Newborn Essential Solutions and Technologies-Education (NEST-ED) Technical Modules provide educational support for each of the technologies included in the NEST360° bundle for newborn care. These materials are intended to strengthen locally developed neonatal and technical trainings in pre-and in-service settings and are not intended to be comprehensive technical guidelines or device-specific manuals.
Newborn Essential Solutions and Technologies-Education
Technical Modules: Flow Splitter

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The authors have made every effort to check the accuracy of all information and instructions for use of any devices or equipment. As knowledge base continues to expand, readers are advised to check current product information provided by the manufacturer of each device, instrument, or piece of equipment to verify recommendations for use and/or operating instructions.

In addition, all forms, instructions, checklists, guidelines, and examples are intended as resources to be used and adapted to meet national and local health care settings’ needs and requirements.
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PREFACE

This series has been designed with the intent of supporting the clinical use and technical repair of technologies in newborn care units.

Newborn Essential Solutions and Technologies-Education (NEST-ED) Technical Modules provide educational support for each of the technologies included in the NEST360° bundle for newborn care. These materials are intended to strengthen locally developed neonatal and technical trainings in pre- and in-service settings. Of note, these materials are not intended to be comprehensive technical guidelines or to replace the use of device-specific user and service manuals or textbooks. They are to be used to facilitate the implementation of comprehensive newborn care, including bubble CPAP, in a resource limited setting.

The NEST-ED Technical Modules were developed through a combination of international standard review, international expert feedback, and multinational NEST360° expert consensus opinion. NEST-ED Modules form the backbone of all lectures, power points, job aids, and other supportive education materials supplied by NEST360°.
ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>bCPAP</td>
<td>Bubble continuous positive airway pressure</td>
</tr>
<tr>
<td>BMET</td>
<td>Biomedical Equipment Technician</td>
</tr>
<tr>
<td>dL</td>
<td>Decilitre</td>
</tr>
<tr>
<td>ESD</td>
<td>Electrostatic Discharge</td>
</tr>
<tr>
<td>FiO₂</td>
<td>Increased Fractional Concentration of Oxygen</td>
</tr>
<tr>
<td>Fr</td>
<td>French size</td>
</tr>
<tr>
<td>HAI</td>
<td>Hospital acquired infections</td>
</tr>
<tr>
<td>HCWs</td>
<td>Healthcare workers</td>
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<tr>
<td>KMC</td>
<td>Kangaroo mother care</td>
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<tr>
<td>LBW</td>
<td>Low birth weight</td>
</tr>
<tr>
<td>LCD</td>
<td>Liquid Crystal Display</td>
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<tr>
<td>LED</td>
<td>Light-Emitting Diode</td>
</tr>
<tr>
<td>mm Hg</td>
<td>Millimeters of mercury</td>
</tr>
<tr>
<td>NEST-ED</td>
<td>Newborn Essential Solutions &amp; Technologies-Education</td>
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<tr>
<td>NEST360°</td>
<td>Newborn Essential Solutions &amp; Technologies</td>
</tr>
<tr>
<td>nm</td>
<td>Nanometer</td>
</tr>
<tr>
<td>O₂</td>
<td>Oxygen</td>
</tr>
<tr>
<td>OGT</td>
<td>Orogastric tube</td>
</tr>
<tr>
<td>PCB</td>
<td>Printed Circuit Board</td>
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<tr>
<td>ppm</td>
<td>Parts per million</td>
</tr>
<tr>
<td>ROP</td>
<td>Retinopathy of Prematurity</td>
</tr>
<tr>
<td>PSA</td>
<td>Pressure Swing Adsorption</td>
</tr>
<tr>
<td>PSU</td>
<td>Power Supply Unit</td>
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<tr>
<td>ROP</td>
<td>Retinopathy of Prematurity</td>
</tr>
<tr>
<td>SpO₂</td>
<td>Peripheral blood oxygen saturation</td>
</tr>
<tr>
<td>UPS</td>
<td>Uninterruptible power supply</td>
</tr>
<tr>
<td>WASH</td>
<td>Water, sanitation and hygiene</td>
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NOMENCLATURE

