

INSPIRE - 100

An Emergency Ventilator Device



Troubleshooting Guide



Contents

| | |
|-------------------------------------|---|
| Figures | 1 |
| General Safety Guidelines | 2 |
| Personnel | 2 |
| Servicing & Testing..... | 2 |
| Power Source | 2 |
| Gas Supply..... | 2 |
| Alarms | 2 |
| Checking for leakages | 3 |
| BVM (AMBU) Bag Specifications | 4 |
| Troubleshooting Tips | 5 |
| Index..... | 0 |

Figures

| | |
|---|---|
| Figure 1: Possible Leakage Points | 3 |
| Figure 2: BVM Bag Specifications | 4 |

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.

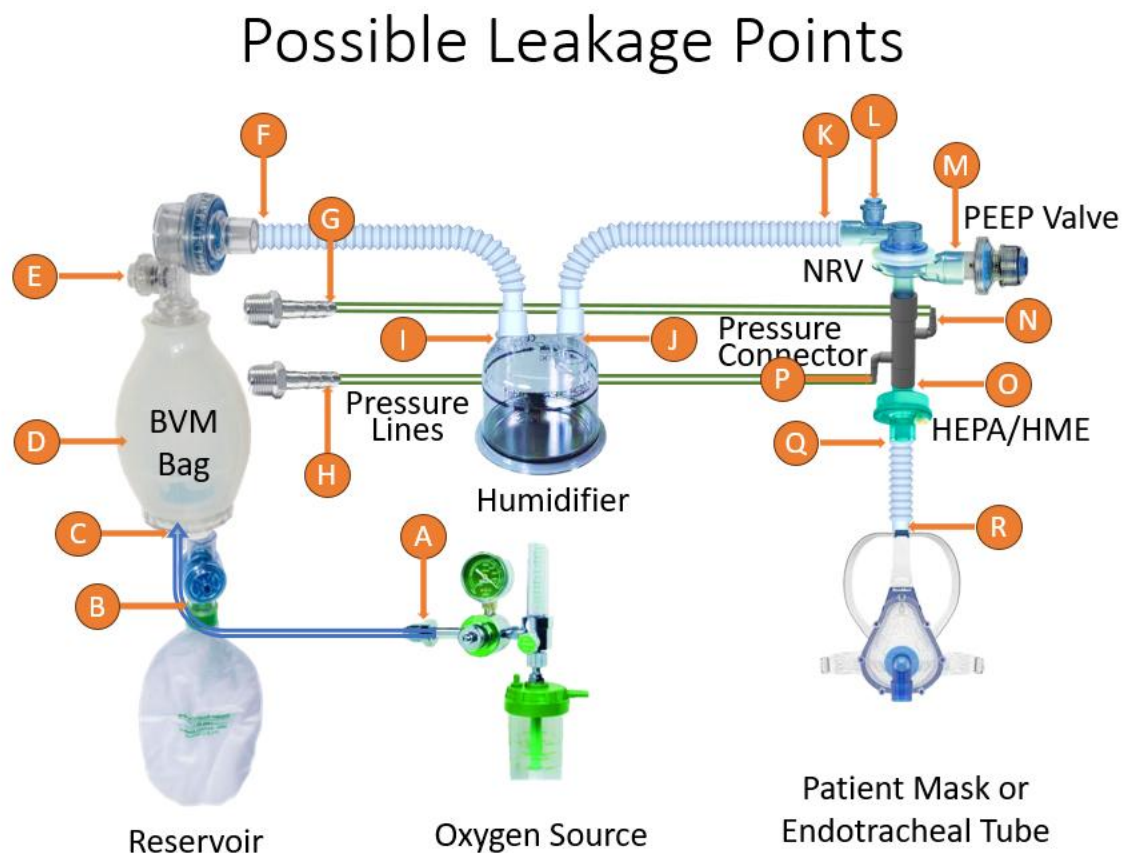


Figure 1: Possible Leakage Points

BVM (AMBU) Bag Specifications

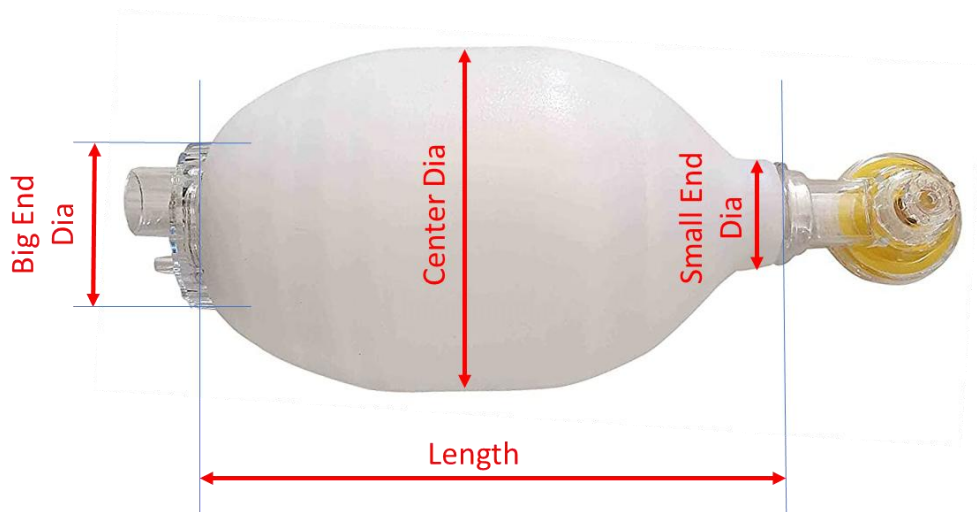


Figure 2: BVM Bag Specifications

| | Units | Min | Max |
|--------------------|-------|------|------|
| Length | mm | 210 | 215 |
| Center Diameter | mm | 130 | 135 |
| Big End Diameter | mm | 60 | 65 |
| Small End Diameter | mm | 25 | 30 |
| Connector Diameter | mm | 22 | 22 |
| Volume | 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. Please study them carefully.

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

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

| | | |
|-------------------------------------|---------------------------|--|
| During System Initialization | Symptom | Clock Battery needs replacing |
| | Message | Clock Battery needs replacing call Technician Continue (YES) ? |
| | Possible Causes | Clock Battery too weak Not able to keep time when power is switched off |
| | Possible Solutions | 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 | Residual Pressure Failure |
| | Message | FAILED because of Residual Pressure in Breathing Circuit Continue (YES) |
| | 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 | No Pressure during Auto-touch |
| | Message | FAILED - No pressure Check Pressure tubes Call Technician Continue (YES) |
| | 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 | Fast Compression Failure |
| | Message | FAST Compression while BLOCKED FAILED Continue (YES) ? |
| | 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 | Symptom | Downstream Pressure Line Leakage |
| | Message | Check for Leakage(s) Downstream Pressure BVM, Breathing tubes Continue (YES) ? |
