



INTELLiVENT-ASV

Operator's Manual

HAMILTON-C3

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Operator's Manual

INTELLiVENT-ASV

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Table of Contents

Chapter 1	INTELLiVENT-ASV	11
1.1	Overview	12
1.2	Indications and contraindications for use	13
1.3	Preparing for ventilation with INTELLiVENT-ASV	13
1.4	Specifying INTELLiVENT-ASV settings	14
1.4.1	Specifying patient data	15
1.4.2	Selecting the INTELLiVENT-ASV mode	16
1.4.3	Selecting ventilation/oxygenation automation options	16
1.4.4	Selecting patient conditions	18
1.4.5	Selecting Quick Wean and SBT options	19
1.4.6	Specifying additional settings	21
1.4.7	Adjusting control settings	23
1.4.8	Adjusting alarm limits	24
1.4.9	Adjusting settings during active ventilation	26
1.4.10	About INTELLiVENT-ASV settings	27
1.5	Monitoring INTELLiVENT-ASV	34
1.5.1	About the INTELLiVENT windows and views	34
1.5.2	About the Ventilation map	37
1.5.3	About the Ventilation horizon	41
1.5.4	About the Oxygenation maps	43
1.5.5	About the Oxygenation horizon	48
1.5.6	About the plethysmogram and capnogram	49
1.5.7	About trends	50
1.5.8	INTELLiVENT-ASV symbols	50
1.6	Troubleshooting alarms	53
1.7	Management of minute volume (%MinVol)	56
1.7.1	Management of %MinVol, passive patient	57
1.7.2	Management of %MinVol, active patient	58
1.7.3	Rules for transitioning between active and passive states	60
1.7.4	Important notes about ventilation management	62
1.8	Management of PEEP and Oxygen	64
1.8.1	Management of PEEP/Oxygen for all patients	64
1.8.2	Emergency increase of Oxygen	65

1.8.3	Oxygenation management rules	66
1.8.4	Important notes about oxygenation management	68
1.9	Manual control of ventilation and oxygenation	70
1.9.1	Manual control of ventilation.....	70
1.9.2	Manual control of oxygenation.....	70
1.10	Assessing results.....	71
Chapter 2	Quick Wean	73
2.1	Overview	74
2.1.1	About Quick Wean use and modes.....	74
2.1.2	Key terms	76
2.2	Quick Wean in clinical use	77
2.2.1	Quick Wean workflow.....	77
2.2.2	About the Quick Wean parameters.....	77
2.2.3	Indications for use	78
2.3	Enabling/disabling and setting up automated SBTs	78
2.4	Conditions for starting weaning activities	81
2.4.1	About %MinVol calculations	83
2.4.2	Parameters used to determine weaning readiness (To start SBT group)	84
2.4.3	User-modifiable SBT parameters, INTELLiVENT Settings window	86
2.4.4	Monitoring progress	86
2.5	Conducting an SBT.....	90
2.5.1	Manually starting/stopping an SBT.....	91
2.5.2	PetCO ₂ increases.....	91
2.6	Conditions for stopping an SBT	92
2.7	Conditions for successfully completing an SBT	95
2.8	About Quick Wean alarms and messages	95
2.9	Configuring Quick Wean and SBTs	97
2.9.1	Adjusting default SBT values in Configuration.....	97
2.9.2	Adjusting default SBT values in the INTELLiVENT Settings window.....	99
2.9.3	Restoring factory default settings.....	100
2.10	Quick Wean parameter specifications	100

Chapter 3	Specifications	107
3.1	Intended use	108
3.2	Technical data	108
3.3	Data logging	111
3.4	References.....	111
	Glossary	113
	Index.....	115

About this guide and related documentation

This guide describes the features and functions of INTELLiVENT-ASV for HAMILTON-C3, and is designed for use together with the following documentation:

- *HAMILTON-C3 Operator's Manual*
- *Pulse Oximetry for HAMILTON-C3 Instructions for Use*
- *INTELLiVENT-ASV Quick Guide*

Conventions used in this guide

- Button and tab names are shown in a **bold** font.
- In this manual, pressure is indicated in cmH₂O, PetCO₂ in mmHg, and length in cm.

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.

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.

1

INTELLiVENT-ASV

1.1	Overview.....	12
1.2	Indications and contraindications for use.....	13
1.3	Preparing for ventilation with INTELLiVENT-ASV	13
1.4	Specifying INTELLiVENT-ASV settings.....	14
1.5	Monitoring INTELLiVENT-ASV	34
1.6	Troubleshooting alarms.....	53
1.7	Management of minute volume (%MinVol)	56
1.8	Management of PEEP and Oxygen	64
1.9	Manual control of ventilation and oxygenation.....	70
1.10	Assessing results	71

1.1 Overview

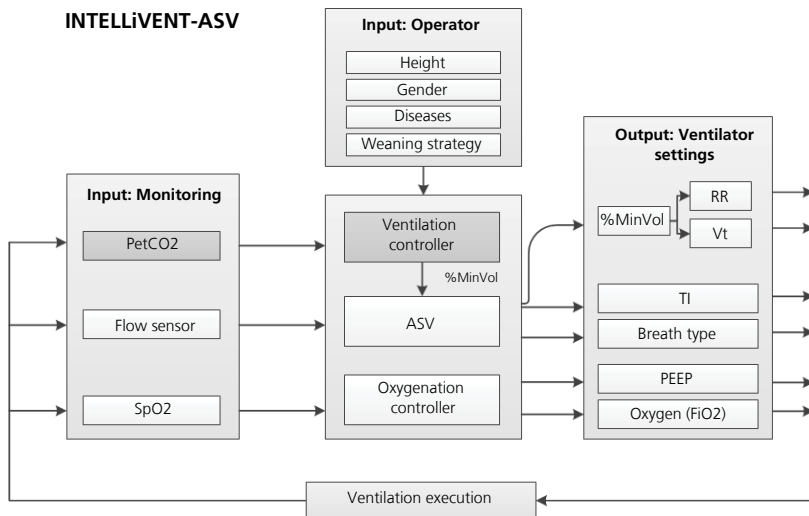
INTELLiVENT-ASV is an advanced ventilation mode, based on the proven Adaptive Support Ventilation (ASV) mode, to automatically regulate CO₂ elimination and oxygenation for both passive and active patients, based on both physiologic data from the patient and clinician-set targets.

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

ment 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 (or “fully closed-loop control”) for adult and pediatric patients only.
- Use INTELLiVENT-ASV for intubated patients.
- Automated oxygenation control is only available when using HPO as the oxygen source.
- 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.
- 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

1.3 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.

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

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

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

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

Specifying INTELLiVENT-ASV settings comprises the following steps.

		See ...
1	Verify the patient settings in the Standby window.	Section 1.4.1
2	Select the INTELLiVENT-ASV mode.	Section 1.4.2
3	Select ventilation and oxygenation automation options, including any needed target shift	Section 1.4.3
4	Select the patient condition, if needed	Section 1.4.4
5	Select Quick Wean options. If enabling Quick Wean and SBTs, select SBT settings.	Section 1.4.5

		See ...
6	Select additional options (auto-recruitment, upper and lower PEEP limits, minimum Oxygen limit).	Section 1.4.6
7	Review and adjust control settings.	Section 1.4.7
8	Review and adjust alarm limits.	Section 1.4.8
9	Adjust settings during active ventilation, if needed.	Section 1.4.9

1.4.1 Specifying patient data

NOTICE

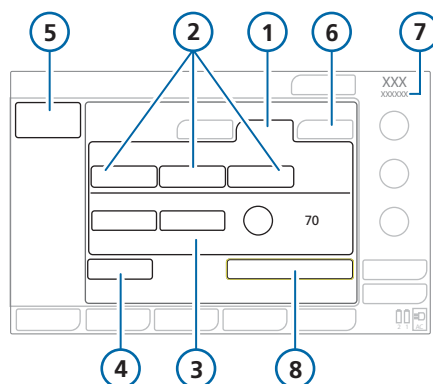
When coming from Standby and Last patient is selected, the last-used values are active, including patient height and gender, alarm limits, and control settings.

To specify patient data

- In the Standby window, choose the correct patient group, gender, and height.

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.

Figure 1-2. Standby window, adult patient



- | | |
|-----------------------------|----------------------------|
| 1 Adult/Ped patient group | 2 Quick setup buttons |
| 3 Gender, Height, and IBW | 4 Preop check button |
| 5 Elapsed time in Standby | 6 Last patient |
| 7 Patient group (Adult/ped) | 8 Start ventilation button |

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

For additional information, see the *Ventilator settings* chapter of the ventilator *Operator's Manual*.

1.4.1.1 Notes about exiting Standby

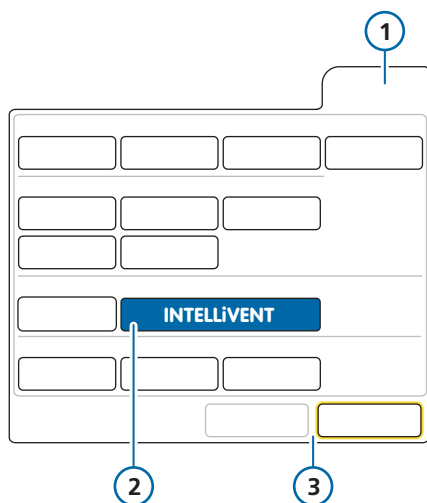
When starting ventilation from standby with a new patient selected and activating INTELLiVENT-ASV, the controllers (%Min-Vol, PEEP, and Oxygen) are set to default settings.

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.

Figure 1-3. Modes window, with INTELLiVENT



- 1 Modes
- 2 INTELLiVENT
- 3 Cancel and Confirm buttons, displayed only when changing modes

To select the INTELLiVENT-ASV mode

1. Touch the **Modes** button to open the Modes window (Figure 1-3).
2. Touch the **INTELLiVENT** button.
3. Touch **Confirm**.

The INTELLiVENT Settings window (Figure 1-4) opens, displaying the **Auto** tab.

Note that **Cancel/Continue** and **Back/Confirm** buttons are displayed only when changing modes. When adjusting settings during ventilation, these buttons are not displayed.

Touching **Cancel** (or doing nothing for 1 min) closes the window and returns you to the previously selected mode.

You can now select INTELLiVENT-ASV options.

1.4.3 Selecting ventilation/oxygenation automation options

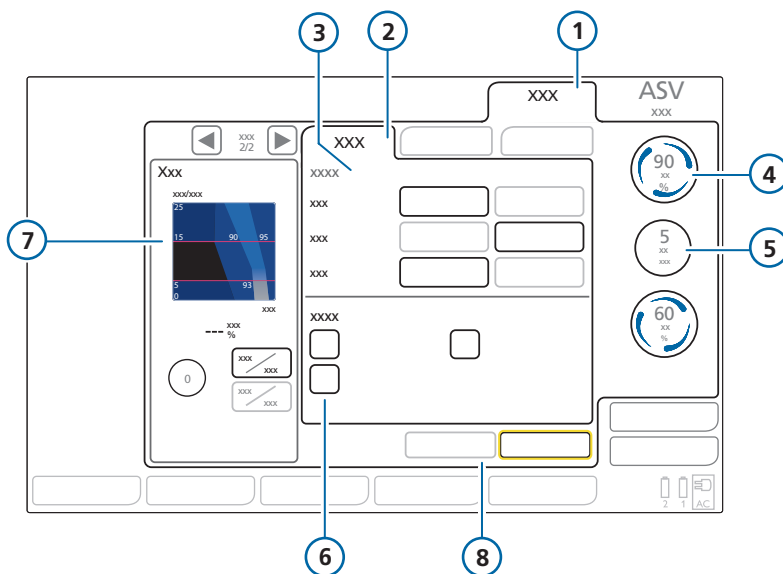
NOTICE

- 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 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
- A patient condition (ARDS, Chronic Hypercapnia, or Brain injury)
- Shift the PetCO2 and/or SpO2 target zones, if needed

Figure 1-4. INTELLiVENT Settings window, Auto tab



- | | | | |
|---|--|---|--|
| 1 | Modes | 2 | Auto tab |
| 3 | Controller settings: Automatic, Manual buttons for %MinVol, PEEP, Oxygen | 4 | Automated management indicator and parameter value |
| 5 | Manual management indicator and parameter value | 6 | Patient condition options |
| 7 | Map panel showing either a CO2 elimination map in view 1 or an Oxygenation map in view 2 | 8 | Cancel/Continue buttons (if displayed) |

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 Settings window, touch the **INTELLiVENT** 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 CO2 elimination 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 **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.
Touching the **X** or **Cancel** buttons, or doing nothing for 1 min closes the window and returns you to the previously selected mode.

