pulse oximetry Instructions for use*.

NOTICE

- The emergency increase of oxygen rules remain in place for all cases as long as the **Oxygen** control is set to **Automatic**.
- The oxygenation controller can only adjust the **Oxygen** between 21% and 100%.
- When the minimum **Oxygen** limit is set > 21%, a red line indicating the limit appears on the Oxygenation maps.
- Outside of performing an SBT, the PEEP controller can only operate between 5 and 24 cmH₂O.
- If the PEEP control is automated, the set PEEP high and low limit controls are activated. The Oxygenation maps show two red lines, one showing the upper PEEP limit and one showing the lower.

Oxygenation (PEEP/Oxygen) management operates in two modes: Automatic and Manual.

Automatic oxygenation (PEEP and Oxygen) management

Automated PEEP/Oxygen management sets the **Oxygen** and **PEEP** values according to the following inputs, which determine the expected **SpO₂** range for the patient:

- Measured oxygen saturation (**SpO₂**)
- Operator-set patient condition (Section 1.4.10.1)
- Operator-set Target Shift (Section 1.4.10.3)

The lung-protective rules for oxygenation management, used during automated PEEP/Oxygen management, are based on the ARDSnet guidance when increasing the therapy, and the Open Lung concept when decreasing the treatment. See Section 1.8.1.

Manual oxygenation management

In manual mode, you keep the **SpO₂** within the target range by adjusting **PEEP** and/or **Oxygen**, based on the **SpO₂** monitoring values and on clinical practice.

1.8.1 Management of PEEP/Oxygen for all patients

Using the **SpO₂** signal retrieved from the pulse oximeter, the system calculates the difference between the current and the target **SpO₂** value. This calculation, together with the operator's input, is used to determine the treatment action.

Automated PEEP/Oxygen management comprises two steps:

- The operator's input and the actual treatment (PEEP) define the **SpO₂** target range. The ranges differ based on patient conditions (Section 1.4.10.1).

The **SpO₂** signal and the **SpO₂** target range are used to define the treatment action (increase, decrease, no change of treatment).

- The system decides, depending on the actual combination of **PEEP** and **Oxygen** on the **PEEP/Oxygen** curve, whether **PEEP** and/or **Oxygen** are increased.

The relationship between **PEEP** and **Oxygen** is based on the ARDSnet guidance for increasing therapy (Figure 1-23, the target path is the bold line) and the Open Lung concept for decreasing therapy (Figure 1-24, the target path are the bold lines).

Figure 1-23. Increase of oxygenation support, ARDSnet guidance

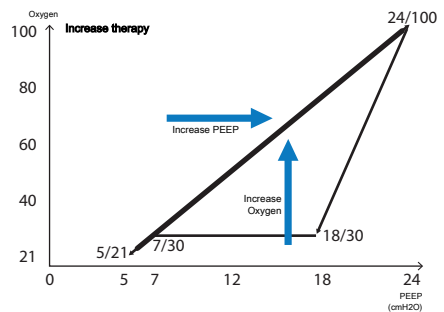
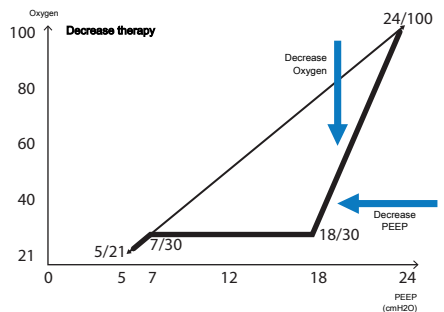


Figure 1-24. Decrease of oxygenation support, Open Lung concept



The device adjusts PEEP and Oxygen, which affect the oxygenation of the patient. Section 1.8.3 provides an overview of the controllers' actions depending on the measured SpO2 value.

1.8.2 Emergency increase of Oxygen

When Oxygen is set to Automatic, the device provides a safety feature that continuously monitors the patient's SpO2 to avoid dangerous desaturation. Upon detecting an inadequate SpO2 level, the device reacts immediately to deliver 100% Oxygen to the patient.

The safety feature is activated when the physiologic SpO2 value of the patient falls below the lowest acceptable value, thus triggering the 100% Oxygen response. The FiO2 set to 100% due to low SpO2 alarm is generated.

1.8.3 Oxygenation management rules

The automated oxygenation controller adjusts PEEP and Oxygen as described here.

SpO2 is in range (within the target zone limits) and the Oxygen setting is above the PEEP/Oxygen curve

The controller *decreases Oxygen support* as long as all of the following conditions are met:

- SpO2 remains in range
- Oxygen was last increased over 10 minutes ago
- There is no change in PEEP

SpO2 is too low (below the lower SpO2 target zone limit)

The controller *increases oxygenation support*.

Position of patient symbol in the FiO2/PEEP map, relative to the ARDSnet curve	
Above the curve	The controller changes PEEP stepwise to the PEEP/Oxygen curve.
On the curve	The controller increases PEEP and Oxygen stepwise at the same time to follow the curve.
Below the curve	The controller increases Oxygen stepwise to the curve.

SpO2 is critically low (in the Emergency zone)

The controller *performs an emergency Oxygen increase*.

The Oxygen control displays the value 100%. See Section 1.8.2.

SpO2 measurement is unavailable

The controller *is frozen*.

The PEEP and Oxygen controls are frozen, displayed as solid red circles, and the **Oxygenation adjustment OFF** alarm is generated. Oxygenation management is no longer automated.

SpO2 is high, above the target zone limit

The controller *decreases oxygenation support*.

Position of patient symbol in the FiO2/PEEP map, relative to the Open Lung curve

Above the curve	The controller decreases Oxygen stepwise to the PEEP/Oxygen curve.
On the curve	The controller first decreases Oxygen , then PEEP to follow the curve.
Below the curve	The controller automatically decreases PEEP stepwise to the curve.

1.8.3.1 How the controller adjusts Oxygen and PEEP
NOTICE

If an upper PEEP limit is specified, the controller will not exceed the limit.

If a lower PEEP and/or Oxygen limit is specified, the controller will not go below the limit.

The following table describes the rules the controller follows to adjust the oxygenation parameters.

Table 1-19. Increase/decrease increments of Oxygen and PEEP by automated oxygenation controller⁹

Oxygenation management	Action	Takes place when ...
Increase Oxygen stepwise	Increases Oxygen by 10% of current Oxygen value every 30 seconds	• Oxygen automatically managed • Increasing Oxygen support
Decrease Oxygen stepwise	Decreases Oxygen by 5% of current Oxygen value every 60 seconds	• Oxygen automatically managed • Decreasing Oxygen support
Increase PEEP stepwise	Increases PEEP by 1 cmH2O every 6 minutes	• PEEP automatically managed • Increasing PEEP support
Decrease PEEP stepwise	Decreases PEEP by 1 cmH2O every 6 minutes	• PEEP automatically managed • Decreasing PEEP support
Decrease PEEP stepwise quickly	Exception: Decreases PEEP by 1 cmH2O quickly every 30 seconds	• PEEP automatically managed • PEEP is above the upper PEEP limit (if PEEP was set manually above the limit)

⁹ When the PEEP and/or Oxygen control setting is manually changed and then control is again set to Automatic, these rules still apply. The time interval starts from the time of the last manual change.

1.8.4 Important notes about oxygenation management

When ventilating with INTELLiVENT-ASV, pay particular attention to important notes in the following areas:

Table 1-20. Important notes about oxygenation management

For ...	See ...
Signal quality and oxygenation management	Section 1.8.4.1
Actions that temporarily halt automatic oxygenation management	Section 1.8.4.2
Oxygen level notification	Section 1.8.4.3
Returning to active ventilation from standby	Section 1.8.4.4

1.8.4.1 Signal quality and oxygenation

The following table summarizes INTELLiVENT-ASV operation depending on the quality of the SpO2 signal.