| | Possible Causes | The downstream pressure line has leakage BVM Bag or the breathing tube has leakage |
| | Possible Solutions | Check points P and H for leakage as shown in Figure 1 above Check BVM bag for wear and tear |

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

| | | |
|-----------------------|--------------------|---|
| During Pre-use Checks | Symptom | Pressure lines interchanged |
| | Message | Upstream / Downstream Pressure lines Leakage or Swapped Continue (YES) ? |
| | Possible Causes | The upstream/downstream pressure lines connected incorrectly BVM Bag or the breathing tube has leakage |
| | Possible Solutions | 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 - PMAX and PEEP |
| | Message | PARAMETER Conflict PMAX less than PEEP Change PARAMETERS YES -> Commit |
| | Possible Causes | PMAX can never be set to be less than PEEP |
| | Possible Solutions | Change parameters and press YES |

| | | |
|----------------------|--------------------|---|
| During STANDBY state | Symptom | Conflicting Parameter settings - PMAX and PS |
| | Message | PARAMETER Conflict PMAX less than PS Change PARAMETERS YES -> Commit |
| | Possible Causes | PMAX 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 ₂ O needs Pop-off valve to be locked Done (YES or NO) ? |
| | Possible Causes | PMAX parameter set greater than 40 cm H ₂ 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 ₂ 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 | <p>Minute Volume Change</p> <p>Set O2 Flow (l/min)</p> <p>-> 4.8 (l/min)</p> |
| | 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 |

Index

| | |
|--------------------------|---------------------|
| Abnormal Breath..... | 14 |
| aspirated..... | 15 |
| Blockage | 15 |
| BVM Bag | 9, 10, 15, 17 |
| Clock | 6 |
| CMV..... | 16 |
| Downstream..... | 9 |
| El 12, 17 | |
| FiO2..... | 18 |
| leakage | 3, 8, 9, 10, 15, 16 |
| Minute Volume..... | 17, 18 |
| PARAMETER Conflict | 10, 11, 12 |
| PEEP..... | 10, 11, 13, 14 |
| PMAX | 11, 13, 16 |
| Pop-off..... | 13 |
| Pressure Lines..... | 15 |
| Pressure Loss..... | 16 |
| Pressure Sensor..... | 7 |
| Pressure Support..... | 12, 17 |
| PS..... | 10, 11, 12, 17 |
| PSV..... | 15, 17 |
| RR..... | 12, 17 |
| Supply Voltage..... | 6 |
| Swapped | 9 |
| TPS..... | 12 |
| Upstream | 9 |
| VT | 12, 16, 17 |
| Watchdog RESET | 6 |
| Wi-Fi | 7 |