1.4.4 Selecting patient conditions

The patient condition options affect some default CO2 elimination and oxygenation startup values and target settings. 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 Settings window, touch the **INTELLiVENT** 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 1-4.

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.

To change the targets, use the **Target Shift** control (Section 1.4.10.3).

4. Review the control settings on the right and, if desired, make any adjustments.
5. Set automation options, as needed, if you haven't already done so.
6. If displayed, touch **Continue** to accept the settings and proceed to the next step.

Touching the **X** or **Cancel** buttons, or doing nothing for 1 min closes the window and returns you to the previously selected mode.

1.4.5 Selecting Quick Wean and SBT options

NOTICE

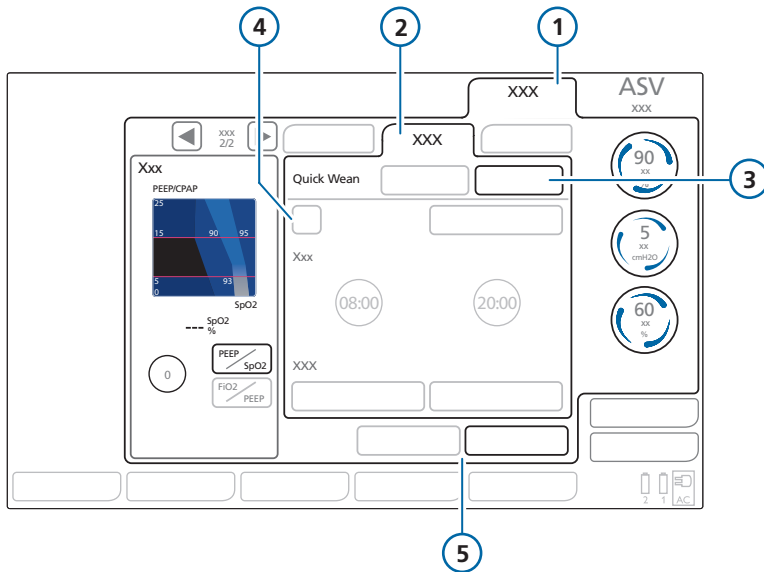
Quick Wean is not available if the patient condition selected in INTELLiVENT-ASV is Brain injury.

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

When Quick Wean is enabled, the device decreases ventilatory support, and, if automated SBTs are also enabled, performs an SBT when criteria are met.

Quick Wean and automated SBTs are both disabled by default, and can be enabled at any time during ventilation. See Section 2.3.

Figure 1-5. INTELLiVENT Settings window, Quick Wean tab



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

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 Settings window, touch the **INTELLiVENT** 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 1-5).

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.

Touching the **Back** button returns you to the Auto window.

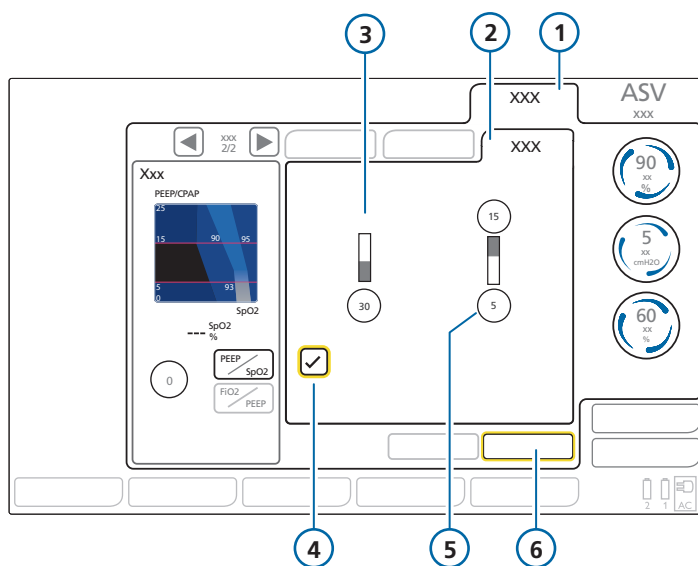
Touching the **X** button or doing nothing for 1 min closes the window and returns you to the previously selected mode.

1.4.6 Specifying additional settings

The INTELLiVENT 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

Figure 1-6. INTELLiVENT Settings window, More tab



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

To set auto-recruitment, PEEP limit, and minimum oxygen limit 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 Settings window, touch the **INTELLiVENT** 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 1-6).

- 3. Set options as specified in Table 1-2.
- 4. If displayed, touch **Confirm** to accept the settings and proceed to the next step, reviewing and adjusting control settings.

Touching the **Back** button returns you to the Quick Wean window.

Touching the **X** or **Cancel** buttons, or doing nothing for 1 min closes the window and returns you to the previously selected mode.

Table 1-2. More tab settings

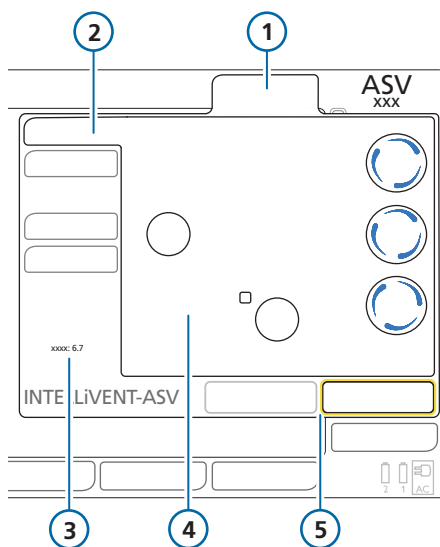
Setting	Description
Oxygen limit	When the Oxygen control is set to Automatic , you can set an absolute lower limit that the Oxygen controller cannot fall below. The limit can be set between 21% and 30%. See Section 1.4.10.5.
PEEP limit	When the PEEP control is set to Automatic , you can set an absolute 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 cmH ₂ O. See Section 1.4.10.4.
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, 2, and 3). By default, auto-recruitment is disabled.

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 Settings > More window.

Figure 1-7. INTELLiVENT Controls window, Basic tab



- | | |
|---|---|
| 1 Modes | 2 Basic |
| 3 Current %MinVol | 4 Control settings:
Pasvlimit and Trigger, in addition to %MinVol, PEEP, and/or Oxygen, if controlled manually |
| 5 Cancel/Confirm buttons (if displayed) | |

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 (Figure 1-8) to adjust any settings 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*.

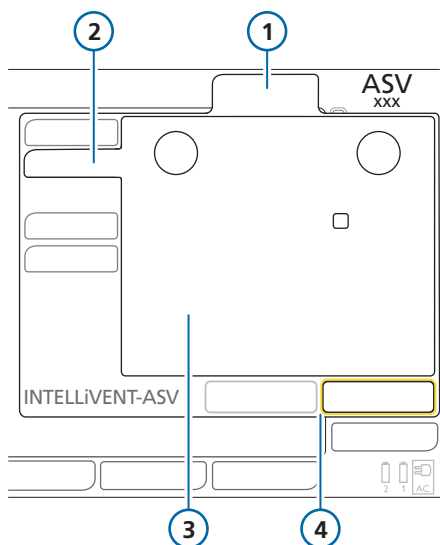
5. Touch the **Patient** tab to review patient data (height, gender), to ensure the correct IBW is calculated.

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.

Touching the **X** or **Cancel** buttons, or doing nothing for 1 min closes the window and returns you to the previously selected mode.

Figure 1-8. INTELLiVENT Controls window, More tab



- | | |
|--|--|
| 1 Modes | 2 More |
| 3 Control settings:
P-ramp, ETS, Sigh | 4 Cancel/Confirm
buttons (if displayed) |

⚠ CAUTION

You can suppress the physiological *PetCO₂* and *SpO₂* alarms for 2 min by pressing the Alarm silence 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*.

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.

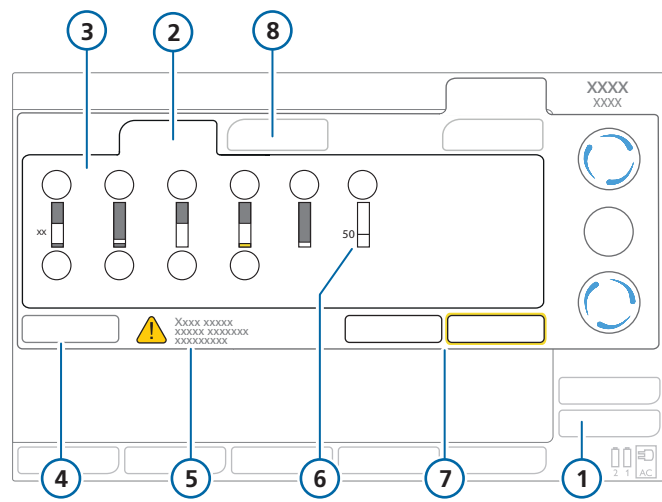
When ventilating with INTELLiVENT-ASV, pay particular attention to alarm limits for the following parameters: Pressure, Vt, *PetCO₂*, and *SpO₂*.

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, including setting an oxygen notification level, if desired (Section 1.4.10.6).
3. Touch the **Limits 2** tab to review and adjust the PetCO₂- or SpO₂-related 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, PI (Masimo only). 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.
 Touching **Cancel** or doing nothing for 1 min during initial setup returns you to the previously selected mode.
 Touching the **X** button or doing nothing for 1 min closes the window and returns you to the previously selected mode.

Figure 1-9. Setting alarm limits



- | | | | |
|---|---|---|-------------------------------|
| 1 | Alarms | 2 | Limits 1 |
| 3 | Alarm limit controls | 4 | Auto button |
| 5 | Notice to use ventilator-independent monitoring system when using INTELLiVENT-ASV | 6 | Oxygen msg (Section 1.4.10.6) |
| 7 | Cancel/Confirm buttons (if displayed) | 8 | Limits 2 |

INTELLiVENT-ASV setup is now complete.

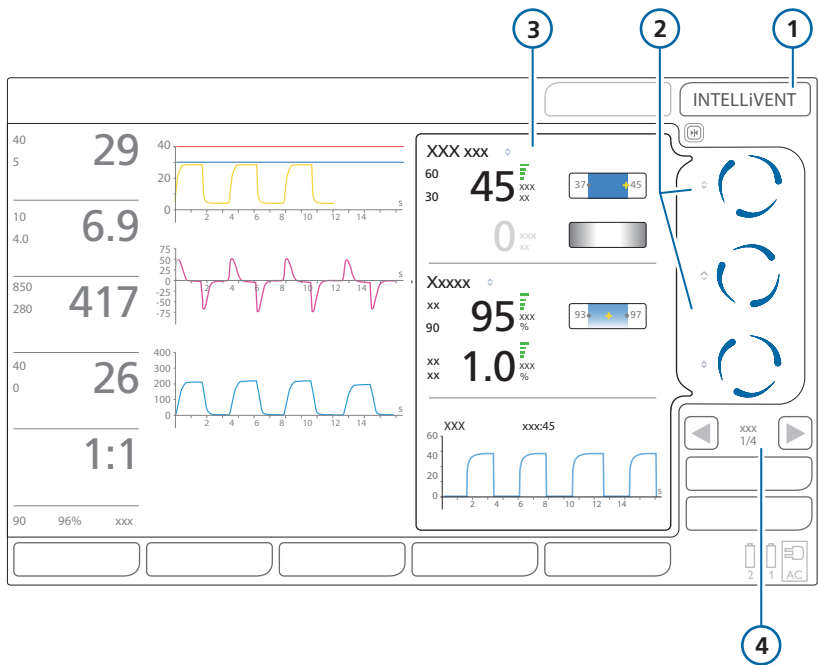
1.4.9 Adjusting settings during active ventilation

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 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 1-10. Active ventilation with INTELLiVENT-ASV



- | | | | |
|---|--|---|-------------------------------------|
| 1 | INTELLiVENT button to access Settings window | 2 | Controls managed by INTELLiVENT-ASV |
| 3 | Ventilation and Oxygenation horizons | 4 | View navigation buttons and number |

To display the INTELLiVENT Settings window

1. At any time during ventilation with INTELLiVENT-ASV, touch the **INTELLiVENT** button at the top right of the display, or touch one of the automated controllers.

The INTELLiVENT Settings window opens, with the **Auto** tab selected (Figure 1-4).

