

# INSPIRE - 100

An Emergency Ventilator Device



## ***Troubleshooting Guide***



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# General Safety Guidelines

## Personnel

- Ensure proper training for staff.
- Familiarize staff with the Operating Manual.
- Familiarize staff with Alarm situations.

## Servicing & Testing

- Never ignore Service alerts.
- Never ignore BVM replacement alerts.
- Never bypass the built-in Pre-use checks.

## Power Source

- Always plug into a UPS after checking UPS battery.
- Ensure that the AC supply is grounded.
- Use correct plug receptacle.
- Secure the power cord.

## Gas Supply

- If using cylinders, ensure that the cylinder is full.
- Always Have a spare cylinder handy.
- If using an Oxygen Concentrator, ensure that it has been recently serviced.
- Never place the ventilator in a combustible environment.

## Alarms

- Never ignore an alarm.
- Never mute the alarm on regular basis.
- If the reason for the alarm(s) cannot be immediately identified, begin manual ventilation until alarm(s) can be corrected.

## Checking for leakages

All the components of the breathing circuit are off-the-shelf with standard industry dimensions and should fit together snugly and without any leakages. The one exception that is not off-the-shelf is the proprietary pressure connector, which also adheres to standard industry dimensions.

During specific troubleshooting, the following possible leakage points may have to be checked carefully. Whenever possible, error messages point to specific connection points for checking.