Note that the controllers may also be frozen as a result of various SpO2- and Oxygen-related alarms.

The automatic emergency increase of Oxygen is inactive when Oxygen is controlled manually.

Table 1-21. SpO2 signal quality and automated oxygenation management

Signal reliability and quality index	These conditions apply ...
SpO2 signal is unavailable or of poor quality for more than 30 seconds Gray (or blue), red, or orange bars 	• The PEEP and Oxygen controls are solid red circles; they are frozen. • The Oxygenation adjustment OFF alarm is generated. • The ventilator uses the same oxygenation rules as when in ASV mode. For details, see your ventilator <i>Operator's Manual</i>. • Automatic emergency increase of oxygen management is <i>inactive</i> (Section 1.8.2).
SpO2 signal is available and reliable Green bars 	• The PEEP and Oxygen controls are blue rotating circles. • The alarm is reset. • Automated oxygenation management resumes. • Automatic emergency increase of oxygen management is <i>active</i> (Section 1.8.2)

1.8.4.2 Actions that temporarily halt automatic oxygenation

Automated oxygenation management pauses during the following actions:

- Disconnection
- Oxygen enrichment
- Flow sensor calibration
- Tightness test
- Suctioning
- Oxygen cell calibration
- Oxygen supply failure
- P/V Tool maneuver
- Inspiratory/Expiratory hold maneuver
- Auto-recruitment

In some cases, the controller remains displayed with a blue rotating circle, and when the action is completed, it resumes automated management with the last-used setting.

1.8.4.3 Oxygen level notification

When the automatic oxygenation controller is active, you can set the ventilator to display a message if the **Oxygen** concentration exceeds a specific limit that you specify. If the notification threshold is reached, an alarm is generated and the message **Oxygen limit exceeded** is displayed. See Section 1.4.10.6.

1.8.4.4 Starting active ventilation from Standby

When starting ventilation with a new patient selected and INTELLiVENT-ASV activated, the **PEEP** and **Oxygen** adjustments initialize with the default settings.

If **Last Patient** was selected, the system assumes the patient settings, in addition to the **PEEP** and **Oxygen** values from the last patient.

1.9 Manual control of ventilation and oxygenation

With INTELLiVENT-ASV, you can manage minute volume (**%MinVol**), **Oxygen**, and/or **PEEP** automatically or manually.

In some cases, automated management is not available, as described in the following sections.

1.9.1 Manual control of ventilation

When **%MinVol** is controlled manually, the device uses the same rules as when in ASV mode. For details, see your ventilator *Operator's Manual*.

Table 1-22. Conditions for manual control of %MinVol

When these conditions are met ...	This control must be adjusted MANUALLY by the operator
CO2 monitoring is disabled	%MinVol is set to Manual

For control to be automated, you must manually set %MinVol to Automatic in the INTELLiVENT-ASV Settings window.

1.9.2 Manual control of oxygenation

You must control PEEP and/or Oxygen manually when any of the conditions listed in the following table occur.

Table 1-23. Conditions for manual control of PEEP and/or Oxygen

When these conditions are met ...	This control must be adjusted MANUALLY by the operator
PEEP • The Chronic Hypercapnia or Brain injury patient condition is selected • SpO2 monitoring is disabled	PEEP is set to Manual
Oxygen • Oxygen monitoring (O2 sensor) is disabled • SpO2 monitoring is disabled	Oxygen is set to Manual

When PEEP or Oxygen is controlled manually, the device uses the same rules as when in ASV mode. For details, see your ventilator *Operator’s Manual*.

For control to be automated, you must manually set the desired controls to Automatic in the INTELLiVENT-ASV Settings window.

1.10 Assessing results

After the calculated targets are reached, the ventilation management results need to be assessed. Use the monitored parameters for this purpose. To assess respiratory acid-base status, it is recommended that arterial blood gases be measured to monitor the minute volume adjustment.

2

Quick Wean

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2.1 Overview

WARNING

Additional ventilator-independent patient monitoring (for example, bedside vital monitoring or a blood gas analyzer) must be used during INTELLiVENT-ASV ventilation. Check PaCO₂ against displayed PetCO₂, and SaO₂ against SpO₂.

CAUTION

The responsibility for final decisions regarding weaning and extubation rests solely with the physician/operator. Additional criteria not provided by the ventilator have to be taken into account.

Quick Wean is integrated into INTELLi-VENT-ASV, and when activated, provides continuous dynamic monitoring and control of patient conditions to evaluate the patient's potential readiness for extubation. Together with the clinician and the patient, Quick Wean is part of a complex care cycle that has as its goal a respiratorily healthy, spontaneously breathing patient.

Weaning from a ventilator is a difficult process that comprises training, evaluation, and testing. A widely accepted and commonly used method is to decrease ventilatory support and, if possible, perform spontaneous breathing trials (SBTs) to evaluate the patient's muscle activity and endurance.

An SBT is a diagnostic tool that can help determine whether the patient is ready to be removed from ventilator support and can breathe on their own. It is known that the use of a protocolized standard process is beneficial in regard to patient safety and outcomes. Note that in INTELLiVENT-ASV, automated SBTs are disabled until explicitly enabled.

2.1.1 About Quick Wean use and modes

Quick Wean offers two modes of use: with and without automated SBTs. For details on enabling or disabling these options, see Section 2.3.

Table 2-1. Quick Wean modes of use

Quick Wean mode	Description
Quick Wean disabled	Default setting. No continuous monitoring against defined weaning criteria occurs.
Quick Wean enabled (set to Automatic)	The device does the following: • Shifts the PetCO₂ range to the right by up to +5 mmHg, depending on pressure, to support spontaneous breathing. • When the patient is active (Section 1.7.2), the device gradually reduces %MinVol. As long as these conditions are met, the %MinVol is decreased to and/or maintained at 70%. • The system continuously monitors the patient against weaning criteria (Section 2.4). Two SBT-related options are then available: automated SBTs enabled or disabled.
Automated SBTs enabled	This option offers all the benefits of providing standardized, protocolized care. • The system continuously monitors the patient against weaning criteria. • When defined criteria are met, automatically initiates an SBT. • All of the related parameters are configurable, and some can be fine tuned during ventilation. • You can manually start an SBT any time the patient is active. See Section 1.4.5.
Automated SBTs disabled	This is the default setting. • The system continuously monitors the patient against weaning criteria. • As long as the patient is breathing spontaneously and the patient's rate is below the upper limit of the target range, the %MinVol is decreased to and/or maintained at 70%. • All of the related parameters are configurable, and some can be fine-tuned during ventilation. • You can manually start an SBT any time the patient is active.

2.1.2 Key terms

The following table describes some key terms for Quick Wean.

Table 2-2. Key terms and parameters for Quick Wean

Term/Parameter	Description
SBT	<i>Spontaneous breathing trial.</i> Diagnostic test to help determine whether patients are ready to be removed from ventilator support and can breathe on their own.
Automated SBT	When enabled, the device performs an SBT when specified criteria are met. By default, disabled.
<i>To start SBT</i> group of parameters	A list of parameters that must all be within a predefined range for a specific amount of time for the patient to be considered ready for an SBT. This set of parameters and values is referred to as the <i>To start SBT criteria</i> .
<i>To stop SBT</i> group of parameters	A list of parameters that are monitored during an SBT, to determine whether to stop the SBT. If any of the values is outside the predefined range for a specified period of time, an ongoing SBT is stopped. This set of parameters and values is referred to as the <i>To stop SBT criteria</i> .
fSpont / %fSpont	fSpont is the absolute number of spontaneous breaths taken. %fSpont is the percentage of spontaneous breaths to total breaths taken. The Quick Wean panel shows fSpont; the SBT history panel shows %fSpont.
Max. duration (min)	Defines the length of time the SBT can run. If the patient conditions continue to stay within defined thresholds, the SBT ends after the time specified by this parameter. Only applies during an SBT.
%MinVol (%)	When Quick Wean is enabled, as long as the patient is active and the patient's rate is below the upper limit of the target range (Section 1.7.2), the device gradually reduces %MinVol to 70%. When SBTs are enabled and an SBT starts, %MinVol is reduced to a default value of 25%.
Oxygen (%)	Inspired oxygen.