<table>
<thead>
<tr>
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<th>Description</th>
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<td>Allen keys</td>
<td>Hex keys</td>
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<tr>
<td>bCPAP prongs</td>
<td>bCPAP patient interface</td>
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<tr>
<td>Christmas tree adapter</td>
<td>Barbed oxygen fitting, nipple and nut adapter</td>
</tr>
<tr>
<td>Control PCB</td>
<td>Main PCB</td>
</tr>
<tr>
<td>Cot</td>
<td>Bassinet, infant crib</td>
</tr>
<tr>
<td>Flat head screwdriver</td>
<td>Slot head screwdriver</td>
</tr>
<tr>
<td>Flow splitter</td>
<td>Oxygen splitter, flow meter stand</td>
</tr>
<tr>
<td>Glucometer</td>
<td>Glucose meter</td>
</tr>
<tr>
<td>Hospital Acquired Infection</td>
<td>Iatrogenic infection, nosocomial infection</td>
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<tr>
<td>Multimeter</td>
<td>Digital multimeter, Avometer</td>
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<tr>
<td>Nasal prongs</td>
<td>Oxygen catheter, oxygen cannula, oxygen prongs</td>
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<tr>
<td>Positive Pressure</td>
<td>Positive end expiratory pressure, positive airway pressure</td>
</tr>
<tr>
<td>Radiant warmer</td>
<td>Resuscitaire, resuscitation table</td>
</tr>
<tr>
<td>Star screwdriver</td>
<td>Torx screwdriver</td>
</tr>
<tr>
<td>Suction pump</td>
<td>Suction machine</td>
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</table>
Introduction

The NEST-ED Technical Modules have been prepared to help technical staff and students understand the basics of when and how to use equipment essential to newborn care. More importantly, the Technical Modules support staff in troubleshooting common issues, as well as prepare staff to repair equipment when it breaks down or malfunctions. Modules may be used by teaching institutions, to supplement current newborn care curricula, or by hospitals, clinical departments and individuals to update their knowledge and to better facilitate the effective and safe use of newborn care equipment. Modules should be used alongside device user and service manuals to provide additional context as needed.

Whilst reading this series, navigate to the Table of Contents by clicking the NEST360° logo that appears at the bottom right corner of each page: NEST360°

Every module has a similar structure with sections and subsections. The sections have similar headings and subheadings to make it easy for the user to navigate them. However, words may have different meanings for the various cadres of staff reading them and so to reduce misinterpretation, the heading titles are explained below.

The NEST-ED Technical Modules are intended as a flexible resource that hospitals and partners can adapt to their specific needs. The Technical Modules consist of generic content that can be applied to any model within a device category, coupled with model specific device images that can be exchanged for alternative images depending on the devices available at your facility. Individuals who are interested in gaining access to the editable NEST-ED Technical Modules should contact the NEST Training Materials Coordinator (Anniina Lockwood, al90@rice.edu) or the NEST Biomedical Tech Training Director (Sara Liaghati-Mobarhan, slmobarhan@rice.edu).

CLINICAL PROBLEM

This section provides useful information on the clinical application of a device that would bear relevance to the biomedical team, not only to aid in their troubleshooting, but also for user training.

ASSESSMENT

This section explains how the device works, and what kinds of patients it is useful for. This section also includes comprehensive diagrams of internal and external views of the devices, including consumables that may be used with the device. This section also contains detailed descriptions of key device components (including alarms) and includes a diagram of typical device flow (including components and how they interact with each other, electrical current and fluid movement through the device if relevant).
MANAGEMENT

This section focuses on clinical management and provides step by step directions on how to set the device up for a patient, followed by instructions on starting the patient on the device and monitoring a patient whilst on the device. This section also describes how to remove the equipment from the patient when it is no longer needed. Although a biomedical engineer or a technician will not be responsible for providing care, understanding these steps will be useful in training and when assessing the device.

INFECTION PREVENTION

This section lays out the basic infection prevention measures that should always be taken when handling equipment, followed by directions for disinfecting the equipment both during and after use. This section also describes the crucial Infection Prevention and Control steps that are particularly relevant to biomedical engineers and technicians.

COMPLICATIONS

This section explains some of the common but serious clinical complications that relate to and can arise from the use of the equipment (e.g., complications that will be seen or directly apply to the patient). Biomedical engineers’ and technicians’ understanding of potential complications for the patient is crucial to ensure patient safety. This section also describes common device complications (e.g., complications that will be seen or directly apply to the device).