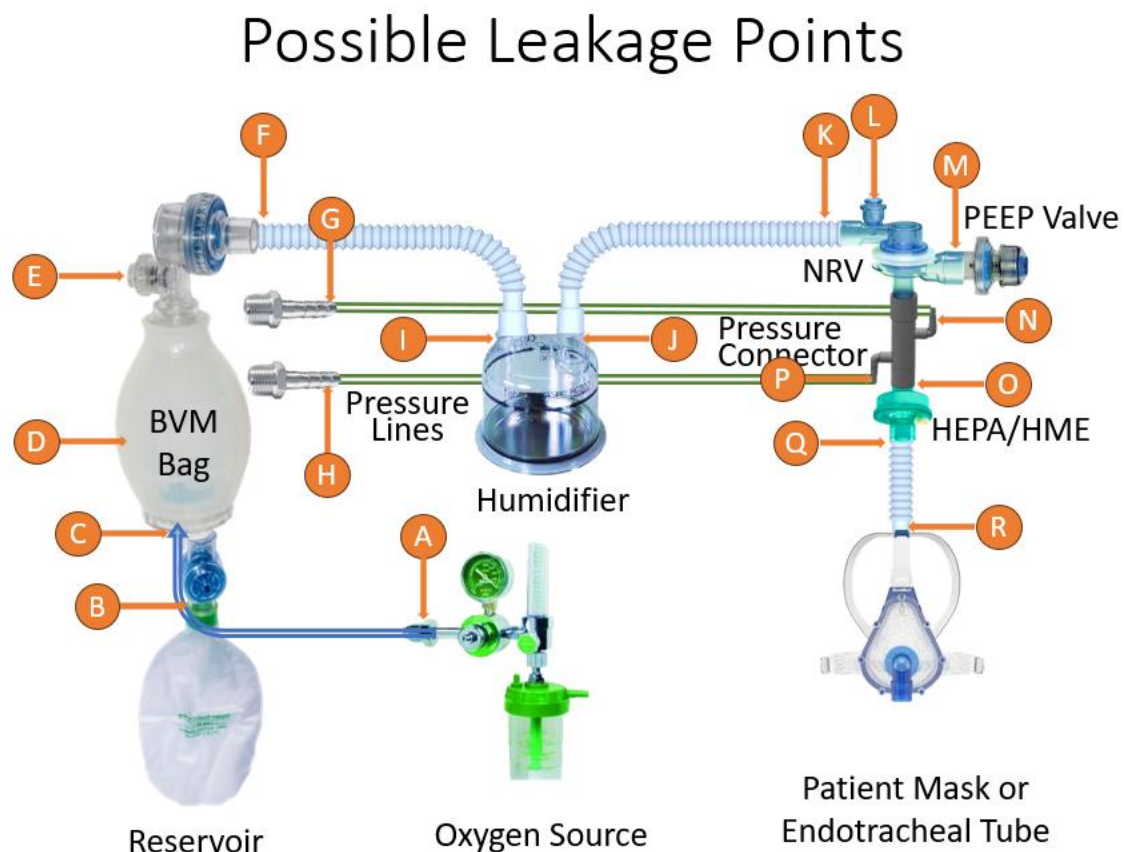


Figure 1: Possible Leakage Points

## BVM (AMBU) Bag Specifications

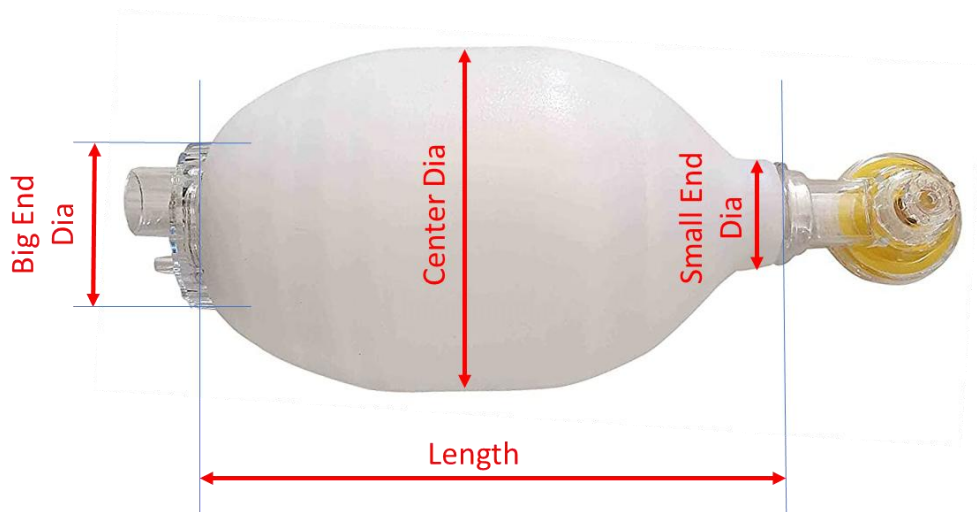


Figure 2: BVM Bag Specifications

	Units	Min	Max
<b>Length</b>	mm	210	215
<b>Center Diameter</b>	mm	130	135
<b>Big End Diameter</b>	mm	60	65
<b>Small End Diameter</b>	mm	25	30
<b>Connector Diameter</b>	mm	22	22
<b>Volume</b>	ml	1600	1800

## Troubleshooting Tips

The table starting from the next page is a list of error and warning messages issued by the system with an explanation of possible causes and possible solutions.

These messages are organized by the system state i.e. INITIAL, STANDBY, ACTIVE or ERROR.

Please consult the index at the end of this document to search for topic of interest.

Figures 1 and 2 above are referred to by some messages.

<b>During System RESET</b>	<b>Symptom</b>	<b>Watchdog RESET</b>
	<b>Message</b>	<< RESTART REASON >> Watchdog RESET Report the problem Continue (YES) ?
	<b>Possible Causes</b>	System reset itself because of an unexpected error
	<b>Possible Solutions</b>	Call Technician Report the problem In the meantime the system is usable starting from RESET

<b>During System Initialization</b>	<b>Symptom</b>	<b>Supply Voltage too low</b>
	<b>Message</b>	Low Board Voltage 4.723 volts Min 4.900 volts Call Technician
	<b>Possible Causes</b>	Defective Power Supply - minimum required is 4.9 volts Loose Spiral Cable connection
	<b>Possible Solutions</b>	Call Technician

<b>During System Initialization</b>	<b>Symptom</b>	<b>Clock Battery needs replacing</b>
	<b>Message</b>	Clock Battery needs replacing call Technician Continue (YES) ?
	<b>Possible Causes</b>	Clock Battery too weak Not able to keep time when power is switched off
	<b>Possible Solutions</b>	Call Technician