2. Make changes as desired on any of the tabs.
3. To review or change control settings, touch the **Controls** button and make changes as needed.
4. 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 1.4.10.4
Oxygen limit	Section 1.4.10.5
Oxygen level notification (Oxygen msg)	Section 1.4.10.6

1.4.10.1 About patient conditions

WARNING

- To prevent possible hyper- or hypo-ventilation, or hyper- or hypoxemia, ensure the patient data is accurate.
- Entering a substantially wrong height/IBW input will lead to a deviation of rate setting and %MinVol start values.
- 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.

CAUTION

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.
- If *Brain injury* is selected, the SpO₂ target range is set to 96% to 99% at minimum PEEP and 95% to 98% at maximum PEEP (with Target Shift set to 0).

This range is always active when **Brain injury** is selected, regardless of other selections; however, the range may change if the Target Shift is other than 0. The **Brain injury** target range setting 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

For details about selecting patient conditions, see Section 1.4.4.

Table 1-3 lists the patient conditions available in the INTELLiVENT Settings window. For patients with mixed conditions, you can select more than one option.

Table 1-3. Patient condition options 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 1-4 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 1-4. Patient conditions and startup values for ventilation

Patient condition	Ventilation		Oxygenation	
	%MinVol startup value (%)	P ASV	Oxygen startup value (%)	PEEP startup value (cmH ₂ O) ²
Normal	100	30	60	5
ARDS	120	35	100	8
Chronic Hypercapnia	100	35	60	Manually controlled
ARDS + Chronic Hypercapnia	120	35	100	8
Brain Injury	100	30	60	Manually controlled

1.4.10.2 Automatic recruitment maneuvers

WARNING

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.

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

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

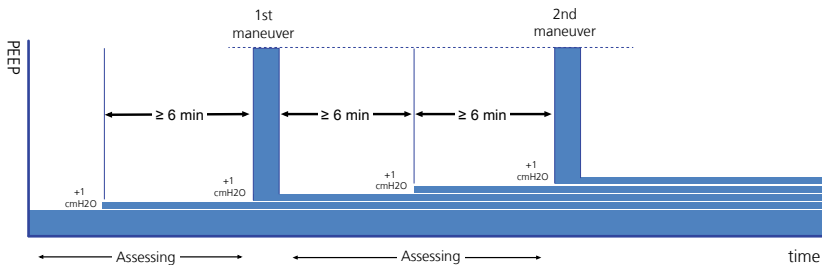
- ▶ In the INTELLiVENT Settings > More window, touch the **Auto-recruitment** checkbox.

When auto-recruitment is enabled, the text **auto-recruitment** is displayed on the Oxygenation maps and horizon (views 1, 2, and 3).

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 PEEP is manually changed or the patient is active.

Figure 1-11. Recruitment maneuver cycle



1.4.10.3 Target shift


WARNING

- Regularly check the patient after specifying a **PetCO2** or **SpO2** 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. These parameter values are used to track **PaCO2** and **SaO2**, respectively.

Target shift refers to:

- Readjustment of the **PetCO2** target range to have the measured **PetCO2** value be in accordance with a measured **PaCO2** value from blood gas analysis. This is referred to as the **PaCO2-PetCO2** gradient.
- Readjustment of the **SpO2** target range to have the measured **SpO2** value be in accordance with a measured **PaO2** value from blood gas analysis.

Table 1-5. SpO2 target shift limits based on patient condition

SpO2 target shift limits ³	
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%

Table 1-6. PetCO2 target shift limits

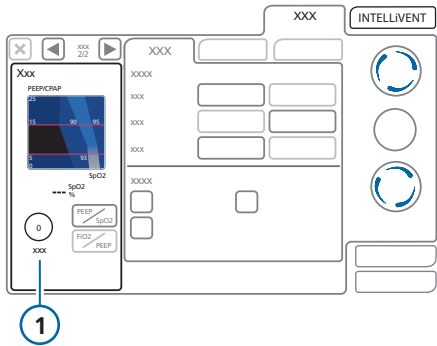
PetCO2 target shift limits	
All patient conditions	-20 mmHg to 10 mmHg

When the Target Shift is set to 0, there is no change to the target range values; they are set to the original INTELLiVENT-ASV settings.

The **Target Shift** control (1) is located in the Ventilation and Oxygenation map panel on the left side of the INTELLiVENT Settings window.

³ 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.

Figure 1-12. Target Shift control



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

1. To open the INTELLiVENT Settings window, touch the **INTELLiVENT** 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 Settings window.
3. Touch the **Target Shift** control to activate it, and turn the P&T knob clockwise or counter-clockwise to adjust the target range limits in increments of 1.
 - 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. Press the P&T knob to accept the changed value.
5. To shift the PetCO₂ target range beyond ± 5 mmHg:
 - Touch the **Target Shift** control again, and turn the P&T knob to set the value as desired.
 - Press the P&T knob to accept the changed 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 in view 3 (see Figures 1-14 and 1-20).

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

Table 1-7. Target shift display

Target Shift control	Text color and description
	White 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 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 1-8.

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

Table 1-8. 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 Settings > More window, set the desired upper and/or lower PEEP limits.

1.4.10.5 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.⁴

This limit is set in the INTELLiVENT Settings > More window. Set the limit to any value between 21% and 30%. The default setting is 30%.

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 1 window. See Section 1.4.8.

⁴ Not available in all markets.

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 s. See Section 1.7.4.
- If the SpO₂ signal is NOT reliable, the automated PEEP and Oxygen controls freeze after 30 s. 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 the chapters, *Monitoring ventilation* and *Intelligent panels* in your ventilator *Operator's Manual*.

1.5.1 About the INTELLiVENT windows and views

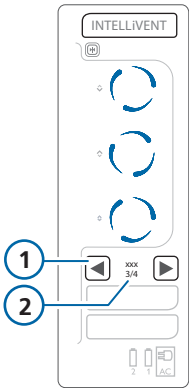
INTELLiVENT-ASV provides a graphical overview of CO₂ elimination (ventilation) and oxygenation, as well as other INTELLiVENT-related data on the main display in specialized windows.

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 buttons to cycle through the views. The view number is displayed between the buttons.

Figure 1-13. Displaying INTELLiVENT views



- | | |
|---------------------------|---------------|
| 1 View navigation buttons | 2 View number |
|---------------------------|---------------|

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

Table 1-9. INTELLiVENT-ASV views, overview

View	Description	See ...
Ventilation map	Shows the current patient PetCO₂ value and target range in relation to PEEP and Ppeak, together with the set limits. The map is shown: • In the INTELLiVENT Settings window, in view 1 • During active ventilation in view 3	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 views 1 and 2.	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. The selected map is shown: • In the INTELLiVENT Settings window, in view 2 • During active ventilation in view 3	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 views 1 and 2.	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 2 and 4 • As a waveform on the main display, if selected	Section 1.5.6
Capnogram	Provides a real-time end-tidal CO₂ waveform. A capnogram is shown: • During active ventilation in view 1 • 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.	See Section 2.4.4.1
SBT history	The SBT history window is shown during active ventilation in view 4.	See Section 2.4.4.2

1.5.2 About the Ventilation 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

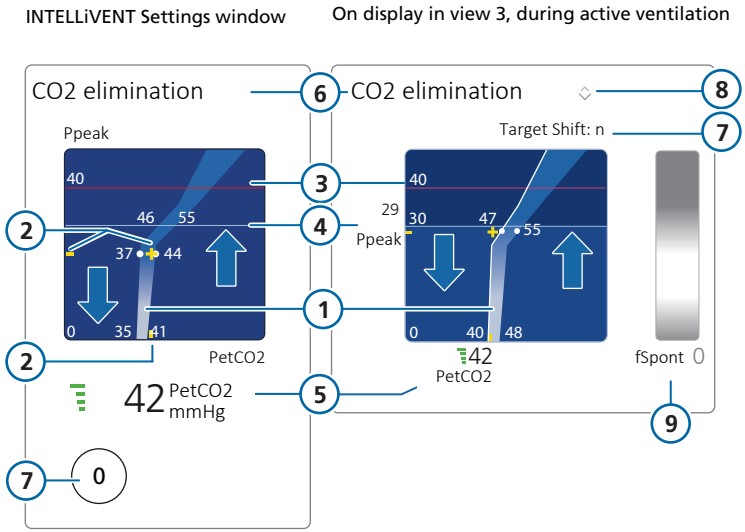
NOTICE

The maximum P_{peak} value that can be shown on the CO₂ elimination map is 50 cmH₂O, so in some cases, the map may not show the patient symbol. INTELLiVENT 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 3

Figure 1-14. Ventilation map, INTELLiVENT Settings window (left), view 3 during ventilation (right)



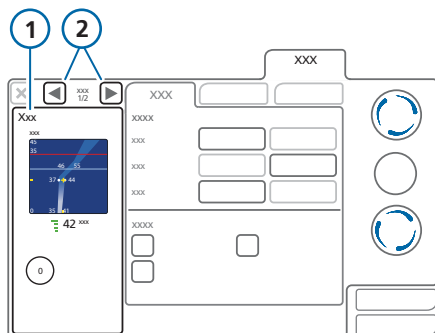
- | | | | |
|---|---|--|--|
| 1 | Target zone | 2 | Yellow patient symbol (cross) and current patient values |
| 3 | High pressure alarm limit | 4 | Pressure limitation: Pasv |
| 5 | Current measured PetCO2 value and quality index | 6 | Map title: CO2 elimination |
| 7 | Target Shift. When set, the map in view 3 shows the setting (<i>Target Shift: n > or Target Shift: < n</i>) | 8 | When %MinVol is increasing (^) or decreasing (v), the appropriate indicator appears. When the arrows are the same size, %MinVol is in target zone. |
| 9 | For active patient: target range and current fSpond value | <div style="display: inline-block; vertical-align: middle; margin-right: 10px;"> <div style="display: inline-block; width: 0; height: 0; border-left: 5px solid transparent; border-right: 5px solid transparent; border-bottom: 10px solid #0070c0;"></div> <div style="display: inline-block; width: 0; height: 0; border-left: 5px solid transparent; border-right: 5px solid transparent; border-top: 10px solid #0070c0;"></div> </div> <div> <p>Up arrow: Increase zone (PetCO2 too high, increase %MinVol)</p> <p>Down arrow: Decrease zone (PetCO2 too low, decrease %MinVol)</p> </div> | |

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

1. To open the INTELLiVENT Settings window, touch the **INTELLiVENT** 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 CO₂ elimination panel 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 1-15. Ventilation map, INTELLiVENT Settings window



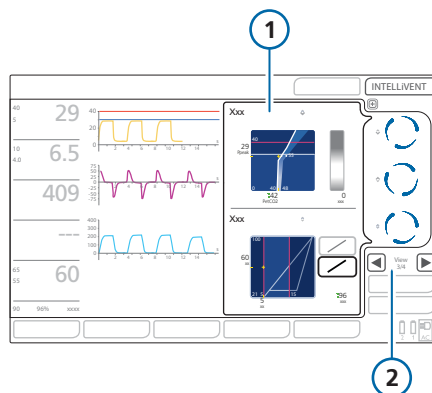
- 1 Ventilation map
- 2 View arrows and current view number

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 until view 3 is displayed.

View 3 shows the Ventilation map and measured PetCO₂ value.

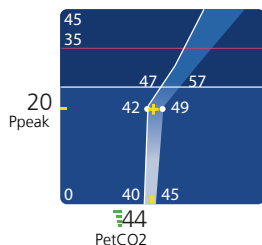
Figure 1-16. Ventilation map, in main display during active ventilation



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

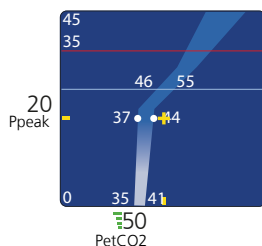
1.5.2.2 About the PetCO₂ target zone

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



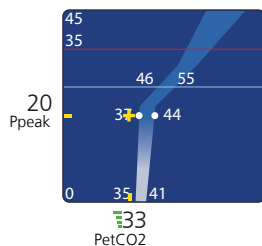
Patient symbol within the PetCO₂ target zone

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

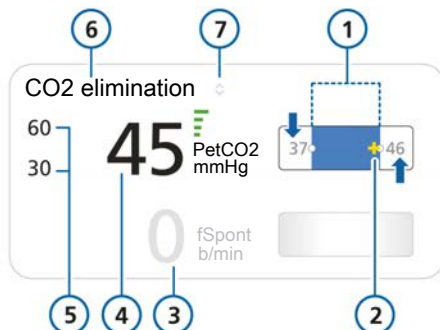
When the patient symbol is to the left of the target zone (in the decrease zone, PetCO₂ is too low), the %MinVol setting decreases.

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.