CARE & MAINTENANCE

This section describes where to place equipment for use, how to safely handle devices and their consumables, whether calibration is recommended, and how to decommission the equipment. Biomedical engineers and technicians are responsible for second-line care and maintenance to ensure the equipment lasts to their potential lifetime; as such, this section also lists the necessary daily, weekly, monthly and annual preventive maintenance steps required to keep the device in good working condition. First-line care and maintenance is the responsibility of the user and is described in the NEST-ED Clinical Modules.

TROUBLESHOOTING & REPAIR

This section describes steps that should be taken when a device malfunctions and first-line troubleshooting efforts have failed to address the issue. This section describes tools and spare parts that might be required to prepare for repairs and to troubleshoot failures, and provides a list of components commonly provided with the device to ensure that all components return to the ward post-repair. Finally, this section also explains steps for testing, repairing, and replacing specific parts of the device.
REFERENCES & ALERTS

References & alert boxes are included within each module to provide clarity on areas where recommendations are governed by published standards, evidence, and/or expert opinion. This is included for the dual purpose of facilitating (1) feedback and continuous improvement of NEST-ED Technical Modules and (2) implementer review of content for incorporation in local trainings.

? ALERT 0.0 Subject

QUERY ALERT BOXES appear where there may be controversy or disagreement. In these cases, alert boxes provide background to the recommendations that are made in the body of the document. Relevant documents are cited and brief explanation of reasoning for current module content provided.

! ALERT 0.0

RECOMMENDATION ALERT BOXES appear where there are recommendations based largely on expert opinion or consensus, or to emphasize an important element of care. Relevant documents are cited and brief explanation of reasoning for current module content provided.
Respiratory Support

Oxygen Therapy

Flow Splitter
1 Clinical Problem

Flow splitters are used exclusively within the newborn and paediatric wards to deliver oxygen to several patients from a single oxygen source.

Supplemental oxygen is indicated for sick children, especially those with low blood oxygen saturation levels (SpO₂<90%) which has many clinical causes. Flow splitters are not typically used in adult wards due to their restriction to low flows, which do not meet typical adult treatment needs.

2 Assessment

Flow splitters are accessory devices that divide oxygen from one source to several patients at independent, adjustable flow rates. Maximum flow delivered per device depends on model and ranges from 1 to 2 L/min.

Flow splitters (2.1) may be used with any oxygen concentrator, oxygen cylinder or piped oxygen to provide low flow supplemental oxygen to patients. Flow splitters may also be combined with CPAP if the oxygen source and splitter flow meter have the capacity for the flow rates required. This technical module will provide visual guidelines for the use of flow splitters with an oxygen concentrator source, although these may be applied to the use of flow splitters with any other oxygen source.

2.1 Typical flow splitter.
Flow splitters may be adjustable or pre-set:

- **Adjustable**: Oxygen flow is divided by branching secondary tubes from a primary tube with one end connected to the oxygen source and the distal end closed. All secondary tubes are equally spaced and have the same diameter and cross-section. Each flow meter operates independently and can be adjusted individually to the preferred flowrate as prescribed by medical personnel.

- **Pre-Set**: Oxygen flowrates on each oxygen outlet are fixed. These systems are usually fastened directly to the oxygen concentrator or cylinder.

Neonatal patients should reach SpO\textsubscript{2} levels of 90–95% by 15 minutes after birth. If oxygen is needed it is recommended to give between 0.5-1 L/min per WHO standard. Whilst on oxygen, regular monitoring should be conducted including use of a pulse oximeter to ensure that this saturation range is maintained for the duration of treatment. Ideally, patients suffering from severe respiratory distress should have continuous pulse oximetry monitoring throughout care.

*A flow splitter has internal tubing with individual flow meters that split incoming oxygen flow coming from an oxygen source (i.e., oxygen concentrator or cylinder). Oxygen flow splitters generally provide low flow rates, from 0.1 up to a maximum of 2 L/min from each port. The oxygen concentration delivered through an oxygen flow splitter remains unchanged from that of the source. Any discrepancies from the oxygen source or tubing circuit will affect the oxygen delivered at the outlets of the flow splitter.*

Standard external and internal device components are annotated below in Figures 2.3 and 2.4. Components should be similar regardless of model. However, specific locations, visual setup and component type may vary by brand and device model. Refer to service and user manuals if model in use is different from the displayed version.
2.3 External flow splitter components.