During System Initialization	Symptom	Portal does not open automatically for Patient, Location Wi-Fi networks when trying to enter Location, Patient or Wi-Fi information
	Message	Connect Laptop / Phone To Wi-Fi Network INSPIRE-100 Patient .. 1 ..
	Possible Causes	Wi-Fi Access device (laptop/smartphone) not configured correctly
	Possible Solutions	Try once again Get an IT technician to configure the access device correctly Use a different access device After logging into the Patient/Location WiFi network, use a Browser and navigate to URL 192.168.1.4

During System Initialization	Symptom	Unable to log into WiFi Network
	Message	Wi-Fi Login Failed Re-enter W-Fi Credentials (YES or NO) ?
	Possible Causes	Wi-Fi Network inaccessible Incorrect WiFi password WiFi Router malfunction Broadband connection is down
	Possible Solutions	Retry the Login process - press NO Enter new WiFi credentials - press YES Reboot the WiFi router - press NO

During System Initialization	Symptom	Failed to calibrate Pressure Sensors
	Message	Pressure Sensor ZERO Calibration FAILED
	Possible Causes	The breathing tube was not open during test Pressure Sensors are defective
	Possible Solutions	Try once again starting from RESET keeping breathing tube open If the failure repeats, call Technician



During System Initialization	Symptom	<b>Residual Pressure Failure</b>
	Message	<b>FAILED because of Residual Pressure in Breathing Circuit Continue (YES)</b>
	Possible Causes	The breathing tube was not open during test
	Possible Solutions	Try once again starting from RESET keeping breathing tube open If the failure repeats, call Technician

During System Initialization	Symptom	<b>No Pressure during Auto-touch</b>
	Message	<b>FAILED - No pressure Check Pressure tubes Call Technician Continue (YES)</b>
	Possible Causes	Major Leakage in the Breathing system Possible disconnect in the Breathing System Remote possibilities include motor failure or a broken belt
	Possible Solutions	Check BVM bag for wear and tear Check points E-P for leakage as shown in Figure 1 above

During Pre-use Checks	Symptom	<b>Fast Compression Failure</b>
	Message	<b>FAST Compression while BLOCKED FAILED Continue (YES) ?</b>
	Possible Causes	The Breathing tube was not blocked properly Leakage in the Breathing system
	Possible Solutions	Try again after blocking Breathing tube firmly Check points E-P for leakage as shown in Figure 1 above

During Pre-use Checks	<b>Symptom</b>	<b>Downstream Pressure Line Leakage</b>
	<b>Message</b>	Check for Leakage(s) Downstream Pressure BVM, Breathing tubes Continue (YES) ?
	<b>Possible Causes</b>	The downstream pressure line has leakage BVM Bag or the breathing tube has leakage
	<b>Possible Solutions</b>	Check points P and H for leakage as shown in Figure 1 above Check BVM bag for wear and tear

During Pre-use Checks	<b>Symptom</b>	<b>Upstream Pressure Line Leakage</b>
	<b>Message</b>	Check for Leakage(s) Upstream Pressure BVM, Breathing tubes Continue (YES) ?
	<b>Possible Causes</b>	The upstream pressure line has leakage BVM Bag or the breathing tube has leakage
	<b>Possible Solutions</b>	Check points N and G for leakage as shown in Figure 1 above Check BVM bag for wear and tear

During Pre-use Checks	<b>Symptom</b>	<b>Pressure lines interchanged</b>
	<b>Message</b>	Upstream / Downstream Pressure lines Leakage or Swapped Continue (YES) ?
	<b>Possible Causes</b>	The upstream/downstream pressure lines connected incorrectly BVM Bag or the breathing tube has leakage
	<b>Possible Solutions</b>	Check points N is connected to G as shown in Figure 1 above Check points P is connected to H as shown in Figure 1 above Check BVM bag for wear and tear

During Pre-use Checks	Symptom	Incorrect BVM Bag size
	Message	BVM Bag is too small or Leakage in the Breathing system Continue (YES) ?
	Possible Causes	System detected that the BVM bag size is too small Could also be due to leakage in the Breathing system
	Possible Solutions	Check Figure 2 for system BVM Bag Specifications Also check for leakages using Figure 1 as a guide