Term/Parameter	Description
PEEP (cmH ₂ O)	Positive end-expiratory pressure. Airway pressure at the end of exhalation.
PetCO ₂ (mmHg)	End-tidal CO ₂ pressure.
PetCO ₂ inc (mmHg)	The absolute increase in PetCO ₂ (relative to an average calculated prior to the start of the SBT) that is permitted during an SBT. Only applies during an SBT.
Psupport max (cmH ₂ O)	The maximum pressure support allowed before starting an SBT, and an absolute upper limit that it cannot exceed during the SBT. If the upper limit is reached during an SBT, the SBT is stopped.
Rate (b/min)	Respiratory rate. Number of breaths per minute. Defines the maximum rate allowed before an SBT can take place, as well as an absolute upper limit that cannot be exceeded during an SBT. If the upper limit is reached during an SBT, the SBT is stopped.
SBT time range	Defines the hours between which an SBT can be started. Even if the <i>To start SBT</i> criteria are met, the SBT will not take place until the current time of day is inside the specified range, if criteria are still met. If an SBT is in progress when the time is out of range, the SBT continues until it is completed.
SpO ₂ (%)	Measurement of oxygen saturation in the blood.
Time before starting SBT (min)	Defines the length of time that patient conditions must stay within the <i>To start SBT</i> limits before an SBT can start. Only applies when automated SBTs are enabled.
Time between 2 SBTs (min)	Defines the minimum length of time that must pass between two SBTs. Only applies when automated SBTs are enabled.
Tolerance time (s)	The length of time a parameter value can be out of range without affecting the countdown to an SBT or an ongoing SBT. If any one parameter is out of range for longer than this time period, the countdown timer is reset or an ongoing SBT is stopped.
Vt/IBW (ml/kg)	Tidal volume per kilogram of ideal body weight.

Term/Parameter	Description
RSB (1 /(l*min))	Rapid shallow breathing index. The total breathing frequency (fTotal) divided by the exhaled tidal volume (VTE). The RSB parameter is only used for patients weighing > 40 kg. For patients weighing less, the PetCO2 parameter is used.

2.2 Quick Wean in clinical use

This section provides a brief overview of the Quick Wean clinical workflow, key parameters, and indications for use.

2.2.1 Quick Wean workflow

Upon enabling Quick Wean, the device does the following:

- Shifts the PetCO2 range to the right by up to +5 mmHg, depending on pressure, to support spontaneous breathing.
- As long as the patient is active (Section 1.7.2), the device gradually reduces %MinVol to 70%.
As long as these conditions are met, the %MinVol is decreased to and/or maintained at 70%.
The device adjusts %MinVol as follows:
 - If %MinVol is already at 70%, the device does nothing.
 - If %MinVol is above 70%, the device decreases %MinVol to 70% in steps of no more than 1% per breath.
- If the patient is passive (Section 1.7.1), INTELLiVENT-ASV continues ventilating the patient. When the conditions are again met, the ventilator repeats the %MinVol reduction process described above.

Note that the up to +5 mmHg PetCO2 target zone shift remains in place as long as Quick Wean is enabled.

2.2.2 About the Quick Wean parameters

Quick Wean monitors a large set of parameters to support weaning. Default settings for these parameters are consensus based, and, if modified, are generally set once and then used as the defaults.

Some of settings can be modified during ventilation; others are defined in Configuration. Further, some parameters are calculated and are not user modifiable.

Parameters are grouped into the following basic categories:

- *To start SBT* parameters that are monitored to determine whether an SBT can be started
- *SBT settings* parameters that determine the settings for an SBT
- *To stop SBT* parameters that are monitored to determine whether to stop an ongoing SBT

For details about the Quick Wean/SBT parameters, see Section 2.10, which lists where each one is set and monitored, and value ranges.

2.2.3 Indications for use

NOTICE

Quick Wean is not available if the patient condition selected in INTELLiVENT-ASV is **Brain injury**.

Quick Wean can be enabled at any time during ventilation. Conducting an SBT, however, is only possible when:

- The patient is active
- Quick Wean is enabled

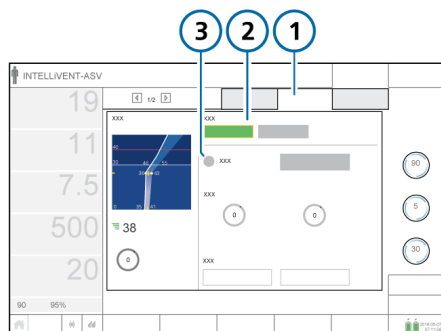
2.3 Enabling/disabling and setting up automated SBTs

Quick Wean must be enabled to automate SBTs. For details about enabling Quick Wean, see Section 1.4.5.

To enable/disable automated SBTs

1. Ensure Quick Wean is enabled in the INTELLiVENT-ASV Settings > Quick Wean window.

Figure 2-1. INTELLiVENT-ASV Settings > Quick Wean window, Quick Wean enabled



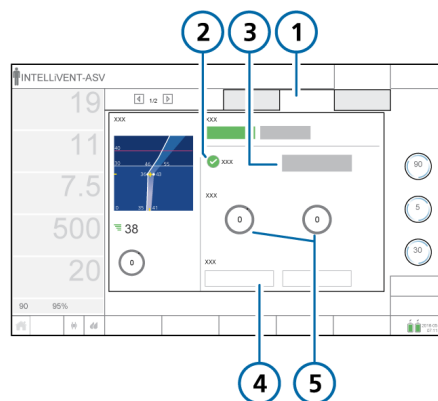
- 1 Quick Wean
- 2 Automatic
- 3 Automatic SBT (not selected)

2. Select whether to enable SBTs.

By default, automated SBTs are disabled.

To enable SBTs, touch the **Automatic SBT** checkbox. A checkmark indicates SBTs are enabled. The **SBT settings** button also becomes available.

Figure 2-2. INTELLiVENT-ASV Settings > Quick Wean window, SBTs enabled



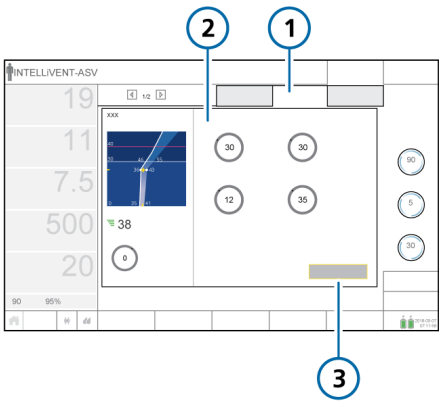
- 1 Quick Wean
- 2 Automatic SBT, selected
- 3 SBT settings button available
- 4 Manually Start/Stop SBT buttons
- 5 Automatic SBT time range

3. Using the SBT Time range controls, set the time period during which automatic SBTs can be performed. By default, they can be performed between 8 am and 8 pm.

For details about the SBT time range, see Table 2-3.

4. If SBTs are enabled, touch the **SBT settings** button to access additional controls.
 These values can be modified during ventilation and in Standby, as appropriate.
 The Quick Wean tab changes to *SBT settings*, and the contents of the window change to show SBT-related options.
5. Set SBT options as desired. Table 2-3 describes these controls.
6. Touch **Close** to accept the settings and return to the Quick Wean window.
7. If displayed, touch **Continue** to accept the settings and proceed to the next step.
 Touching the **Back** button returns you to the Auto window.
 Touching the **X** button or doing nothing for 1 minute closes the window and returns you to the previously selected mode.