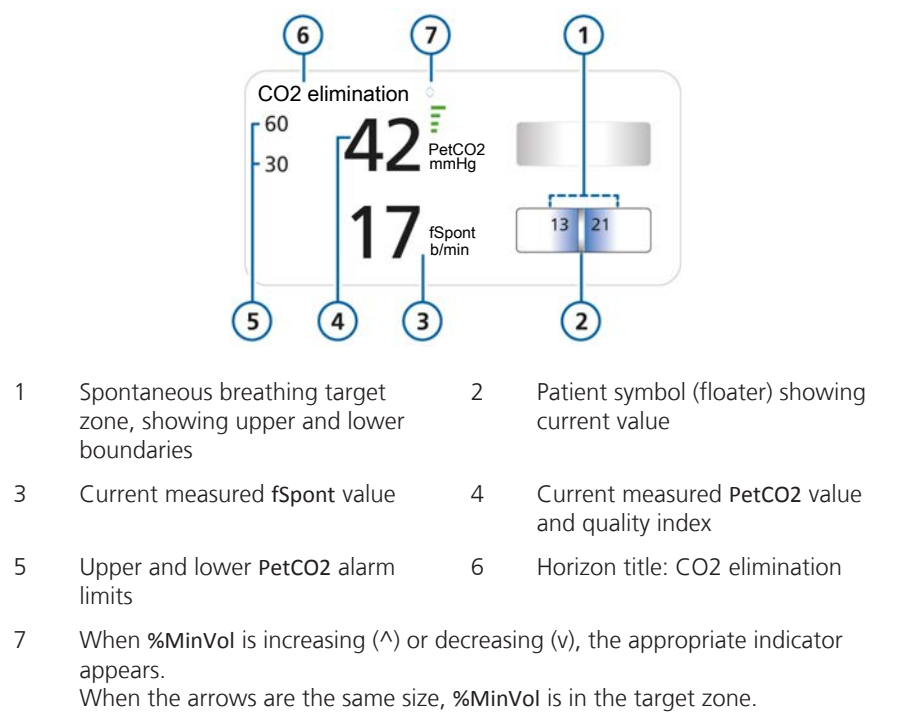
When the patient is active, the horizon shows spontaneous breathing activity (**fSpont**).

Figure 1-17. Ventilation horizon, passive patient



- | | | | |
|---|--|---|---|
| 1 | Target zone, showing upper and lower boundaries | 2 | Patient symbol (yellow) showing current value |
| 3 | fSpont value (0) | 4 | Current measured PetCO₂ value and quality index |
| 5 | Upper and lower PetCO₂ alarm limits | 6 | Horizon title: CO₂ elimination |
| 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. |  | Increase (up) and decrease (down) end-tidal CO₂ volume zone |

Figure 1-18. Ventilation horizon, active patient

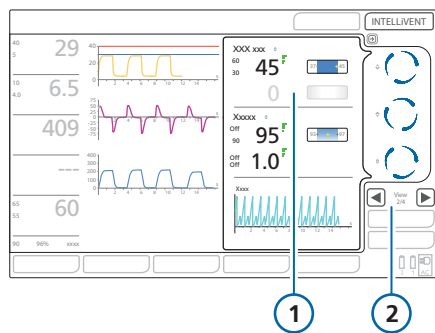


At a very basic level, the ventilation controller attempts to keep the patient within the target range as described in Section 1.5.2.2. Note that when the controller is increasing or decreasing %MinVol, an up or down arrow indicator appears on the horizon graph next to the title.

The appropriate Ventilation horizon (for active or passive patient) is shown on the main display during active ventilation, in views 1 and 2.

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

Figure 1-19. 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 *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.

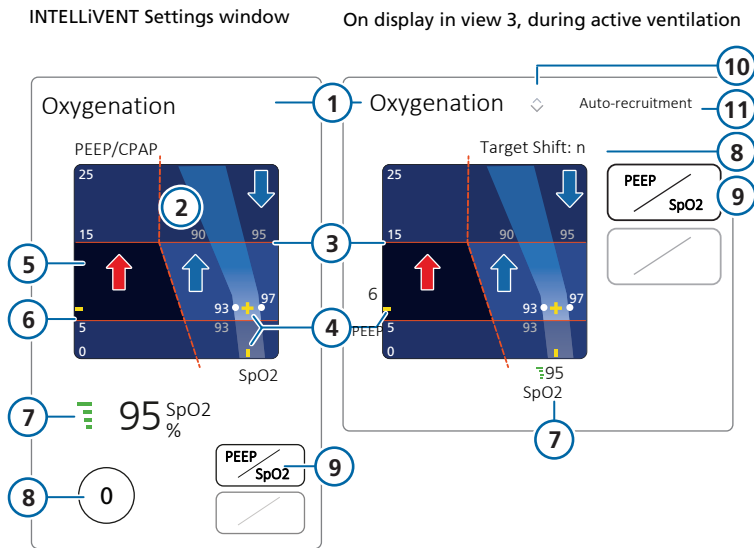
The *FiO2/PEEP* schema shows Oxygen on the y-axis and PEEP on the x-axis. The yellow cross is the patient symbol denoting the patient's current measured combination of Oxygen/PEEP values. The triangular PEEP/Oxygen curve shows the target treatment levels, depending on whether treatment remains unchanged, 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 3

Figure 1-20. Oxygenation map, PEEP/SpO₂, in INTELLiVENT Settings window (left), in view 3 during ventilation (right)



- | | | | |
|----|--|----|--|
| 1 | Map title: Oxygenation | 2 | Target zone |
| 3 | Upper PEEP limit | 4 | Yellow patient symbol (cross) and current patient values |
| 5 | Dark blue emergency zone | 6 | Lower PEEP limit |
| 7 | Current measured SpO2 value and quality index | 8 | Target Shift. When set, the map in view 3 shows the setting (<i>Target Shift: n > or Target Shift: < n</i>) |
| 9 | Oxygenation map selection button: PEEP/SpO2 | 10 | 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. |
| 11 | When auto-recruitment is enabled, text is displayed on the map | | |
- 

Blue up arrow: Increase treatment zone

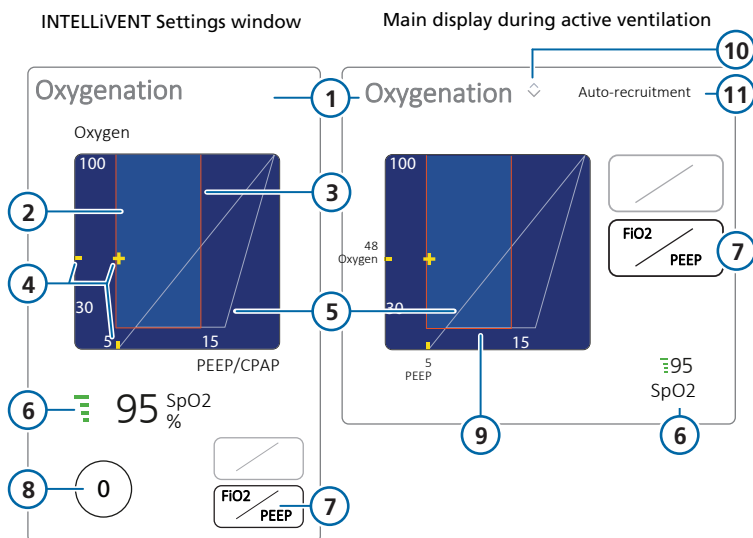


Blue down arrow: Decrease treatment zone

Red arrow: Emergency increase zone (dark blue area), Oxygen set to 100%

The dotted line is only for illustration purposes. It does not appear on the device.

Figure 1-21. Oxygenation map, FiO₂/PEEP, in INTELLiVENT Settings window (left), in view 3 during ventilation (right)

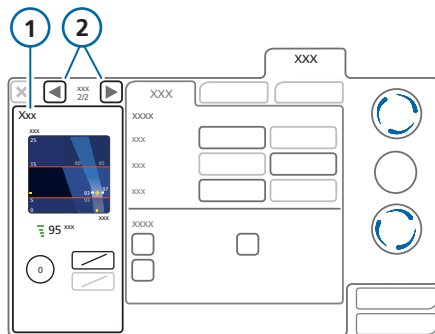


- | | | | |
|----|--|----|--|
| 1 | Map title: Oxygenation | 2 | Lower PEEP limit |
| 3 | Upper PEEP limit | 4 | Yellow patient symbol (cross) and current patient values |
| 5 | PEEP/Oxygen curve | 6 | Current measured SpO ₂ value and quality index |
| 7 | Oxygenation map selection button: FiO ₂ /PEEP | 8 | Target Shift |
| 9 | Lower Oxygen limit | 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. |
| 11 | 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 Settings window, touch the **INTELLiVENT** 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 1-22. Oxygenation map, INTELLiVENT Settings window



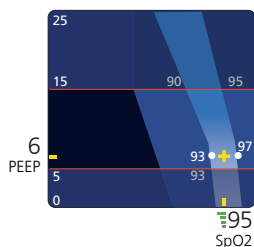
- 1 Oxygenation map 2 View arrows and current view number

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 3 is displayed.
View 3 shows the Oxygenation map and the measured SpO₂ value. See Figure 1-16.
2. To display the FiO₂/PEEP map, touch the **FiO₂/PEEP** button.
To display the PEEP/SpO₂ map, touch the **PEEP/SpO₂** button.

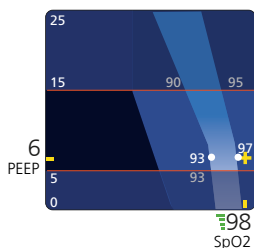
1.5.4.2 About the SpO2 target zone

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



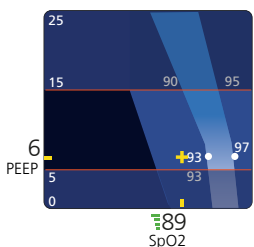
Patient symbol within the SpO2 target zone

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



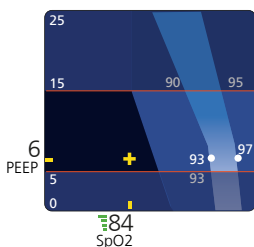
Patient symbol above the SpO2 target zone

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.



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.



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

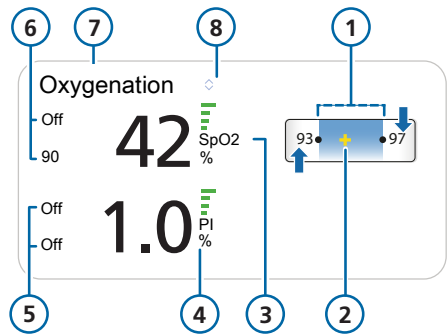
If the patient symbol is to the far left of the target zone in the dark blue *emergency zone* indicating hypoxemia, **Oxygen** is immediately increased to 100% and PEEP is quickly increased.

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 sensor, the horizon also shows the measured perfusion index (PI).

Figure 1-23. Oxygenation horizon

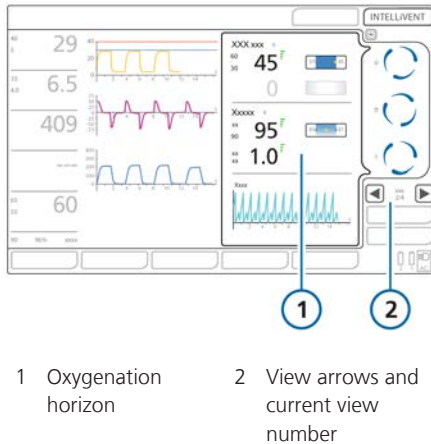


- | | | | |
|---|---|---|--|
| 1 | Target zone, showing upper and lower boundaries | 2 | Yellow patient symbol (cross) and current patient values |
| 3 | Current SpO2 value and quality index | 4 | Current PI value and quality index (Masimo only) |
| 5 | Upper and lower PI alarm limits (Masimo only) | 6 | Upper and lower SpO2 alarm limits |
| 7 | Horizon title: Oxygenation | 8 | When PEEP or Oxygen is increasing (^) or decreasing (v), the appropriate indicator appears. When the arrows are the same size, SpO2 is in the target zone. |

↕ Up arrow: Increase treatment zone
Down arrow: Decrease treatment zone

The Oxygenation horizon is shown on the main display during active ventilation in views 1 and 2.

Figure 1-24. 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 depends on your ventilator model, and 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. For details about selecting the capnogram as a waveform on the ventilator main display, see your ventilator *Operator's Manual*.