During STANDBY state	Symptom	Patient not connected
	Message	Patient Disconnected from the Breathing Circuit Reconnect when ready
	Possible Causes	The Breathing tube is not connected to the patient
	Possible Solutions	Connect patient to the Breathing tube before starting breath delivery

During STANDBY state	Symptom	Conflicting Parameter settings - PS and PEEP
	Message	PARAMETER Conflict PS less than PEEP Change PARAMETERS YES -> Commit
	Possible Causes	PS can never be set to be less than PEEP
	Possible Solutions	Change parameters and press YES

During STANDBY state	Symptom	PS Parameter too low
	Message	PS setting too close to PEEP Confirm to accept (YES or NO) ?
	Possible Causes	Support pressure PS parameter too low
	Possible Solutions	Reconfirm to accept - press YES Change parameters - press NO

During STANDBY state	Symptom	Conflicting Parameter settings - P <sub>MAX</sub> and PEEP
	Message	PARAMETER Conflict P <sub>MAX</sub> less than PEEP Change PARAMETERS YES -> Commit
	Possible Causes	P <sub>MAX</sub> can never be set to be less than PEEP
	Possible Solutions	Change parameters and press YES

During STANDBY state	Symptom	Conflicting Parameter settings - P <sub>MAX</sub> and PS
	Message	PARAMETER Conflict P <sub>MAX</sub> less than PS Change PARAMETERS YES -> Commit
	Possible Causes	P <sub>MAX</sub> can never be set to be less than PS
	Possible Solutions	Change parameters and press YES

During STANDBY state	Symptom	Conflicting Parameter settings - TPS and RR
	Message	PARAMETER Conflict TPS more than (RR/2) Change PARAMETERS YES -> Commit
	Possible Causes	TPS cannot be set to more than half of RR time
	Possible Solutions	Change parameters and press YES

During STANDBY state	Symptom	Extreme Volume Control settings
	Message	VT,RR,EI combination may be too extreme Confirm to accept (YES or NO) ?
	Possible Causes	The VT, RR, EI parameter settings may cause too much breath volume in too short a time.
	Possible Solutions	Reconfirm to accept - press YES Change parameters - press NO

During STANDBY state	Symptom	Extreme Pressure Support settings
	Message	PS, TPS combination may be too extreme Confirm to accept (YES or NO) ?
	Possible Causes	The PS, TPS parameter settings may cause result in high support pressure
	Possible Solutions	Reconfirm to accept - press YES Change parameters - press NO

During STANDBY state	Symptom	Extreme PEEP setting
	Message	PEEP Parameter may be too high Confirm to accept (YES or NO) ?
	Possible Causes	PEEP parameter set too high
	Possible Solutions	Reconfirm to accept - press YES Change parameters - press NO

During STANDBY state	Symptom	Extreme PMAX setting
	Message	PMAX Parameter may be too high Confirm to accept (YES or NO) ?
	Possible Causes	PMAX parameter set too high
	Possible Solutions	Reconfirm to accept - press YES Change parameters - press NO

During STANDBY state	Symptom	Pop-off valve warning
	Message	Pressure > 40 cm H <sub>2</sub> O needs Pop-off valve to be locked Done (YES or NO) ?
	Possible Causes	PMAX parameter set greater than 40 cm H <sub>2</sub> O Pop-off valves must be locked to enable this
	Possible Solutions	Lock the Pop-off valves Reduce PMAX parameter setting

During STANDBY state	Symptom	Cannot start Breath delivery if patient disconnected
	Message	Cannot START Breath Delivery Connect Patient and Press START again
	Possible Causes	The Breathing tube is not connected to the patient
	Possible Solutions	Connect patient to the Breathing tube and press START again

During ACTIVE state	Symptom	PEEP valve needs adjustment
	Message	PEEP delta Observed +1.5 cmH <sub>2</sub> O Adjust PEEP valve or PEEP setting
	Possible Causes	Measured PEEP different from the desired PEEP setting It could be higher or lower
	Possible Solutions	Adjust the PEEP valve while checking the measured PEEP on display There is no need to pause the breath delivery