2.4 Internal flow splitter components.
Flow splitters should be designed to have independent flow regulation; changing the flow rate at one port should have no (or only temporary) effect on the other ports. (2.5)

2.5 Flow of oxygen in an independently regulated flow splitter.

If the flow splitter is designed such that individual flow meters provide feedback into the general oxygen flow circuit, flows may be dependent: as one port flow is changed, other port flows may change. (2.6) These flow splitters should be changed for flow splitters with independent as quickly as possible to ensure reliable treatment.

2.6 Flow of oxygen in a dependently regulated flow splitter.
MAIN COMPONENTS

The following device components should be similar regardless of model. However, specific locations, visual setup and component type may vary by brand and device model. Refer to model service and user manuals if different from the displayed model for more device-specific information.

Oxygen Source Inlet port

The inlet port is the oxygen inlet source, typically located on the side of the device.

Outlet port

Flow splitters usually have four to five oxygen outlet ports, individually controlled by flow meters. Oxygen ports not in use should remain closed.

Flow meter

The flow meter, or flow regulator, controls and displays the oxygen delivery rate to the patient(s) in L/min, from 0.1 up to a maximum of 2 L/min from each port. The flow meter is marked for low flow rates, with individual graduations from 0.1 to 0.5 L/min to provide the low flow rates needed in neonatal or infant patients.

3 Management

Management covers how to use the flow splitter, including set up for a patient. Patient commencement, care whilst on oxygen and removal of the patient from oxygen are generic to oxygen therapy care guidelines. These instructions are helpful for a biomedical engineer or technician both in user training and in assessing the appropriate functionality of the device.

SETTING UP FOR A PATIENT

1. Ensure oxygen flow splitter is secured in a location where it cannot be easily dislodged and where staff can easily view and adjust the flow meter regulators on the splitter. (3.1) Open flow meters.
2 Connect oxygen splitter tubing from oxygen outlet source to oxygen splitter inlet port. (3.2)

3 Assess level of oxygen needed from oxygen source. The source of oxygen (e.g., the concentrator, oxygen cylinder or piped oxygen) must be adjusted to provide a flow of at least 1 L/min oxygen more than the total requirement from all the ports that are in use. (3.3)

For example: If 2 ports are in use (one port is set at 1 L/min, one port is set at 0.5 L/min) and three ports are shut, the total supply of oxygen required from the concentrator is 2.5 L/min (i.e., $0 + 0.5 + 0 + 1 + 0 + 1$ (extra L) = 2.5 L/min)

4 Turn on oxygen at source. The flow meter beads on the oxygen splitter should pop up.

5 Adjust the flow meter regulators individually to the required flow rates (3.4), observing the L/min at eyelevel. (3.5) The flow rates at the other outlet ports should not change as a single port is adjusted. If being used with an oxygen concentrator, some cyclical variation may occur.
Check that the ports have been numbered and number oxygen tubing to prevent infants receiving an incorrect flow. When changing flows for one patient, ensure that any other patients also on the flow splitter are receiving the correct amounts of oxygen.

4 Infection Prevention

Routine and adequate cleaning of medical devices is critical to prevent hospital-acquired infections in newborn care units.

**CLINICAL INFECTION PREVENTION**

1. Clean hands with soap and water or 70% alcohol before and after placing a patient on oxygen or handling any tubing that will be used on a patient.

2. Ensure that all patient-related tubing is new or has been cleaned thoroughly and dried as per re-use guidelines. *(Alert 4.1)* Any patient-related tubing must be cleaned before it is used to place another patient on nasal prongs. Nasal prongs are especially difficult to clean thoroughly. Tubing should be hung to dry after disinfection and should not touch the floor or other unsanitary surfaces whilst drying. Any item falling on the floor is contaminated and must be cleaned thoroughly again.

3. The housing of the flow splitter should be cleaned according to ward guidelines for disinfecting surfaces, or by wiping down with soapy water followed by 70% alcohol. Flow splitter oxygen ports should be cleaned using forceps wrapped in gauze and soaked in 70% alcohol.