Figure 2-3. INTELLiVENT-ASV Settings > SBT Settings window



- | | |
|--|---------|
| 1 SBT settings | 3 Close |
| 2 SBT controls: Time before starting SBT,
Time between 2 SBTs, Psupport max, Rate | |

Table 2-3. SBT settings, available during ventilation

SBT setting	Description
Automatic SBT	Select checkbox to enable automatic SBTs when specified clinical conditions are met.
SBT settings	Touch to display additional SBT-related settings.
SBT time range	Hours between which an SBT can be started. Even if clinical conditions match the specified SBT starting criteria, if the start time for the SBT is outside of the range specified here, the SBT will not take place. To allow automated SBTs to start at any time, set both controls to the same time.
Manually start/stop SBT	Manually start/stop an SBT. Only available when the patient is active and the patient's Rate is below the upper limit of the target range.
Start SBT	Touch to immediately start an SBT. The system: • Adjusts %MinVol to the configured setting • Adjusts PEEP to the configured setting (if automatically controlled) • Displays the SBT history window • Displays the Quick Wean & SBT status window
Stop SBT	Select to immediately stop an ongoing SBT. The system returns to the previous INTELLiVENT-ASV settings and monitors patient conditions for the next possible SBT.
Time before starting SBT (min)	Length of time that <i>To start SBT</i> parameters must remain within specified limits before an SBT can start. See Section 2.4.2).
Time between 2 SBTs (min)	The minimum length of time after an automated SBT is executed before another automated SBT can be started.
Psupport max (cmH2O)	The maximum pressure support allowed before starting an SBT, and an absolute upper limit that it cannot exceed during an SBT. Shown as the upper P _{insp} limit in the Quick Wean & SBT Status window.
Rate (b/min)	The maximum rate allowed before starting an SBT, and an absolute upper limit that it cannot exceed during an SBT.

2.4 Conditions for starting weaning activities

Quick Wean continuously monitors the patient’s condition against a set of criteria that must be met for weaning activities to be possible. They are referred to as the *To start SBT parameters* or *To start SBT criteria*.

1. When Quick Wean is enabled, the device starts monitoring *To start SBT* parameters.
2. When all of the following conditions are met, the steps listed in Table 2-4 occur, depending on whether automated SBTs are enabled:
 - The patient is active
 - The *To start SBT* criteria are met

Table 2-4. Device actions when To start SBT criteria are met

When *To start SBT* criteria are met and ...

Quick Wean/Quick Wean & SBT Status window (see Section 2.4.4)

Automated SBTs are enabled

Quick Wean & SBT

Conditions fulfilled
Starting SBT in 30 min

00:00:20

40 21 00:10 Oxygen 30	8 0 00:07 PEEP 5	5.0 30.0 00:05 Vt/IBW 14.5	12 5.0 00:04 Piawp 7.0	105 15 00:03 RSB ---	35 0 00:04 fSpont 24
--	---	---	---	---	---

- The device shows the status *Conditions fulfilled, starting SBT in XX min* in the Quick Wean & SBT Status window, and starts a timer.
- The measured values for each of the *To start SBT* parameters must remain within the defined ranges for the length 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 by the **Tolerance time** parameter without affecting the countdown.

For example, with a **Tolerance time** of 30 seconds, any parameter can be out of range for up to 30 seconds with no effect. If a parameter value remains out of range for 31 or more seconds, the process resets.

When *To start SBT* criteria are met and ...

Quick Wean/Quick Wean & SBT Status window (see Section 2.4.4)

Automated SBTs are disabled

Quick Wean

Conditions fulfilled
SBT will not start

00:00:20

40

8

5.0

12

105

35

21

0

30.0

5.0

10

0

00:10

00:07

00:05

00:04

00:05

00:04

Oxygen
30

PEEP
5

VVIBW
14.5

P_{resp}
7.0

RSB

fSpont
24

The device shows the status *Conditions fulfilled, SBT will not start* in the Quick Wean Status window.

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

For example, with a Tolerance time of 30 seconds, any parameter can be out of range for up to 30 seconds with no effect. If a parameter value remains out of range for 31 or more seconds, the *Conditions fulfilled* status is removed, and the device continues to monitor the patient's condition.

You can also manually start an SBT. See Section 2.5.1.

2.4.1 About %MinVol calculations

When Quick Wean is enabled, once the patient is active and the patient's Rate is within the target range as described in Section 1.7.2, the device decreases %MinVol stepwise to 70%.

The device adjusts %MinVol as follows:

Table 2-5. %MinVol adjustments

Patient status	Quick Wean status	The device ...
Active, Rate within target range	Quick Wean enabled	Decreases %MinVol to 70%
	Quick Wean disabled	No %MinVol change
Active, Rate out of range	Quick Wean enabled or disabled	INTELLiVENT-ASV %MinVol management

2.4.2 Parameters used to determine weaning readiness (To start SBT group)

NOTICE

In the Quick Wean & SBT Status panel, the RSB parameter is shown only for patients weighing > 40 kg. For patients weighing ≤ 40 kg, the PetCO2 parameter is shown instead.

The following parameters are monitored to determine the patient’s readiness for weaning activities. They are monitored regardless of whether automated SBTs are enabled or disabled.

For the definition of a parameter, see Section 2.1.2. For parameter ranges and other details, see Section 2.10.

Some parameters use different thresholds depending on the patient weight. Where applicable, these differences are marked.

Table 2-6. Quick Wean To start SBT criteria

Parameter (unit)	Where set/how used	Default <i>To start SBT</i> value
%fSpont	Not configurable	100% during Time before starting SBT
Oxygen (%)	Configuration > Modes > SBT > To start SBT window	≤ 40
PEEP (cmH2O)	Configuration > Modes > SBT > To start SBT window	Patients > 40 kg: ≤ 8 Patients ≤ 40 kg: ≤ 6
Psupport max (cmH2O)	INTELLiVENT-ASV Settings > Quick Wean/SBT settings window	≤ 12
Rate (b/min)	INTELLiVENT-ASV Settings > Quick Wean/SBT settings window	Patients > 30 kg: ≤ 35 Patients ≤ 30 kg: ≤ 45
RSB (1/(l*min))	Not configurable	≤ 105
SpO2 (%)	Not configurable	In INTELLiVENT-ASV normal/high range (within or above target zone)
Vt/IBW (ml/kg)	Configuration > Modes > SBT > To start SBT window	≥ 5
Time before starting SBT (min)	INTELLiVENT-ASV Settings > Quick Wean/SBT settings window	30

Parameter (unit)	Where set/how used	Default <i>To start SBT</i> value
Time between 2 SBTs (min)	INTELLiVENT-ASV Settings > Quick Wean/SBT settings window	30
SBT Time range (hh:mm)	INTELLiVENT-ASV Settings > Quick Wean window To allow automated SBTs to start at any time, set both controls to the same time.	Between 8:00 and 20:00 (8 am to 8 pm)
Tolerance time (s)	Configuration > Modes > SBT > To start SBT window If any one parameter (listed in this table) is out of range for longer than this time period, the count-down timer is reset.	Patients > 40 kg: 180 Patients ≤ 40 kg: 60

The default values for most of these parameters are set in Configuration (Section 2.9). A few of the parameters can be modified during ventilation in the INTELLiVENT-ASV Settings window, as described in Section 2.4.3.

2.4.3 User-modifiable SBT parameters, INTELLiVENT-ASV Settings window

The INTELLiVENT-ASV Settings > Quick Wean/SBT settings windows provide access to the SBT-related parameters that you can adjust during ventilation, if needed. You do not have to put the ventilator into Standby to make changes. Changes are implemented immediately, and the system starts making adjustments, if needed.