About the plethysmogram

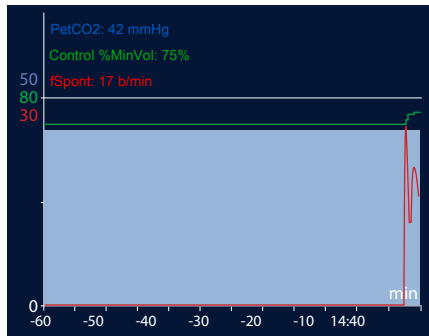
A plethysmogram is a waveform that represents the pulsating blood volume; it is delivered by the pulse oximeter.

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.⁵

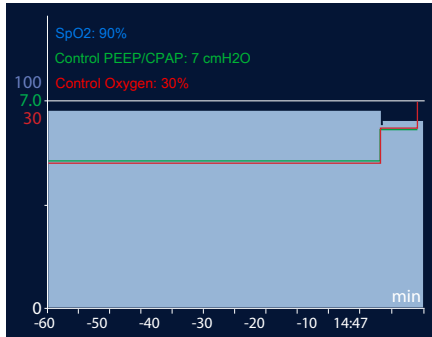
Ventilation controller trend graph



The Ventilation controller trend graph provides data for the following parameters:

- PetCO2
- Control %MinVol
- fSpont

Oxygenation controller trend graph



The Oxygenation controller trend graph provides data for the following parameters:

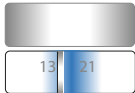
- SpO2
- Control PEEP/CPAP
- Control Oxygen

1.5.8 INTELLiVENT-ASV symbols

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

⁵ Note that the graphs provided here do not represent actual data, they just illustrate how the different parameters are represented.

Table 1-10. INTELLiVENT-ASV-related symbols and controls

Symbol	Color	Description
	White	View selection. In the INTELLiVENT Settings window, two views are available; the view navigation arrows change the view between the CO₂ elimination (view 1) and Oxygenation (view 2) panels. During active ventilation, four 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 (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 ghosted; fSpont horizon is active	When the PetCO₂ horizon is ghosted, the patient is breathing spontaneously. The fSpont horizon is active. When the fSpont horizon is ghosted, 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.
	Red	Critical SpO₂ value. SpO₂ is below the set lower alarm limit.

Symbol	Color	Description
	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.
	Gray	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.
	Solid blue 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

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.

Oxygen-, PetCO2-, and SpO2-related alarms can affect automated ventilation and oxygenation management.

For additional information about alarms, see your ventilator *Operator's Manual*. For details about SpO2-related alarms, see the *Pulse Oximetry Instructions for Use*.

Note that in all cases, the low alarm limit must be set lower than the high alarm limit.

Table 1-11. 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 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)

Alarm/Priority	Definition/Corrective action
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
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)

Alarm/Priority	Definition/Corrective action
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 resolved
PetCO ₂ -related alarms. See your ventilator <i>Operator's Manual</i> .	
Recruitment in progress <i>Low priority.</i>	To resolve Check patient condition
SpO ₂ -related alarms. See the <i>Pulse oximetry Instructions for use</i> .	
Ventilation adjustment OFF <i>Medium priority.</i>	Ventilation controller is frozen due to poor or absent CO₂ signal, or fSpont > 100 b/min To resolve • Check CO₂ connections • Set %MinVol to Manual
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.
- 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 breathing passively or spontaneously.
 - **Passive patient:** The controller uses the measured end-tidal CO₂ partial pressure, PetCO₂. For details, see Section 1.7.1.
 - **Active patient:** When PetCO₂ is at or below the target range, the controller uses the difference between the targeted and actual respiratory rate. For details, see Section 1.7.2.
- All ASV safety limits are active for prevention of Apnea, baro- and volutrauma, auto-PEEP, and dead-space ventilation, including the tidal volume (V_t) limit of 1.5 x (upper V_t 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 optimal rate is defined by the Otis and Mead equations, same as in ASV. For details, see the ASV appendix in your ventilator *Operator's Manual*.

The %MinVol limits that are in force during automatic minute volume management are listed in Table 1-12.

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

Table 1-12. %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

NOTICE

In passive patients, automatic control is always based on etCO2 (PetCO2).

End-tidal CO2 partial pressure (PetCO2), available when the CO2 sensor is connected, is the maximum partial pressure of CO2 exhaled during a tidal 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.

Under common clinical conditions, this represents a reliable index of CO2 partial pressure in the arterial blood. It has been shown that under normal conditions, PaCO2 is about 3 to 5 mmHg higher than PetCO2.

Under special clinical conditions (including massive ventilation/ perfusion problems or presence of a shunt), the difference between PetCO2 and PaCO2 might increase. You can set the controller to take this PaCO2–PetCO2 difference into account by shifting the range of acceptable PetCO2 values using the **Target Shift** control (Section 1.4.10.3) in the Ventilation panel; the target range is displayed on the Ventilation map.

To get the most accurate approximation to PaCO2, the second highest PetCO2 value out of 8 breaths is used. The optimal ranges of PetCO2 depend 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 1-13. Automated management of %MinVol, passive patient

When these conditions apply ...	%MinVol change
PetCO2 is above the upper limit of acceptable values	%MinVol increase
PetCO2 is below the lower limit of acceptable values	%MinVol decrease
PetCO2 is within the target range	Minor %MinVol changes, if any
PetCO2 measurement is invalid or unreliable for at least 30 seconds	%MinVol control is frozen. The Ventilation adjustment OFF alarm is generated.

The absolute limits for %MinVol when automated are:

- Minimum physiological %MinVol value: 70%
- Maximum physiological %MinVol value: 200%

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 spontaneous breathing rate, f_{Spont} , is compared to the target rate as defined by the ASV rate (calculated using Otis' and Mead's equations).

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 1-14. Automated management of %MinVol, active patient

When these conditions apply ...	%MinVol change
- The patient complies with Rule 1 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 Rule 1 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 Rule 1 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.

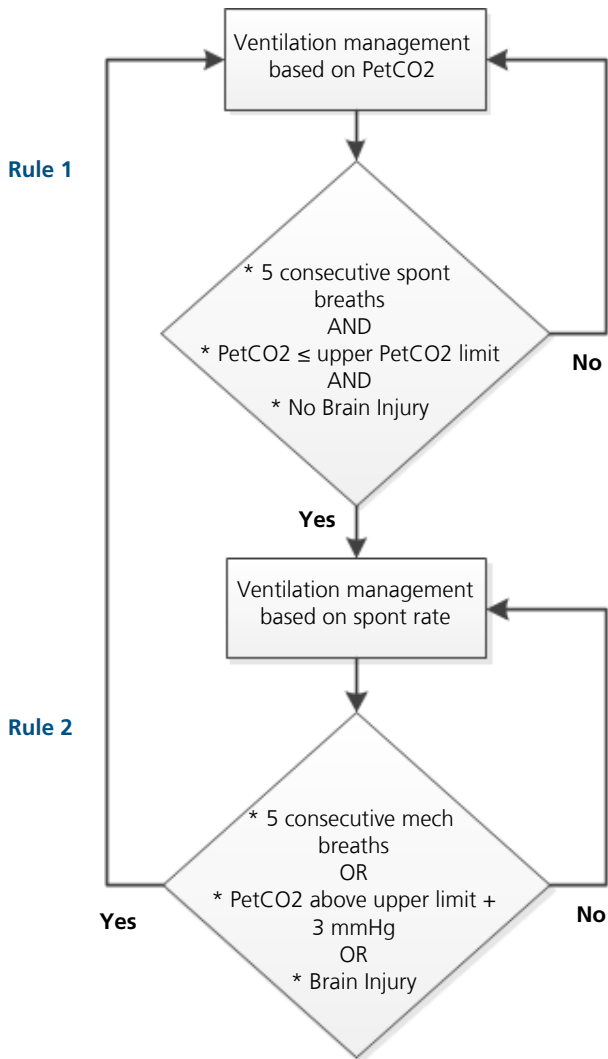
The acceptable range for the spontaneous breathing rate is determined as follows:

Table 1-15. Spontaneous breathing rate range calculation

Lower limit of range	ASV Rate + 2 When Quick Wean is enabled: ASV Rate + 3
Upper limit of range	ASV 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. If Quick Wean is enabled, the range for acceptable PetCO₂ is increased by up to 5 mmHg, depending on the pressure.

1.7.3 Rules for transitioning between active and passive states



Rule 1. 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 Rule 2 (below) since it uses **Rate** as input criteria.

If Rule 2 does not apply, the controller continues to adjust the rate for the %MinVol based on the spontaneous breathing rate of the patient.

If the patient's spontaneous rate is invalid (> 100 b/min) for more than 30 s, 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 1-17), the ventilation controller suspends automated management, and the %MinVol control is frozen. The **Ventilation adjustment OFF** alarm is generated.

Rule 2. Passive patient

For a patient who is not breathing spontaneously, 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 1-17), the ventilation controller suspends automated management, and the %MinVol control is frozen. The **Ventilation adjustment OFF** alarm is generated.

1.7.4 Important notes about ventilation management

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

Table 1-16. Important notes about ventilation management

	See
Signal quality and ventilation	Section 1.7.4.1
Actions that temporarily halt automatic ventilation management	Section 1.7.4.2
PetCO ₂ 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 1-17. 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, 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 the ASV appendix in 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 is in progress

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 PetCO₂ is not available, the sensor value becomes unavailable, or the sensor is switched off, 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.

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 pauses P_{insp} (pressure support above PEEP for all (mechanical and spontaneous) breaths) and RRIMV (IMV rate calculated by the rate adjustment) remains unchanged for 4 breaths after reconnection.
- If the adjustment is in its initialization phase, it remains there for at least 3 more breaths.

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 Returning to active ventilation from standby

When returning from Standby with a new patient selected and INTELLiVENT-ASV activated, the %MinVol adjustment reinitializes 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 stops.

When the **PetCO₂** quality index is above 50, the alarm state clears and ventilation management returns to the automatic mode. The **%MinVol** control reverts to the 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.
- 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 automatic 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 actual 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.

Figure 1-25. Increase of oxygenation support, ARDSnet guidance

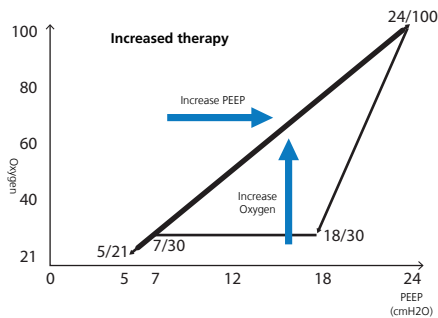
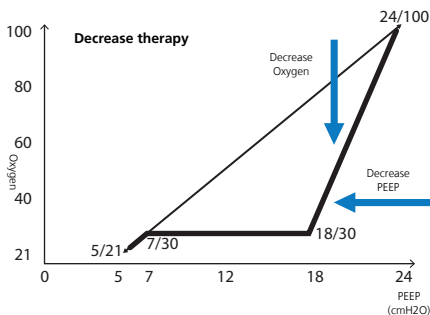


Figure 1-26. Decrease of oxygenation support, Open Lung concept



The device adjusts PEEP and Oxygen, which affect the oxygenation of the patient. Table 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 in the background to avoid dangerous desaturation. Upon detecting an inadequate SpO₂ level or signal, 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 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.
-----------------	--

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 min 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*.

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

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.

How the controller adjusts Oxygen and PEEP

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

Table 1-18. Increase/decrease increments of Oxygen and PEEP by automated oxygenation controller⁶

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 NOTICE. If a lower limit is specified, Oxygen will not go below the lower limit.
Increase PEEP stepwise	Increases PEEP by 1 cm-H ₂ O every 6 minutes	• PEEP automatically managed • Increasing PEEP support • PEEP is below the upper PEEP limit NOTICE. If an upper limit is specified, PEEP will not go above the upper limit.
Decrease PEEP stepwise	Decreases PEEP by 1 cm-H ₂ O every 6 minutes	• PEEP automatically managed • Decreasing PEEP support NOTICE. If a lower limit is specified, PEEP will not go below the lower limit.

⁶ 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.

Oxygenation management	Action	Takes place when ...
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)

1.8.4 Important notes about oxygenation management

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

Table 1-19. Important notes about oxygenation management

	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 1-20. 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, 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. See the ASV appendix in 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 is in progress

In some cases, the controllers remain blue rotating circles, and when the action is completed, they resume automated management with the last-used settings.

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 Returning to active ventilation from standby

When returning from Standby with a new patient selected and INTELLiVENT-ASV activated, the PEEP and **Oxygen** adjustment reinitializes 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

WARNING

The responsibility for settings rests solely with the physician/operator.

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 the ASV appendix in your ventilator *Operator's Manual*.