4. Clean any used equipment that has been in contact with patient or staff.
**DISINFECTION AFTER USE**

1. Turn off the oxygen source. Disconnect oxygen tubing from source and flow splitter. If reusing tubing, immediately remove and begin hospital protocol for disinfection as outlined in [Oxygen Therapy: Infection Prevention](#).

2. Clean the flow splitter housing and regulators using 70% alcohol after every use. *(Alert 4.1)*

**BMET INFECTION PREVENTION**

1. Any piece of equipment used in providing patient care must be handled carefully, as it may be contaminated & have the potential to spread infection.

2. Clean & disinfect flow splitter housing & components whilst wearing PPE as appropriate (e.g., rubber gloves, apron, face protection, etc.) before any repairs or maintenance are made.

3. Avoid any contact between used piece of equipment & skin, mucosa or clothing.

4. Post-maintenance, decontaminate all tools and surfaces used with 70% alcohol or according to manufacturer guidelines. Do not use equipment until it has fully dried following decontamination.

---

**Alert 4.1 Disinfecting Equipment**

Disinfection of equipment should always comply with manufacturer guidelines. WHO recommends 0.5% dilution of chlorine (0.5% or > 100ppm available sodium hypochlorite) as the standard disinfectant for materials and surfaces contaminated by blood or body fluids. For metal and rubber surfaces, which may be corroded by chlorine, 70% alcohol is also commonly utilised for low level disinfection.

Other appropriate low-level disinfectants include quaternary ammonium, improved hydrogen peroxide and Iodophor germicidal detergent. Phenolic germicidal detergent is also identified but should not be used in neonatal wards since affordable, effective alternatives are available; and, there are concerns it may cause hyperbilirubinemia and/or neurotoxicity in neonates.

5 Complications

Equipment in newborn care units are highly specialised. Without proper knowledge and skills, this equipment can be potentially dangerous for the infants, families and care providers.

DEVICE COMPLICATIONS

- **Device positioning**: flow splitters are heavy devices and are frequently positioned on walls or shelves. This is appropriate if well secured. If improperly secured, flow splitters may fall onto patients, causing potential permanent or fatal injury.

- **Independent flows**: flow splitters should be designed to have independent flow regulation. If the flow splitter is not designed correctly, flows may be dependent: as one port flow is changed, other port flows may change. These splitters should be exchanged for one that has independent flow. If a dependent flow splitter is available, nursery staff should take care when changing flows for one patient and ensure that any other patients also on the flow splitter are receiving correct amounts of oxygen.

- **Flow delivery**: staff should always check the oxygen prongs for oxygen flow before placing patient on machine. If there is no flow, follow steps to troubleshoot in Flow Splitter: Troubleshooting & Repair.

6 Care & Maintenance

Biomedical engineers and technicians are responsible for second-line care and maintenance to ensure equipment lasts to their potential lifetime.

POWER SOURCE

Flow splitters are not powered.
WARD LOCATION

Flow splitters should be mounted and secured in a location where nursing staff can regulate and view flows easily, e.g., securely mounted on a wall within easy and reachable access. The splitter should be able to be adjusted at eye level. If possible, the surface on which the splitter is mounted should have a raised edge to prevent the device from falling. Clinical and nursing staff should be encouraged to number the ports and tubing to prevent infants receiving an incorrect flow.

Tubing leading from the flow splitter may be fixed to the wall to distribute oxygen to several cots without the tubing being trailed across the floor. Technical staff should measure flow rates at the patient end of this tubing and compare them to the set flow rate at the splitter to ensure flow rate is as expected. If installing in this manner, numbering of ports and tubing is essential to correctly manage patients. For comprehensive guidance on setting up such an installation we recommend referencing the WHO Medical Device Technical Series: Technical Specifications for Oxygen Concentrators (2015).

DEVICE CALIBRATION

Manufacturers do not typically recommend calibration for any flow splitter components.

DECOMMISSIONING

Assuming appropriate use and consistent maintenance, a flow splitter may last up to 4 years or longer. Flow splitters vary widely in cost. Decisions to decommission should be taken based on a comparison of repair to replacement cost. Both internal tubing and intact flow meters may be repurposed for other devices, although care should be taken to ensure that components meet the specifications required for the device into which they are installed.
**PREVENTIVE MAINTENANCE**

**After Each Use**

- Turn off the oxygen source. Use gauze and 70% alcohol or diluted chlorine to thoroughly wipe the oxygen flow meter controls and ports.