The time-related parameters (Time before starting SBT, Time between 2 SBTs, and SBT time range) are only effective when automated SBTs are enabled. You can adjust the other parameters in this window at any time.

When Quick Wean is enabled, the system monitors the non-time-related parameters to help determine whether to start an SBT, and once an SBT is taking place, whether to stop an ongoing SBT. These values are used in addition to the *To start SBT* parameters and *To stop SBT* parameters specified during configuration.

To access SBT settings

See Section 2.3.

2.4.4 Monitoring progress

When Quick Wean is enabled, two additional monitoring windows are available:

- Quick Wean or Quick Wean & SBT Status window
- SBT history window (view 3)

2.4.4.1 Quick Wean/Quick Wean & SBT Status window

Like the ventilation Vent Status window, the Quick Wean/Quick Wean & SBT Status window uses floating indicators moving up and down within the columns to show the values for SBT- and weaning-related parameters. The data is updated every breath.

To help you quickly determine the SBT status (automatic or not), the window name changes as follows:

- When automatic SBTs are disabled, the window is labeled *Quick Wean*.
- When automatic SBTs are enabled, the window is labeled *Quick Wean & SBT*.

The content of the window changes depending on which phase the device is in.

Table 2-7. Quick Wean/Quick Wean & SBT Status window

When ...	Quick Wean/Quick Wean & SBT Status window ...
Quick Wean is enabled	Displays the text <i>Verifying conditions</i> .
To start SBT conditions are met	Displays: • The text <i>Conditions fulfilled/Starting SBT in XX time period</i>. • Displays a timer (HH:MM:SS) showing how long the patient values have been within the target ranges.

When ...	Quick Wean/Quick Wean & SBT Status window ...
To start SBT conditions are met	Displays: • The text <i>Conditions fulfilled/SBT will not start</i>. • A timer (HH:MM:SS) showing how long the patient values have been within the target ranges.
SBT is in progress	Displays: • The text <i>SBT running</i> • A timer (HH:MM:SS) showing how long the SBT has been running • Pulsing green bars above and below the floats for parameters that are within the defined thresholds Parameters that are out of range do not show the green bar.

2.4.4.2 SBT history window

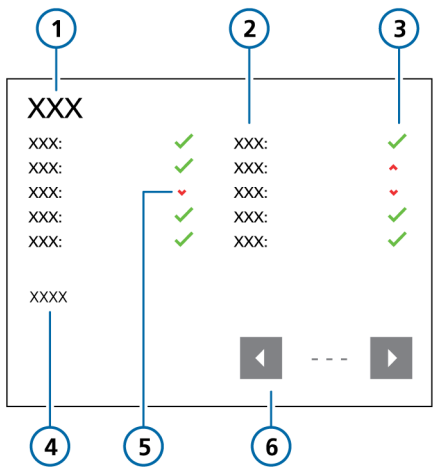
The SBT history window, available in view 3 of the INTELLiVENT-ASV views, displays an overview of all of the key ventilation parameters.

A green checkmark indicates that the parameter is within acceptable limits. A red up or down arrow indicates a parameter value that is out of the acceptable range.

During an active SBT, the window displays the start time and date, as well as the status message, *SBT running*. When an SBT is ended, the window displays information about how the previous SBT ended (successfully completed (*fulfilled*) or stopped prematurely (*stopped*)).

The History (arrow) buttons at the bottom of the window allow you to scroll through previous SBT data.

Figure 2-4. SBT history window



- | | |
|------------------------------------|--|
| 1 Panel title: SBT history | 4 SBT status, time started |
| 2 Weaning parameters | 5 Value out of range (red up arrow: too high; red down arrow: too low) |
| 3 Value in range (green checkmark) | 6 View previous SBT data |

To display the SBT history window

- ▶ Touch the view buttons until the SBT history window is displayed.

2.5 Conducting an SBT

SBTs can be started manually (Section 2.5.1) or automatically.

To start an automated SBT, all of the following conditions must be met:

- The patient must be active
- Automated SBTs are enabled
- Patient conditions must be within target ranges for all of the *To start SBT* criteria, for the time specified in the *Time before starting SBT* setting
- Enough time has passed since the last SBT (*Time between 2 SBTs* setting), if applicable
- The current time is within the allowed range (*SBT Time Range* setting)

If all conditions are met, the system starts an SBT.

The following changes occur.

Table 2-8. System changes when conducting an SBT

System changes	For details, see ...
The Quick Wean & SBT status window displays pulsing green bars for parameters within the defined thresholds, and starts a timer.	Section 2.4.4.1
The SBT history window shows the time the SBT started.	Section 2.4.4.2

System changes	For details, see ...
Additional parameters are used during the SBT: • Rate inc% • PetCO₂ inc (absolute increase in PetCO₂) Rate inc% and PetCO₂ inc values are used as <i>To stop SBT</i> criteria. The limits are set in Configuration.	Section 2.5.2
The system changes the settings for %MinVol and PEEP, if needed, to those specified in Configuration (Configuration > Modes > SBT settings window). Note that PEEP settings are changed only if PEEP management is automated.	Section 2.9.1

2.5.1 Manually starting/stopping an SBT

You can manually start an SBT any time the patient is breathing spontaneously. The Start SBT button becomes available in the INTELLiVENT-ASV Settings > Quick Wean window.

To manually start an SBT

1. Touch the **Target** button to access the INTELLiVENT-ASV Settings window.
2. Touch the **Quick Wean** tab.
Note that the **Start SBT** button is enabled only when the patient is breathing spontaneously.
3. Touch the **Start SBT** button.

The system immediately starts an SBT by reducing %MinVol and PEEP (when management is automated) to the configured settings. For details on what the device does, see Table 2-8.

The SBT continues until it successfully completes or it is stopped. See Section 2.6.

The SBT history window displays the start time of the SBT, with the text, *SBT manually started*. It also provides the end time, with a short description of how the SBT ended: *SBT successfully fulfilled* (completed the specified time), *SBT stopped* (stopped ahead of time due to parameter value(s) being out of range, or *SBT manually stopped*.

To manually stop an SBT

- In the INTELLiVENT-ASV Settings > Quick Wean window, touch the **Stop SBT** button.

The SBT history window records the time the SBT was stopped, and shows the text, *SBT manually stopped*.

The system returns to the previous INTELLiVENT-ASV settings and starts monitoring patient conditions for the next possible SBT.

2.5.2 PetCO₂ increases

NOTICE

PetCO₂ inc is used as part of *To stop SBT* criteria; it is not displayed.

During an SBT, the system uses the PetCO₂ increase as a *To stop SBT* criterion. You set a maximum allowed value in the *To stop SBT* window in Configuration.

The changes in **PetCO₂** can give an indication of whether the patient is experiencing increased work of breathing (WOB). The system monitors the **PetCO₂** increase, as well as the measured **PetCO₂** value against the defined target range. For details about how the controller uses this data, see Section 1.7.2.

2.5.3 Monitoring breath rate increases

NOTICE

Rate inc % is only monitored during an SBT.

During an SBT, the breathing rate increase (**Rate inc %**), in percent, is also monitored.

The changes in this value can provide an indication of whether the patient is experiencing increased work of breathing (WOB) during an SBT. The rate increase is measured every minute by taking the current value and calculating the percent change from an average rate established just prior to the start of the SBT.

The parameter is displayed in the Monitoring 1 window, as main monitoring parameters (MMP) (configurable), secondary monitoring parameters (SMPs) in the Monitoring window, trend graphs, and in the SBT history window.

2.6 Conditions for stopping an SBT

NOTICE

The maximum length of time a disconnection is allowed is 1 minute, regardless of the **Tolerance time** setting.