Note that the control remains in Manual mode even if these conditions are resolved. If you wish control to be automated, you must manually set %MinVol to **Automatic** in the INTELLiVENT Settings window.

1.9.2 Manual control of oxygenation

Under some circumstances, automated control of PEEP and/or **Oxygen** is disabled. You must control PEEP and/or **Oxygen** manually when any of the conditions listed in the following table.

Table 1-21. 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 selected patient condition requires manual control (see Section 1.4.10.1). The Chronic Hypercapnia or Brain injury patient condition is selected. • The ventilator is using a low pressure oxygen (LPO) supply • SpO2 monitoring is disabled	PEEP is set to Manual
Oxygen • The ventilator is using a low pressure oxygen (LPO) supply • SpO2 monitoring is disabled • Oxygen monitoring (O2 cell) 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 the ASV appendix in your ventilator *Operator’s Manual*.

Note that the controls remain in Manual mode even if these conditions are resolved. If you wish them to be automated, you must manually set the desired controls to **Automatic** in the INTELLiVENT Settings window.

1.10 Assessing results

 **WARNING**

The responsibility for settings rests solely with the physician/operator.

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

2.1	Overview.....	74
2.2	Quick Wean in clinical use.....	77
2.3	Enabling/disabling and setting up automated SBTs.....	78
2.4	Conditions for starting weaning activities.....	81
2.5	Conducting an SBT.....	90
2.6	Conditions for stopping an SBT.....	92
2.7	Conditions for successfully completing an SBT.....	95
2.8	About Quick Wean alarms and messages.....	95
2.9	Configuring Quick Wean and SBTs.....	97
2.10	Quick Wean parameter specifications.....	100

2.1 Overview

WARNING

- The physician or caregiver is solely responsible for final decisions regarding weaning and extubation. Additional criteria not provided by the ventilator have to be taken into account.
- 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.

NOTICE

- Refer to your ventilator *Operator's Manual* for details on general ventilator use, alarms, customizing the layout, and so on.
- Quick Wean is not available when:
 - The selected patient condition is Brain injury
 - The %MinVol control is set to Manual (that is, it is NOT automated)
- The RSB parameter is only used for patients weighing > 40 kg.

Quick Wean is integrated into INTELLiVENT-ASV, and when activated, provides closed-loop, 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.

When Quick Wean is enabled, the device decreases ventilatory support, and, if automated SBTs are also enabled, performs an SBT when criteria are met.

Quick Wean and automated SBTs are both disabled by default, and can be enabled at any time during ventilation. See Section 2.3.

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	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 breathing spontaneously 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%. 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. 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.

2.1.2 Key terms

The following table describes some key terms for Quick Wean.

Table 2-2. Key terms for Quick Wean

Parameter	Description
SBT	Spontaneous breathing trial. 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>.
Tolerance time parameter	Specifies the length of time that an SBT-related parameter can be out of range before a countdown to SBT readiness is restarted or an ongoing SBT is stopped.

2.2 Quick Wean in clinical use

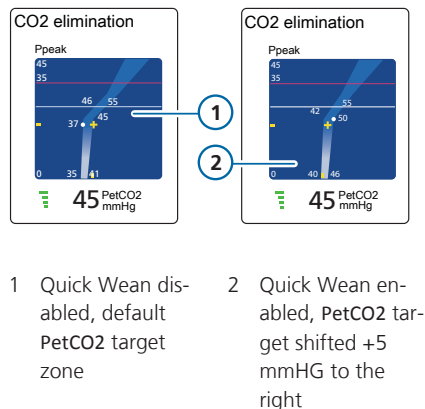
2.2.1 Quick Wean workflow

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 breathing spontaneously and the patient's rate is within the target range (as described in Section 1.7.2), the device gradually reduces %MinVol to 70%.
 - 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 conditions described in Section 1.7.2 are not met, INTELLiVENT-ASV continues ventilating the patient normally. 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.

Figure 2-1. CO₂ target shift with Quick Wean



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/STB parameters, see Table 2.10, listing 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 breathing spontaneously
 - The patient’s SpO2 values are in the normal range (see Section 1.7.2)
 - Quick Wean is enabled
 - The required Quick Wean parameters meet configured criteria

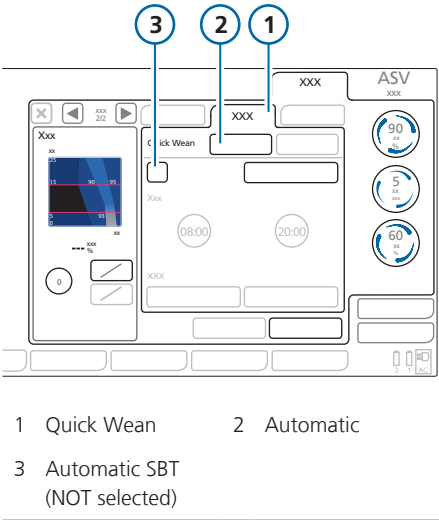
2.3 Enabling/disabling and setting up automated SBTs

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

To enable/disable automated SBTs

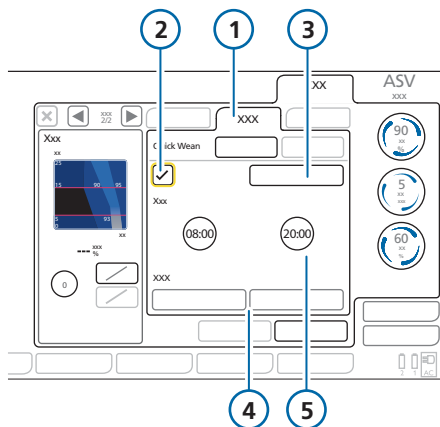
1. Ensure Quick Wean is enabled in the INTELLiVENT Settings > Quick Wean window.

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



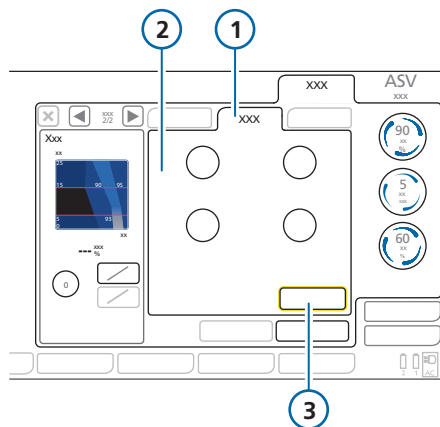
2. Select whether to enable SBTs.
By default, automated SBTs are disabled.
To enable SBTs, touch the Automatic SBT checkbox. A checkmark indicates SBTs are enabled. The **SBT Settings** button also becomes available.

Figure 2-3. INTELLiVENT Settings > Quick Wean window, SBTs enabled



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

Figure 2-4. INTELLiVENT Settings > SBT settings window



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

- 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.

- If SBTs are enabled, touch the **SBT settings** button to access additional controls.

These values can be modified during ventilation, as appropriate.

The Quick Wean tab changes to *SBT settings*, and the contents of the window change to show SBT-related options.

- Set SBT options as desired. Table 2-3 describes these controls.

- 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 min closes the window and returns you to the previously selected mode.

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: • Reduces %MinVol to the configured settings • Adjusts PEEP to the configured setting (if automatically controlled) • Displays the SBT history window (view 4) • Displays the Quick Wean & SBT status window
Stop SBT	Select to immediately stop an ongoing SBT. The system returns to normal 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 upper limit of applied pressure required during the inspiratory phase. The patient must require less than the limit specified. Shown as the upper P _{insp} limit in the Quick Wean & SBT Status window.
Rate (b/min)	Respiratory rate. The patient must require less than the limit specified.

To disable SBTs

- ▶ In the INTELLiVENT Settings > Quick Wean window, clear the **Automatic SBTs** checkbox.

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 patient's **Rate** is below the upper limit of the target range (as described in Section 1.7.2)
 - 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 ...

Automated SBTs are enabled

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

Quick Wean & SBT

Conditions fulfilled
Starting SBT in 30 min

00:00:20

40	8	5.0	12	100	35
25	0	30.0	5.0	10	0
00:10	00:07	00:05	00:04	00:05	00:04
Oxygen 30	PEEP 5	VtIBW 14.5	P _{resp} 7.0	RSB ---	fS _{pont} 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, process resets.

XXX

xxx:	✓	xxx:	✓
xxx:	✓	xxx:	▲
xxx:	▼	xxx:	▼
xxx:	✓	xxx:	✓
xxx:	✓	xxx:	✓

xxxx

◀

▶

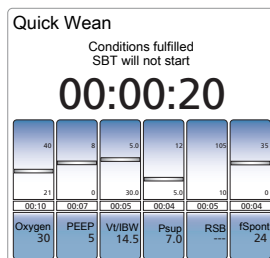
- The SBT history (view 4) window shows green checkmarks for the parameters that are monitored in the Quick Wean & SBT status window.

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

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

The device ...

Automated SBTs are disabled



- 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, <i>Rate</i> in range	Quick Wean enabled	Decreases %MinVol to 70%
	Quick Wean disabled	No %MinVol change
Active, <i>Rate</i> out of range	Quick Wean enabled or disabled	Normal 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 adult patients. For pediatric patients, 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 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 parameter SBT definitions

Parameter (unit)	Description	Default To start SBT value
%fSpont	Percentage of spontaneous breaths to total breaths taken.	100% during Time before starting SBT
Oxygen (%)	% of inspired oxygen Where set: Configuration > Modes > SBT > To start SBT window	≤ 40
PEEP (cmH2O)	Positive end-expiratory pressure; airway pressure at the end of exhalation Where set: Configuration > Modes > SBT > To start SBT window	Patients > 40 kg: ≤ 8 Patients ≤ 40 kg: ≤ 6
Psupport max (cm-H2O)	Upper threshold of applied inspiratory pressure required during the inspiratory phase Where set: INTELLiVENT Settings > Quick Wean/SBT settings window	≤ 12
Rate (b/min)	Respiratory rate in number of breaths per minute Where set: INTELLiVENT Settings > Quick Wean/SBT settings window	Patients > 30 kg: ≤ 35 Patients ≤ 30 kg: ≤ 45
RSB (1/(l*min))	Rapid shallow breathing index. Used only for patients weighing > 40 kg. This parameter is not configurable.	≤ 105

SpO2 (%)	Indirect measurement of oxygen saturation in the blood This parameter is not configurable.	In INTELLiVENT-ASV normal/high range (within or above target zone)
VT/IBW (ml/kg)	Tidal volume per kilogram of ideal body weight (kg/IBW) Where set: Configuration > Modes > SBT > To start SBT window	≥ 5
Time before starting SBT (min)	Length of time that patient conditions must stay within the To start SBT limits before an SBT can start Where set: INTELLiVENT Settings > Quick Wean/STB settings window	30
Time between 2 SBTs (min)	Minimum length of time that must pass between two automated SBTs Where set: INTELLiVENT Settings > Quick Wean/STB settings window	30
SBT Time range (hh:mm)	The hours between which an SBT can be started. Even if patient conditions match the <i>To start SBT</i> criteria for the required amount of time, if the start time for the SBT is outside of the range specified here, the SBT will not take place until the current time of day is inside the specified range, if criteria are still met. To allow automated SBTs to start at any time, set both controls to the same time. Where set: INTELLiVENT Settings > Quick Wean window	Between 8:00 and 20:00

Tolerance time (s)	Length of time a parameter value can be out of range without affecting the count-down to an SBT (the time period defined in the Time before starting SBT parameter). If any one parameter (listed in this table) is out of range for longer than this time period, the countdown timer is reset. Where set: Configuration > Modes > SBT > To start SBT window	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 Settings window, as described in Section 2.4.3.

2.4.3 User-modifiable SBT parameters, INTELLiVENT Settings window

The INTELLiVENT 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 SBTs are enabled, the system monitors these 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 4)

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.

This window is always displayed when Quick Wean is enabled.

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. See Table 2-7.

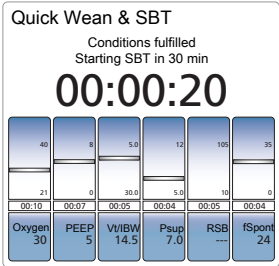
Table 2-7. Quick Wean/Quick Wean & SBT Status window

When ...	Automated SBT status	Quick Wean/Quick Wean & SBT Status window ...
Quick Wean is enabled	SBTs enabled	Quick Wean & SBT Verifying conditions 40 8 5.0 12 105 35 21 0 30.0 5.0 10 0 00:07 00:05 00:04 00:05 00:04 Oxygen46 PEEP5 Vi/BW11.8 Psup7.0 RSB31 fSpont26 Displays the text <i>Verifying conditions</i>.
SBTs disabled	SBTs disabled	Quick Wean Verifying conditions 40 8 5.0 12 105 35 21 0 30.0 5.0 10 0 00:07 00:05 00:04 00:05 00:04 Oxygen46 PEEP5 Vi/BW11.8 Psup7.0 RSB31 fSpont26 Displays the text <i>Verifying conditions</i>.