During ACTIVE state	Symptom	Abnormal Breath Pressure waveform
	Message	Abnormal Breath Patient might be coughing hiccupping Check immediately
	Possible Causes	The breath waveform shows too many peaks and troughs The patient may be distressed
	Possible Solutions	Check with the Doctor immediately May need to disconnect patient and give manual resuscitation till the problem is identified and resolved

During ACTIVE state	Symptom	No Patient initiated breath for a long time
	Message	Delivered Mandatory Breath in PSV mode Missing Spontaneous Breath for a while
	Possible Causes	While in PSV ventilation mode, all breaths are expected to be initiated by the Patient instead of by the ventilator system The system was forced to deliver a mandatory breath because of too long interval(s) between Patient-initiated breaths
	Possible Solutions	Check with the Doctor

During ACTIVE state	Symptom	Pressure Leak detected during Breath delivery
	Message	Some Pressure Leak Check BVM Bag Check Patient Mask Check Pressure Lines
	Possible Causes	Some connection in the Breathing circuit has become loose
	Possible Solutions	Check points E-R as shown in Figure 1 for leakage

During ACTIVE state	Symptom	Total loss of Pressure
	Message	Airway Blockage Check Breathing tube Aspirate Patient Call Technician
	Possible Causes	A sudden rise detected in measured lung pressure
	Possible Solutions	Patient may need to be aspirated There may be a sudden decline in patient's lung compliance Consult the Doctor immediately



During ACTIVE state	Symptom	Airway blockage detected during Breath delivery
	Message	TOTAL Pressure Loss Check Patient Mask Check Breathing tube Call Technician
	Possible Causes	Patient disconnected suddenly Some component of Breathing system disconnected
	Possible Solutions	Check all possible leakage points as shown in Figure 1

During ACTIVE state	Symptom	Pressure exceeded PMAX limit
	Message	Pressure beyond PMAX Temporarily changed Breath Settings Check DISPLAY
	Possible Causes	Peak pressure exceeded the set PMAX limit Patient may be in distress Patient's lung compliance may have changed
	Possible Solutions	System temporarily reduces VT to continue breath delivery Consult the Doctor Change PMAX parameter setting Change other parameter settings

During ACTIVE state	Symptom	Patient Initiated breaths while system in CMV Ventilation mode
	Message	123 Patient Initiated breaths Detected but Ignored while in CMV mode
	Possible Causes	While in CMV mode, the system ignores all patient-initiated breaths and only delivers mandatory breaths according to set parameters
	Possible Solutions	It is an informational message - not an alarm If the number is too high, it may be time to change ventilation mode Consult the Doctor

During ACTIVE state	Symptom	System unable to provide set level of Pressure support
	Message	Unable to deliver set Pressure Support Change setting for Pressure Support
	Possible Causes	The PS parameter setting may be too high for the patient
	Possible Solutions	Consult the Doctor Change PS parameter setting

During ACTIVE state	Symptom	System unable to provide set Volume Controlled breaths
	Message	Unable to deliver set Tidal Volume BVM Bag too small Change Settings
	Possible Causes	VT, RR, EI parameter settings are too high for the patient's lungs
	Possible Solutions	Consult the Doctor Change VT, RR and EI parameter settings

During ACTIVE state	Symptom	Minute volume discrepancy between expect and actual in PSV ventilation mode
	Message	Low Minute Volume Minute Vol=4200 ml Expected > 5000 ml Backup SIMV active
	Possible Causes	Patient-initiated breaths not ready for expected Minute volume Either the frequency of patient initiated is too small or the patient not drawing enough during each breath
	Possible Solutions	Consult the Doctor Change MV parameter settings Change the ventilation mode System has switched to SIMV mode automatically

During ACTIVE state	Symptom	Change Oxygen Inflow rate
	Message	Minute Volume Change Set O2 Flow (l/min) -> 4.8 (l/min)
	Possible Causes	Required Oxygen inflow rate is dependent on Minute Volume
	Possible Solutions	Change the Oxygen inflow rate to that specified in the message to achieve required FiO2

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