If an SBT is stopped due to disconnection (whether inadvertent or for suctioning), the ventilator continues with the previous INTELLiVENT-ASV settings.

The SBT window displays the message **SBT stopped manually**.

During an SBT, the device monitors the *To stop SBT* parameters and other settings to determine whether to stop the SBT.

An SBT (automated or manual) is stopped if any of the following conditions is met:

- If a *To stop SBT* parameter is out of range for longer than the time interval specified in the **Tolerance time** parameter, the SBT is stopped, and an alarm, **SBT aborted**, is generated.
- Quick Wean is disabled in the INTELLiVENT-ASV Settings window.
- The device is placed into standby.
- The **%MinVol** is manually changed.
- The ventilation mode is changed.
- A P/V Tool maneuver is performed.
- The patient becomes passive (no longer meets the active criteria).
- The measured **SpO₂** value meets the criteria for a rapid therapy escalation.
- A disconnection > 1 minute occurs.

The following table lists the *To stop SBT* parameters and the default threshold values.

Some of the *To stop SBT* parameters are not explicitly set. Rather, they are either calculated, or you set the *To start/during SBT* value, and a value outside of this setting becomes the *To stop SBT* criterion.

For the definition of a parameter, see Section 2.1.2. For parameter ranges and other details, see Section 2.10.

Table 2-9. Quick Wean To stop SBT criteria

Parameter (unit)	Where set/how used	Default <i>To stop SBT</i> value
Oxygen (%)	Configuration > Modes > SBT > To start SBT window Set in the To start SBT window. The Oxygen setting to end an SBT is always the Oxygen setting in the To start SBT window + 10.	> 50
PEEP (cmH ₂ O)	Configuration > Modes > SBT > To start SBT window Set the upper limit that PEEP cannot exceed during an SBT.	Patients > 40 kg: > 8 Patients ≤ 40 kg: > 6
PetCO ₂ (mmHg)	Used indirectly together with PetCO ₂ inc as <i>To stop SBT</i> criteria. For additional details, see Section 1.7.2.	If PetCO ₂ > (upper limit INTELLiVENT-ASV PetCO ₂ target range + 3 mmHg), an ongoing SBT is stopped immediately.
PetCO ₂ inc (mmHg)	Configuration > Modes > SBT > To stop SBT window End-tidal CO ₂ pressure increase compared to the values before the SBT. Only applies during an SBT.	> 8 mmHg
Psupport max (cmH ₂ O)	INTELLiVENT-ASV Settings > Quick Wean/STB settings window Set the upper limit that Psupport cannot exceed during the SBT.	> 12
Rate (b/min)	INTELLiVENT-ASV Settings > Quick Wean/STB Settings window Set the upper limit that Rate cannot exceed during SBT.	Patients > 30 kg: > 35 Patients ≤ 30 kg: > 45

Parameter (unit)	Where set/how used	Default <i>To stop SBT</i> value
Rate inc	Configuration > Modes > SBT > To stop SBT window Percentage increase in respiratory rate as a result of the SBT. Only applies during an SBT.	> 50% increase over the average rate established just prior to the SBT
RSB (1/(l*min))	Not configurable.	> 105
SpO2 (%)	Not configurable.	< (INTELLiVENT-ASV-set SpO2 target range)
Vt/IBW (ml/kg)	Configuration > Modes > SBT > To start SBT window Here you specify the minimum Vt/IBW setting allowed during an SBT.	< 5
Tolerance time (s)	Configuration > Modes > SBT > To stop SBT window	Patients > 40 kg: 180 Patients ≤ 40 kg: 30
Max. duration (min)	Configuration > Modes > SBT > To stop SBT window	30

2.7 Conditions for successfully completing an SBT

During an SBT, the device monitors parameters against the *To stop SBT* threshold values. If parameters remain in range for the duration set for the SBT (specified by the **Max. duration** parameter), the SBT is ended and marked as **SBT successfully fulfilled**. An **SBT Fulfilled** alarm is generated.

When an SBT is fulfilled, the device:

- Returns to the previous INTELLiVENT-ASV settings
- Returns %MinVol and PEEP (when automated) to the value prior to the start of the SBT
- Starts monitoring patient conditions against the *To start SBT* thresholds (Section 2.4), and the **Time between 2 SBTs** time.

2.8 About Quick Wean alarms and messages

Quick Wean provides a set of alarms and messages related to weaning activities, including SBTs. Messages are written to the Event log. Alarms and messages are displayed in the following locations:

- Alarm message bar
- Event log
- SBT history window

To review and dismiss an alarm

- ▶ Do any of the following:

- Touch the message to open the Alarms > Buffer window. Review the message, then close the window.
- Touch the red I-icon and view the alarm log.
- Open the Alarms > Buffer window and review the alarm message, then close the window.

To review help information for the alarm, touch the alarm entry in the buffer. A short description is displayed.

The following table provides an overview of the Quick Wean-related alarms and messages. For detailed information about system alarms, see your ventilator *Operator's Manual*.

Table 2-10. Quick Wean alarms and messages

Alarm message	Description
SBT aborted <i>Medium priority.</i>	The SBT was stopped. For possible reasons, see Section 2.6. Dismiss the alarm as described in Section 2.8.
SBT successfully fulfilled <i>Medium priority.</i>	The SBT was ended because Max. duration was reached. Dismiss the alarm as described in Section 2.8.
SBT stopped after HHH hours MM minutes	How long the SBT ran before being stopped. Shown in SBT history window and Event log.
SBT started at YYYY-MM-DD HHH hours MM minutes	When an SBT starts automatically, this message records the time. Shown in SBT history window and Event log.
SBT fulfilled after HHH hours MM minutes	When SBT ends successfully, this message records the time. The time is equal to the Max. duration value. Shown in SBT history window.
SBT manually started at YYYY-MM-DD HHH hours MM minutes	When an SBT is manually started by selecting the Start SBT button, this message records the time. Shown in SBT history window.

Alarm message	Description
SBT manually stopped after HHH hours MM minutes	When an SBT is manually ended by selecting the Stop SBT button, this message records for how long the SBT ran. Shown in SBT history window and Event log.
Too high (red up arrow) and Too low (red down arrow) indicators	When a parameter's value goes above the allowed range, a red up arrow is displayed next to the parameter in the SBT history window. When a parameter's value is below the allowed range, a red down arrow is displayed.
Within range (green checkmark) indicator	When a parameter's value is within the specified range, a green checkmark is displayed.

2.9 Configuring Quick Wean and SBTs

You configure Quick Wean using the Configuration screens, in Standby mode. These settings cannot be modified while ventilating a patient.

While the default parameter values are all based on the currently available literature, you can change the settings if you prefer to use a different protocol.

The system monitors patient conditions against these parameter thresholds to determine whether the patient is ready for weaning activities, what adjustments to make when an SBT begins, and whether to stop the weaning activities.

For details on putting the ventilator into Standby and accessing Configuration mode, refer to the ventilator *Operator's Manual*.

Some settings are based on the patient's weight: patients weighing > 40 kg and those weighing ≤ 40 kg. For the list of default values, see Table 2-12.

2.9.1 Adjusting default SBT values in Configuration

The default SBT control settings are defined in the following locations:

- In Configuration mode, in the Modes > SBT windows: To start SBT, SBT settings, and To stop SBT
- In the INTELLiVENT-ASV Settings > Quick Wean/SBT settings window (Section 2.3)

The SBT configuration windows provide access to the following controls:

Table 2-11. SBT default settings configuration windows

Configura- tion window	Controls
To start SBT	Patient conditions are monitored against the limits defined here for the listed parameters to determine when they are ready for an SBT: PEEP, Oxygen, Vt/IBW, Tolerance time
SBT settings	When an SBT begins, the device adjusts PEEP (when automated) and %MinVol to the values specified here.
To stop SBT	During an SBT, patient conditions are monitored against the limits defined here for the listed parameters to determine whether to stop the SBT: Rate inc, PetCO2 inc, Tolerance time, Max. duration

Each of these windows is divided into two groups: the controls on the top half apply to patients weighing > 40 kg; the controls on the bottom half apply to patients weighing ≤ 40 kg.