When ...	Automated SBT status	Quick Wean/Quick Wean & SBT Status window ...
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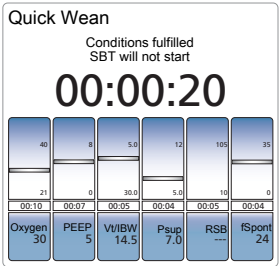
To start SBT conditions are met

SBTs enabled



- Displays:
- The text *Conditions fulfilled/Starting SBT in XX time period.*
 - Displays a timer (HH:MM:SS) showing how long the patient values have been within the target ranges.

SBTs disabled



- Displays:
- The text *Conditions fulfilled/STB will not start.*
 - A timer (HH:MM:SS) showing how long the patient values have been within the target ranges.

When ...	Automated SBT status	Quick Wean/Quick Wean & SBT Status window ...																		
SBT is in progress		Quick Wean & SBT 00:02:52 SBT running <table><tr><td>50</td><td>8</td><td>5.0</td><td>12</td><td>100</td><td>35</td></tr><tr><td>21</td><td>0</td><td>30.0</td><td>5</td><td>10</td><td>100</td></tr><tr><td>Oxygen 30</td><td>PEEP 5</td><td>Vt/BW 2.6</td><td>Psup 15</td><td>RSB 126</td><td>fSpont 24</td></tr></table>	50	8	5.0	12	100	35	21	0	30.0	5	10	100	Oxygen 30	PEEP 5	Vt/BW 2.6	Psup 15	RSB 126	fSpont 24
50	8	5.0	12	100	35															
21	0	30.0	5	10	100															
Oxygen 30	PEEP 5	Vt/BW 2.6	Psup 15	RSB 126	fSpont 24															

Displays:

- The text *SBT running*
- 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

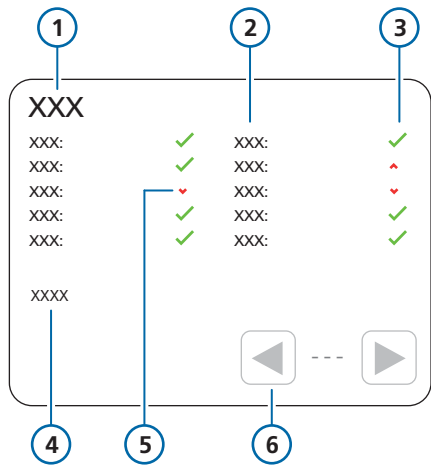
The SBT history window (Figure 2-5), available in view 4 of the scrollable INTELLi-VENT-ASV views, displays an overview of all of the key ventilation parameters.

The window shows green checkmarks next to parameters that are within the target ranges, that is, below the *To stop SBT* limits. The data is updated every breath. If a parameter goes out of range, the checkmark is replaced by a red up or down arrow, indicating whether the value is too high or too low.

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 2-5. SBT history window



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

To display the SBT history window

- ▶ Touch the view buttons until view 4, SBT history, is displayed. For details, see Section 1.5.1.

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 and the patient’s Rate must be below the upper limit of the target range
- 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. 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 Settings > Quick Wean window.

To manually start an SBT

1. Touch the **INTELLiVENT** button to access the INTELLiVENT 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 (view 4) 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 Settings > Quick Wean window, touch the **Stop SBT** button.

The SBT history window (view 4) records the time the SBT was stopped, and shows the text, *SBT manually stopped*.

The system returns to normal 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.

2.6 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), simply start a manual SBT when the patient is reconnected

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.
- **PetCO2** > ((the upper limit **PetCO2** target range) + 3 mmHg), the SBT is stopped immediately, regardless of the time interval specified in the **Tolerance time** parameter.
- Quick Wean is disabled in the INTELLI-VENT 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 min 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.

Table 2-9. Quick Wean To stop parameter SBT definitions

Parameter (unit)	Description	Default To stop SBT value
Oxygen (%)	% of inspired oxygen. The value cannot exceed 10% above the <i>To start SBT</i> setting. Where set: Configuration > Modes > SBT > To start SBT window	> 50
PEEP (cmH2O)	Positive end-expiratory pressure; airway pressure at the end of exhalation. You can configure the maximum pressure allowed before starting an SBT, and an absolute upper limit that it cannot exceed during an SBT. Where set: Configuration > Modes > SBT > To start SBT window	Patients > 40 kg: > 8 Patients ≤ 40 kg: > 6
PetCO2 inc (mmHg)	End-tidal CO2 pressure increase compared to the values before the SBT. Only applies during an SBT. Where set: Configuration > Modes > SBT > To stop SBT window	> 8 mmHg
Psupport max (cm-H2O)	The maximum pressure support allowed before starting an SBT, and an absolute higher limit that it cannot exceed during the SBT. Where set: INTELLiVENT Settings > Quick Wean/SBT Settings window	> 12
Rate (b/min)	Respiratory rate. Maximum Rate allowed before SBT and the absolute maximum limit that it cannot exceed during SBT. Where set: INTELLiVENT Settings > Quick Wean/SBT Settings window	Patients > 30 kg: > 35 Patients ≤ 30 kg: > 45

Rate inc	Percentage increase in respiratory rate as a result of the SBT. Only applies during an SBT. Where set: Configuration > Modes > SBT > To stop SBT window	> 50% increase over the average rate established just prior to the SBT
RSB (1/(l*min))	Rapid shallow breathing index. Used only for patients weighing > 40 kg. This parameter is not configurable.	> 105
SpO2 (%)	Indirect measurement of oxygen saturation in the blood. This parameter is not configurable.	< (INTELLI-VENT-ASV normal target range)
VT/IBW (ml/kg)	Tidal volume per kilogram of ideal body weight (kg/IBW). You can configure the minimum VT/IBW allowed before starting an SBT, and an absolute low limit that it cannot fall below during an SBT. Where set: Configuration > Modes > SBT > To start SBT window	< 5
Tolerance Time (s)	Defines the length of time a parameter can be out of range during an SBT before the SBT is stopped. Where set: Configuration > Modes > SBT > To stop SBT window	Adult/ped > 40 kg: 180 Adult/ped ≤ 40 kg: 30
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 interval specified by this parameter. Only applies during an SBT. Where set: 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 normal 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 (view 4)

To review and dismiss an alarm

- ▶ Do any of the following:
 - Touch the message. The Alarms > Buffer opens. 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

SBT aborted <i>Medium priority.</i>	The SBT was stopped. For possible reasons, see Section 2.6.
SBT successfully fulfilled <i>Medium priority.</i>	The SBT was ended because Max. Duration was reached.
SBT stopped after MM minutes	How long the SBT ran before being stopped. Shown in SBT history (view 4) window and Event log.
SBT started at YYYY-MM-DD HH:MM	When an SBT starts automatically, this message records the time. Shown in SBT history (view 4) window and Event log.
SBT fulfilled after MM minutes	When SBT ends successfully, this message records the time. The time is equal to the Max. Duration value. Shown in SBT history (view 4) window.
SBT manually started at YYYY-MM-DD HH:MM	When an SBT is manually started by selecting the Start SBT button, this message records the time. Shown in SBT history (view 4) window.
SBT manually stopped after 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 (view 4) 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 (view 4) window. When a parameter's value is below the allowed range, a red down arrow 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 two places:

- In Configuration mode, in the Modes > SBT windows: To start SBT, SBT settings, and To stop SBT
- In the INTELLiVENT Settings > Quick Wean/SBT Settings window (Section 2.9.2)

The SBT configuration windows provide access to the following controls:

Table 2-11. SBT default settings configuration windows

Configura- tion win- dow	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 Adult/Ped patients weighing > 40kg; the controls on the bottom half apply to Adult/Ped patients weighing ≤ 40 kg.

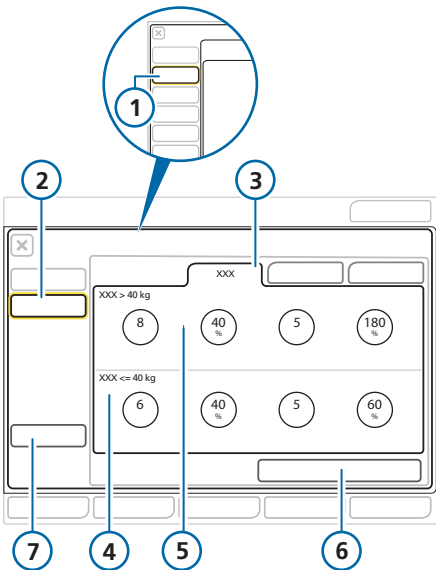
You can change the default settings to match your institution's protocol, if needed.

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

1. Without a patient connected, put the ventilator in Standby.

- 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.
- In the To start SBT window, make changes as desired to the parameter thresholds.

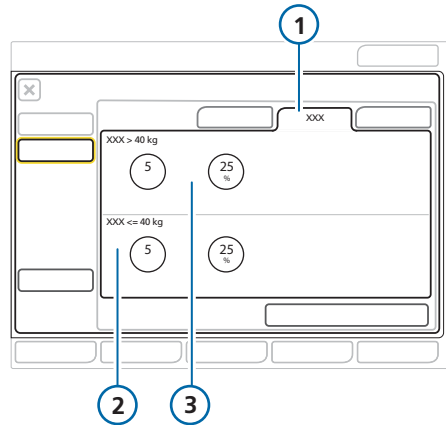
Figure 2-6. SBT configuration: To start SBT



- | | |
|--|---|
| 1 Modes | 2 SBT |
| 3 To start SBT | 4 To start SBT controls for patients ≤ 40 kg: PEEP, Oxygen, Vt/IBW, Tolerance time |
| 5 To start SBT controls for patients > 40 kg | 6 Use factory settings |
| 7 Back | |

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

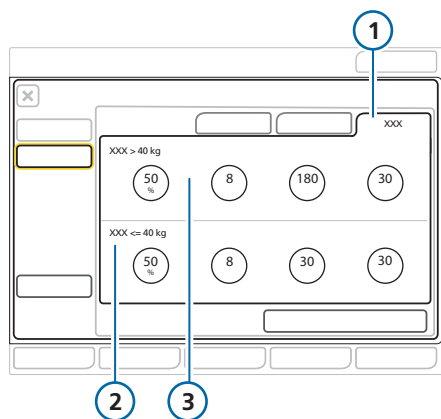
Figure 2-7. SBT configuration: SBT settings



- | | |
|--|--|
| 1 SBT settings | 2 SBT settings controls for patients ≤ 40 kg: PEEP, %MinVol |
| 3 SBT settings controls for patients > 40 kg | |

- Touch the **To stop SBT** tab to review and adjust the threshold values for stopping an SBT.

Figure 2-8. SBT configuration: To stop SBT



- 1 To stop SBT
- 2 To stop SBT controls for patients ≤ 40 kg: Rate inc, PetCO₂ inc, Tolerance time, Max. Duration
- 3 To stop SBT controls for patients > 40 kg

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 Adjusting default SBT values in the INTELLiVENT Settings window

The SBT controls provided in the INTELLiVENT Settings window are not available in the Configuration window; however, you can change the default settings if desired. You can also set separate values for patients weighing > 40 kg and ≤ 40 kg.

The default values for these controls, Psupport max, Rate, Time before starting SBT, and Time between 2 SBTs, are stored with individual Quick Setups.

To change default SBT values in the INTELLiVENT Settings window

1. Set all ventilator parameters, alarm limits, graphics layout, and SBT values (in the INTELLiVENT Settings > Quick Wean/SBT settings window) to the desired settings for the target patient group (adult or pediatric).
2. Put the ventilator into Standby and access the Configuration > Setups window.
3. Select the Quick Setup option to configure, make any further changes to settings, and save the settings as described in your ventilator *Operator's Manual*.

The SBT parameter values that you saved in the INTELLiVENT Settings window are now saved as the default values for the selected Quick Setup.

2.9.3 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 Settings window. Those parameter defaults are configured in individual Quick Setups.

2.10 Quick Wean parameter specifications

NOTICE

- Adult and pediatric settings (based on weight) are the same unless otherwise noted.
- The RSB parameter is only used for patients weighing > 40 kg.