You can change the default settings to match your institution's protocol, if needed.

To change the default *To start SBT*, *SBT*, and/or *To stop SBT* settings in Configuration

1. Without a patient connected, put the ventilator into Standby.
2. Access the Configuration screens, and on the left side, touch **Modes**, then touch **SBT**.

The **SBT** tabs appear, with the *To start SBT* parameters displayed by default.

3. In the *To start SBT* window, review and adjust the threshold values for starting an SBT for the following parameters: PEEP, Oxygen, Vt/IBW, and Tolerance time.

For details about the parameters, see Table 2-6.

4. Touch the **SBT settings** tab to review and adjust the starting PEEP and %MinVol values for an SBT.

When conditions to start an SBT are met, the device adjusts these parameters to the values set here for the duration of the SBT.

5. Touch the **To stop SBT** tab to review and adjust the threshold values for stopping an SBT for the following parameters: Rate inc, PetCO2 inc, Tolerance time, and Max. duration.

For details about the parameters, see Table 2-9.

6. To reset the values to the factory defaults, touch the **Use factory settings** button, and when prompted to confirm, touch **Yes**.

Touch **No** to cancel the reset.

All of the controls on all three SBT windows are reset to the factory default settings.

7. Touch the **Back** button to return to the main Configuration window.
8. When finished, exit Configuration mode.

2.9.2 Restoring factory default settings

To return the SBT parameter values to factory defaults

1. Open the Configuration > Modes > SBT window.
 2. Touch the **Use factory settings** button.
- All of the controls on all three SBT windows are reset to the factory default settings.

Note that this does not affect the SBT parameters that are set in the INTELLi-VENT-ASV Settings window. Those parameter defaults are configured in individual Quick Setups.

2.10 Quick Wean parameter specifications

The following table is a comprehensive list of all of the Quick Wean-related parameters.

For the definition of a parameter, see Section 2.1.2.

Note that references to the Quick Wean status window apply to both *Quick Wean* and *Quick Wean & SBT*.

Table 2-12. Quick Wean parameters

Parameter	Default values	Where displayed/Where set	Range
%fSpont (%)	To start SBT: 100%	Displayed in: SBT history window Set in: N/A (calculated value)	--
fSpont	--	Displayed in: - Quick Wean & SBT status window - SBT history window - Monitoring window Set in: N/A	--
Max. duration (min)	By default, set to 30 minutes OFF means that there is no limit to how long the SBT can run.	Displayed and set in: Configuration > Modes > SBT > To stop SBT	OFF, 20–240
%MinVol (%)	Quick Wean enabled: 70 During SBT: 25	Displayed in: INTELLiVENT-ASV main display in the %MinVol control Set in: Configuration > Modes > SBT > SBT settings	%MinVol during SBT: 25–70
Oxygen (%)	To start SBT: ≤ 40 To stop SBT: > 50 The buttons are interdependent: The <i>To start SBT</i> setting is always 10 below the <i>To stop SBT</i> setting.	Displayed in: - INTELLiVENT-ASV main display in the Oxygen control - Quick Wean & SBT status window - SBT history window - Monitoring window Set in: Configuration > Modes > SBT > To start SBT	To start SBT: 30–50 To stop SBT: 40–60

Parameter	Default values	Where displayed/Where set	Range
PEEP (cmH ₂ O)	To start SBT: Patients > 40 kg: ≤ 8 Patients ≤ 40 kg: ≤ 6 To stop SBT: Patients > 40 kg: > 8 Patients ≤ 40 kg: > 6 During SBT: PEEP is set to 5 by default.	Displayed in: • INTELLiVENT-ASV main display in PEEP control • Quick Wean & SBT status window • SBT history window • Monitoring window Set in: • Configuration > Modes > SBT > To start SBT • Configuration > Modes > SBT > SBT settings	To start SBT: 5–10 PEEP during SBT: 0–5
PetCO ₂ (mmHg)	To stop SBT: PetCO₂ > (upper limit INTELLiVENT-ASV PetCO₂ target range + 3 mmHg)	Displayed in: • Patients ≤ 40 kg: Quick Wean status panel • SBT history window • Ventilation horizon and map • Monitoring > CO₂ window • Dynamic Lung panel This value is not configured. You can, however, shift the target range, if needed. See Section 1.4.10.3.	Depends on PetCO ₂ target range
PetCO ₂ inc (mmHg)	To stop SBT: > 8 increase	Not displayed. Set in: Configuration > Modes > SBT > To stop SBT	4–20
Psupport max (cmH ₂ O)	To start SBT: ≤ 12 To stop SBT: > 12	Displayed in: • INTELLiVENT-ASV Settings > Quick Wean/STB settings window • SBT history window Set in: INTELLiVENT-ASV Settings > Quick Wean/STB settings window	6–25

Parameter	Default values	Where displayed/Where set	Range
RSB (1 /(l*min))	To start SBT: ≤ 105 To stop SBT: > 105	Displayed in: - Patients > 40 kg: Quick Wean & SBT status panel - SBT history window The RSB parameter is only used for patients weighing > 40 kg. This value is not configured.	105
Rate (b/min)	To start SBT: Patients > 30 kg: ≤ 35 Patients ≤ 30 kg: ≤ 45 To stop SBT: Patients > 30 kg: > 35 Patients ≤ 30 kg: > 45	Displayed in: - Quick Wean & SBT status window (as fSpont) - SBT history window (as fSpont) - INTELLiVENT-ASV Settings > Quick Wean/STB settings window Set in: INTELLiVENT-ASV Settings > Quick Wean/STB settings window	25–65
Rate inc (%)	To stop SBT: > 50% increase over the average rate established just prior to the start of the SBT	Displayed in: SBT history window Set in: Configuration > Modes > SBT > To stop SBT	20–100
SBT time range	To allow SBTs at any time, set both controls to the same time. Default: Between 8:00 and 20:00.	Displayed and set in: INTELLiVENT-ASV Settings > Quick Wean/STB settings window	HH:MM

Parameter	Default values	Where displayed/Where set	Range
SpO2 (%)	To start SBT: Within or above the INTELLiVENT-ASV SpO2 target range To stop SBT: Below the INTELLiVENT-ASV SpO2 target range minus 2%	Displayed in: - Oxygenation horizon and map (views 1, 2, 3) - Monitoring > SpO2 window - SBT history window - Dynamic Lung panel - Main window under MMP list This value is not configured. You can, however, shift the target range, if needed. See Section 1.4.10.3.	Depends on the SpO2 target range
Time before starting SBT (min)	By default, set to 30 minutes	Displayed and set in: INTELLiVENT-ASV Settings > Quick Wean/STB settings window	10–120
Time between 2 STBs (min)	To start next SBT: By default, 30 minutes	Displayed and set in: INTELLiVENT-ASV Settings > Quick Wean/STB settings window	30–240
Tolerance time (s)	To start SBT: Patients > 40 kg: 180 s Patients ≤ 40 kg: 60 s To stop SBT: Patients > 40 kg: 180 s Patients ≤ 40 kg: 30 s	Displayed and configured in: - Configuration > Modes > SBT > To start SBT - Configuration > Modes > SBT > To stop SBT	10–300
For the following parameters, the Tolerance time setting is predefined (regardless of the Configuration settings): %fSpont: must be 100% for a minimum of 60 seconds - For patients ≤ 40 kg, the Tolerance Time for Rate and Vt/IBW is 180 seconds			
Vt/IBW (ml/ kg)	To start SBT: ≥ 5 ml/kg To stop SBT: < 5 ml/kg	Displayed in: - Quick Wean & SBT status window - SBT history window - Monitoring window Set in: Configuration > Modes > SBT > To start SBT	3–6

3

Specifications

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3.1 Intended use

The INTELLiVENT-ASV software is an option for the HAMILTON-C6 ventilator, and is, for all legal purposes, subject to the Intended Use as stated in the current ventilator *Operator's Manual*.

3.2 Technical data

The following table provides technical data related to INTELLiVENT-ASV.

Table 3-1. INTELLiVENT-ASV technical data

Operator settings	
Patient height (cm)	30 to 250 (adult, pediatric)
%MinVol (%)	25 to 350 (manual) 70 to 200 (automatic)
Oxygen (%)	21 to 100 (manual and automatic)
PEEP (cmH2O)	0 to 50 (manual) 5 to 24 (automatic)
Internal calculations	
Ideal body weight, IBW (kg)	Calculation based on patient height and gender. For details, see your ventilator <i>Operator's Manual</i> . INTELLiVENT-ASV can only be used for patients weighing more than 7 kg.
MinVol (target) (l/min)	Target MinVol is calculated as: $IBW \times NormMinVent \times \%MinVol / 100$ where <i>NormMinVent</i> (l/kg/min) is the normal minute ventilation (not valid for pediatric patients < 30 kg). For details, see your ventilator <i>Operator's Manual</i> .
ASV target respiratory rate (b/min)	Calculated as described in Section 1.7.2.
Vdaw (ml/kg)	Calculation of the dead space: $IBW \times 2.2$
Vt (target)	$MinVol / f$ (target)

Monitoring

Values (numerical)	PetCO ₂ target range, depending on patient condition and treatment (P _{peak}); SpO ₂ target range, depending on patient condition and treatment (PEEP)
Current ventilation settings	ExpMinVol, f _{Total} , f _{Control} , P _{peak} (P _{insp} + PEEP), Oxygen, PEEP
Patient status	f _{Spont} , PetCO ₂ , SpO ₂
Graphics	f (target)/V _t , PetCO ₂ /target, PEEP/O ₂ , PEEP/SpO ₂
Trend parameters	Ventilation control, Oxygenation control

Performance specifications, Ventilation controller

Settling time	< 5 minutes
Response time (90% of steady state)	< 5 minutes (typical)
(Rel./command) Overshoot/undershoot	< 20%
Steady state deviation	5%
Maximum change of %MinVol per breath	1%

Performance specifications, Oxygenation controller

	Oxygen	PEEP
Settling time	The settling time depends on the patient condition relative to the SpO ₂ target, as defined by the appropriate approach (ARDSnet or Open Lung concept) for the current treatment. Note that if SpO ₂ enters the emergency zone, the system immediately sets Oxygen to 100%.	6 minutes
Response time (90% of steady state)	N/A, only target range for SpO ₂ specified	6 minutes
Rel/Command overshoot	none	N/A, SpO ₂ of some patients does not respond at all to PEEP changes. In this case, Oxygen is also changed if it is set to Automatic.
Command overshoot	none	N/A, SpO ₂ of some patients does not respond at all to PEEP changes. Upper PEEP limit, 24 cmH ₂ O, user can set lower limit.
Steady state deviation	N/A, only target range for SpO ₂ specified	N/A, only target range for SpO ₂ specified
Tracking error	N/A	N/A, only target range for SpO ₂ specified
Maximum change	Decrease: 5% of current Oxygen setting every 60 s Increase: 10% of current Oxygen setting every 30 s	1 cmH ₂ O every 6 min

Lung-protective ventilation, Ventilation controller

Minimum %MinVol	70% (100% if no PetCO ₂ is available)
Maximum %MinVol	200%

Lung-protective ventilation, Oxygenation controller

Minimum Oxygen	21% or 30%, depending on what is selected in the Oxygen limit control in the INTELLiVENT-ASV Settings > More window. Default: 30%
Maximum Oxygen	100%
PEEP limits	Low: 5 to 22 (Default: 5) High: 7 to 24 (Default: 15)

3.3 Data logging

Breath-by-breath data representing the actual values of these listed monitoring values and settings are saved by the ventilation unit of the processor.

Table 3-2. Data log inputs

Saved parameters	Unit
Date	N/A
Time	N/A
ARDS	N/A
Chronic hypercapnia	N/A
Brain injury	N/A
Quick Wean	N/A
Controller ventilation	N/A
Controller oxygena- tion	N/A
Controller PEEP	N/A
Recruitment passive	N/A
Recruitment running	N/A
fSpont	N/A
PEEP limit	cmH2O
%MinVol	%
ExpMinVol	l/min
RRIMV	breaths per min
RRtot	breaths per min
RRtarget	breaths per min
fSpont	breaths per min
Ti	s
Pinsp	cmH2O
SpO2	%

Saved parameters	Unit
PetCO2	mmHg
Oxygen	%
PEEP/CPAP	cmH2O
Pulse	bpm (beats per minute)
QI-SpO2	%
VtTarget	ml
RCexp	s

The memory reserved for breath-by-breath data allows storage of at least 10 days of recording. The data is saved breath-by-breath, but at most one time per second.

Data is exported using the test software. Refer to the ventilator *Service Manual*.

3.4 References

References are available on the Hamilton Medical website, www.hamilton-medical.com.

active patient

An active patient is one who is making inspiratory efforts. Active breathing is identified as the occurrence of at least five (5) consecutive spontaneous breaths. Spontaneous breaths are those for which inspiration is both patient triggered and patient cycled. In addition to spontaneous breaths as described, an active patient must also meet the requirements described in the rules for transitioning between active and passive states.

alarm buffer

Contains information on recent alarm occurrences

ARDS

Acute respiratory distress syndrome, which presents as an acute, severe injury to most segments of the lung

brain injury

Patients with brain injuries with whom it is critical to maintain CO₂ under strict control to keep intracranial pressures at safe levels, and to keep oxygenation within a normal range

chronic hypercapnia

For patients with chronically high arterial CO₂ values, usually as a result of obstruction in airways due to chronic bronchitis, emphysema, or both

IBW

Ideal body weight; a calculated value for adult and pediatric patients based on the patient's gender and height; used as the basis for the initial settings of various parameters

Oxygen

Oxygen (FiO₂) concentration of the delivered gas, a control setting, monitored parameter.

Oxygenation controller

Automated PEEP and Oxygen controller, available in INTELLiVENT-ASV

PaCO₂-PetCO₂ gradient

The difference between the PaCO₂ measured in the blood (using blood gas analysis) and the PetCO₂ measured using a noninvasive CO₂ sensor. Under normal conditions, PaCO₂ is approximately 3-5 mmHg higher than PetCO₂.

passive patient

A passive patient is one who is not making inspiratory efforts. Passive breathing is identified as the occurrence of at least five (5) consecutive mandatory breaths. In general, mandatory breaths are those for which inspiration is either machine triggered or machine cycled. In INTELLiVENT-ASV, mandatory inspirations are both machine triggered and machine cycled. In addition to mandatory breaths as described, a passive patient must also meet the requirements described in the rules for transitioning between active and passive status.

PEEP/CPAP

PEEP (positive end-expiratory pressure) and CPAP (continuous positive airway pressure), a control setting and monitored parameter. PEEP and CPAP are constant pressures applied during both the inspiratory and expiratory phases.

Plethysmogram

The waveform that visualizes the pulsating blood volume; it is delivered by the pulse oximeter.

SpO₂

Oxygen saturation.

Ventilation controller

Automated %MinVol controller, available in INTELLiVENT-ASV. The controller uses different inputs to control the target minute volume, depending on whether the patient is passive or active.

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