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

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	Definition/Default values	Where displayed/Where set	Range
%fSpont (%)	Percentage of spontaneous breaths to total breaths taken. When patient is fully spontaneously breathing, this value is 100. To start SBT: 100%	Displayed in: • Quick Wean status window • SBT history window (view 4) • Monitoring window Set in: N/A (calculated value)	--

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. By default, set to 30 min. -- (undefined) means that there is no limit to how long the SBT can run.	Displayed and set in: Set in: Configuration > Modes > SBT > To stop SBT	--, 20–240
%MinVol (%)	Minute volume. 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%. 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 (%)	Inspired 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 • Quick Wean status window • SBT history window (view 4) • Monitoring window Set in: Configuration > Modes > SBT > To start SBT	To start SBT: 30–50 To stop SBT: 40–60

PEEP (cmH ₂ O)	Positive end-expiratory pressure. Airway pressure at the end of exhalation. To start SBT: Adult/Ped > 40 kg: ≤ 8 Adult/Ped ≤ 40 kg: ≤ 6 To stop SBT: Adult/Ped > 40 kg: > 8 Adult/Ped ≤ 40 kg: > 6 During SBT: PEEP is set to 5 by default.	Displayed in: • Quick Wean & SBT status window • INTELLiVENT-ASV main display in PEEP control • Monitoring window • SBT history window (view 4) 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)	End-tidal CO₂ pressure. Used indirectly together with PetCO₂ inc as <i>To stop SBT</i> criteria. If PetCO₂ > (PetCO₂ upper limit + 3 mmHg), an ongoing SBT is stopped immediately. For additional details, see Section 1.7.2. To stop SBT: PetCO₂ > (PetCO₂ upper limit + 3 mmHg)	Displayed in: • Adult/Ped ≤ 40 kg: Quick Wean status window • SBT history window (view 4) • CO₂ elimination horizon and map (views 1, 2, 3) • 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)	The absolute increase in PetCO₂ (relative to an average calculated prior to the start of the SBT) that is permitted during an SBT. Only applies during an SBT. To stop SBT: > 8 increase	Not displayed. Set in: Configuration > Modes > SBT > To stop SBT	4–20

Psupport max (cmH ₂ O)	The upper threshold of applied inspiratory pressure required during the inspiratory phase. To start SBT: ≤ 12 To stop SBT: > 12	Displayed in: • INTELLiVENT Settings > Quick Wean/STB Settings window • SBT history window (view 4) Set in: INTELLiVENT Settings > Quick Wean/STB settings window	6–25
RSB (1 / (l*min))	Rapid shallow breathing index. The total breathing frequency (f_{Total}) divided by the exhaled tidal volume (VTE). The RSB parameter is only used for Adult/Ped patients weighing > 40 kg. To start SBT: ≤ 105 To stop SBT: > 105	Displayed in: • Adult/Ped > 40 kg: Quick Wean & SBT status window • SBT history window (view 4) This value is not configured.	105
Rate (b/min)	Respiratory rate. Number of breaths per minute. To start SBT: Adult/Ped > 30 kg: ≤ 35 Adult/Ped ≤ 30 kg: ≤ 45 To stop SBT: Adult/Ped > 30 kg: > 35 Adult/Ped ≤ 30 kg: > 45	Displayed in: • Quick Wean & SBT status window • SBT history window (view 4) • INTELLiVENT Settings > Quick Wean/STB settings window Set in: INTELLiVENT Settings > Quick Wean/STB settings window	25–65
Rate inc (%)	Percentage increase in the respiratory rate as a result of the SBT. Only applies during an SBT. To stop SBT: $> 50\%$ increase over the average rate established just prior to the start of the SBT	Displayed in: SBT history window (view 4) Set in: Configuration > Modes > SBT > To stop SBT	20–100

SBT time range	Defines the hours between which an SBT can be started. Even if patient conditions match the <i>To start SBT</i> criteria for the required amount of time, if the start time for the SBT is outside the range specified here, 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 exceeds the upper limit of this range, the SBT continues until it is completed. 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 Settings > Quick Wean/STB settings window	HH:MM
SpO2 (%)	Indirect measurement of oxygen saturation in the blood. To start SBT: in INTELLiVENT-ASV normal or high SpO2 target range To stop SBT: below INTELLiVENT-ASV normal SpO2 target range minus 2%	Displayed in: • Oxygenation horizon and map (views 1, 2, 3) • Monitoring > SpO2 window • SBT history (view 4) 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)	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. By default, set to 30 min.	Displayed and set in: IN-TELLiVENT Settings > Quick Wean/STB settings window	10–120
Time between 2 SBTs (min)	Defines the minimum length of time that must pass between two SBTs. Only applies when automated SBTs are enabled. To start next SBT: By default, 30 min	Displayed and set in: IN-TELLiVENT Settings > Quick Wean/STB settings window	30–240
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. NOTICE. For some parameters, the setting is fixed (regardless of what this control is set to), as follows: • %fSpont: must be 100% for a minimum of 60 s • For patients ≤ 40 kg, the Tolerance Time for Rate and Vt/IBW is 180 s To start SBT: Adult/Ped > 40 kg: 180 s Adult/Ped ≤ 40 kg: 60 s To stop SBT: Adult/Ped > 40 kg: 180 s Adult/Ped ≤ 40 kg: 30 s	Displayed and configured in: • Configuration > Modes > SBT > To start SBT • Configuration > Modes > SBT > To stop SBT	10–300

Vt/IBW (ml/ kg)	Tidal volume per kilogram of ideal body weight. To start SBT: ≥ 5 ml/kg To stop SBT: < 5 ml/kg	Displayed in: • Quick Wean & SBT status window • SBT history window (view 4) • Monitoring window Set in: Configuration > Modes > SBT > To start SBT	3–6
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3

Specifications

3.1	Intended use	108
3.2	Technical data	108
3.3	Data logging	111
3.4	References	111

3.1 Intended use

The INTELLiVENT-ASV software is an option for the HAMILTON-C3 ventilator, and is, for all legal purposes, subject to the Intended Use as stated in the current ventilator *Operator's Manual*.

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 35 (manual) 5 to 24 (automatic)

Internal calculations	
Ideal body weight, IBW (kg)	NOTICE. INTELLiVENT-ASV can only be used for patients weighing more than 7 kg. Calculation based on patient height and gender. For details, see chapter <i>Ventilator settings</i> in your ventilator <i>Operator's Manual</i> .
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). IBW is in kg.
ASV target respiratory rate (b/min)	Calculated on the basis of Otis' and Mead's equations.

3.2 Technical data

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

Monitoring: Trends

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 SpO2 target, as defined by the appropriate approach (Open Lung Concept or ARDSnet) for the current treatment. Note that if SpO2 is $\leq 84\%$, the system immediately sets Oxygen to 100%.	6 minutes
Response time (90% of steady state)	6 minutes	N/A, only target range for SpO2 specified
Rel/Command overshoot	none	N/A, SpO2 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 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 oxygenation	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

Saved parameters	Unit
Pinsp	cmH2O
SpO2	%
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.

To export the data to a USB memory device

1. In the Service software, touch the **Logs/Config Files** tab.
2. Touch **Export**.
3. Touch **Black box**.

The data is exported. The breath-by-breath data are retained in the event of a power failure or shut down.

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 the four most 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

fSpont

Spontaneous breathing frequency, a monitored parameter.

IBW

Ideal body weight.

INTELLiVENT-ASV

Fully closed loop ventilation solution, automatic MinVol, PEEP, and Oxygen adjustment based on physiological patient conditions.

Oxygen

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

Oxygenation controller

Automated PEEP and Oxygen controller, available in INTELLiVENT-ASV

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, 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.

PetCO₂

Measured end-tidal CO₂ partial pressure

Psupport

Pressure support, a control setting valid during spontaneous breaths in SPONT, SIMV+, and NIV modes.

Psupport is pressure (additional to PEEP/CPAP) to be applied during the inspiratory phase.

rate

Breath frequency or number of breaths per minute, a control setting.

SpO2

Oxygen saturation

Ventilation controller

Automated %MinVol controller, available in INTELLiVENT-ASV

Icons

- %MinVol
 - management of 56

A

- active patient, defined 61
- alarms
 - Quick Wean 95
 - troubleshooting 53
- Alarms window 24
- alarms, setting limits 24
- ARDS patient condition 28
- auto-recruitment
 - enabling/disabling 21
- auto-recruitment maneuvers
 - about 29

B

- Brain injury patient condition 28

C

- capnogram
 - about 36, 49
 - displaying 49
- Chronic hypercapnia patient condition 28
- configuring Quick Wean and SBTs 97
- control settings
 - specifying 23
- Controls window, for INTELLiVENT-ASV 23

F

- FiO2 set to 100% due to low SpO2 53

I

- INTELLiVENT Settings window
 - Auto tab 18
 - automation options, selecting 16
 - auto-recruitment, enabling/disabling 21
 - displaying during ventilation 27
 - patient condition, selecting 16
 - PEEP limits, setting 21
 - Quick Wean tab 19

- specifying patient conditions 18
- INTELLiVENT-ASV
 - Alarms window, setting limits 24
 - contraindications for use 13
 - Controls window 23
 - indications for use 13
 - overview 12
 - preparing for ventilation using 14
 - selecting in the Modes window 16
 - symbols, about 50
- INTELLiVENT-ASV views
 - displaying 34
 - overview 34

M

- management of %MinVol
 - actions that halt automatic management 62
 - active patient 58
 - automatic 56
 - important notes 62
 - manual 57, 70
 - no PetCO2 signal 62
 - passive patient 57
 - rules to transition between active and passive states 61
 - signal quality 62
 - with disconnection 62
- management of oxygenation
 - automatic 64
 - manual 64
- minimum Oxygen level, setting 21

O

- Oscillation %MinVol 54
- Oscillation Oxygen 54
- Oscillation PEEP/CPAP 54
- Oxygen
 - emergency increase, about 65
 - setting minimum limit 21
 - setting minimum, about 33
- Oxygen control limit exceeded 54
- Oxygen control limit message
 - about 33
- Oxygen Controller at limit 54
- Oxygen msg control, about 33
- Oxygen supply failed 55
- Oxygenation adjustment off 54

- Oxygenation horizon
 - about 35, 48
- oxygenation management
 - actions that stop automated management 69
 - important notes about 68
 - manual 70
 - oxygen limit exceeded message 69
 - rules for 66
 - signal quality 68
- Oxygenation maps
 - about 35, 43
 - displaying 46
 - reviewing 43

P

- passive patient, defined 61
- patient conditions
 - about 28
 - ARDS 28
 - brain injury 28
 - chronic hypercapnia 28
 - selecting 16
- patient data, specifying 15
- patient symbols
 - in Oxygenation horizon, about 48
 - in Oxygenation maps, about 43, 47
 - in Ventilation horizon, about 41
 - in Ventilation map, about 37, 40
- PEEP
 - high and low limits, about 33
 - setting high and low limits 21
- PetCO2
 - signal not available 62
- PetCO2 target zone
 - about 40
 - changing 32
- plethysmogram
 - about 36, 49
- plethysmogram, SpO2 data in 49

Q

- Quick Wean
 - about 74
 - alarms 95
 - conditions for starting weaning activities 81
 - conditions for stopping 92
 - configuring 97
 - enabling/disabling 20

- parameters, specifications for 100
- To start SBT criteria 81
- workflow 77

R

- Recruitment in progress 55

S

- SBT
 - defined 76
- SBT settings
 - during ventilation 80
- SBT settings, configuring 97
- SBTs
 - allowing automatic SBTs at any time 80, 85
 - automated, defined 76
 - conditions for stopping 92
 - configuring 97
 - enabling/disabling 78
 - settings available during ventilation 80
- settings, adjusting during active ventilation 26
- signal quality
 - and oxygenation 68
- signal quality, effect on ventilation management 62
- specifications 108
 - Quick Wean parameters 100
- SpO2 data, viewing
 - in plethysmogram 49
- SpO2 signal
 - quality of 68
- SpO2 target zone
 - about 47
- Standby window, about 15
- Start ventilation button 15
- starting weaning activities
 - conditions for 81
- stopping an SBT
 - conditions for 92

T

- target shift
 - about 31
 - changing ventilation/oxygenation targets 32
- To start SBT

- defined 76
- To start SBT criteria 81
- To stop SBT
 - defined 76
- Tolerance time
 - defined 76
- trend graphs, displaying 50

V

- Ventilation adjustment OFF 55
- Ventilation Controller at limit 55
- Ventilation horizon
 - about 35, 41
 - displaying 42
 - reviewing 41
- Ventilation map
 - about 35, 37
 - displaying 37, 39
- views
 - displaying 34



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