  See [Flow Splitter: Disinfection After Use](#) and [Alert 4.1](#) for more information.

**Weekly**

- Visually inspect flow splitter components.
- Use gauze and 70% alcohol to clean the housing of the flow splitter.
- Connect to an oxygen source, open all ports to maximum delivery rate and flush the flow splitter with oxygen for 15 minutes to clear the flow splitter of any ambient humidity-related buildup.
- Document preventive maintenance actions taken.

**Monthly**

- Perform Weekly preventive maintenance steps.
- Visually assess the oxygen ports for dust and debris. Clean using forceps wrapped in gauze and soaked in alcohol if necessary.
- Document preventive maintenance actions taken.

**Quarterly**

- Perform Monthly preventive maintenance steps.
- Using an oxygen analyser or independent flow meter and pressure gauge, assess the delivery rate and pressure for each flow splitter port.
- Document preventive maintenance actions taken.

**Annually**

- Perform Quarterly preventive maintenance steps.
- Confirm supply of spare flow meters and tubing are adequate to support estimated replacement for next year.
- Document preventive maintenance actions taken.
# Troubleshooting & Repair

Biomedical engineers & technicians are responsible for providing rapid maintenance, troubleshooting & repair support for users.

## PREPARE FOR REPAIR

<table>
<thead>
<tr>
<th>ACCESSIBLE TOOLS</th>
<th>SPARE PARTS</th>
<th>DEVICE CHECKLIST</th>
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<tbody>
<tr>
<td>Forceps or tweezers</td>
<td>Flow meter</td>
<td>□ Flow splitter</td>
</tr>
<tr>
<td>Soapy water</td>
<td>Tubing</td>
<td>□ Oxygen source tubing</td>
</tr>
<tr>
<td>Phillips, star &amp; flathead screwdrivers</td>
<td>Crimp or zip ties</td>
<td>□ Oxygen tubing or nasal prongs</td>
</tr>
<tr>
<td>Cotton buds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure gauge</td>
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</tr>
</tbody>
</table>

## TROUBLESHOOTING FAILURES

### No oxygen flows from any outlet ports of the splitter.

**Probable Cause:** Oxygen source connection or functionality issue

**Components to Check:** Oxygen source connection and functionality
Flow splitter outlet port physical condition
Internal tubing seal & placement

### The flow meter ball fluctuates when flow rates are adjusted.

**Probable Cause:** Leakages in flow splitter or source connections

**Components to Check:** Oxygen source oxygen setting, connection & functionality
Internal tubing seal & placement
Flow meter physical condition

### The flow meter ball is missing or stuck at the top of the flow meter.

**Probable Cause:** Damaged / stuck flow meter ball

**Components to Check:** Flow meter physical integrity
No oxygen flows from some of the outlet ports.

**Probable Cause:** Blocked oxygen port or internal displaced tubing

**Components to Check:** Flow splitter outlet port physical condition
Flow meter physical condition

---

**REPAIR & REPLACE**

Where technically possible and not likely to obstruct clinical care, repairs may be made within the newborn care ward. Use discretion to determine if this is appropriate or if the device should be removed to the biomedical workshop for more testing or repair. *(Alert 7.1)*

---

**Troubleshooting the oxygen source**

Flow splitters function by distributing flow from a single oxygen source to 4 to 5 outlet ports. If the oxygen source is not connected adequately, well maintained or turned to the appropriate output settings, flow delivery rates and oxygen at the flow splitter outlet ports will be unable to deliver therapeutic oxygen concentrations and delivery flows.

If using a flow splitter with a dual port oxygen concentrator, the cumulative flow delivery of the source should also be assessed. Both oxygen flow meters on a dual port oxygen concentrator are graduated to the maximum capacity of the machine and may be used simultaneously, the maximum flowrate at which the device can produce recommended purity of oxygen remains the same (e.g., a 10 L/min oxygen concentrator can only produce 10 L/min of oxygen at a time, regardless of the number of ports or splitters in use). Users must be educated that the combined flowrate during use does not exceed the capacity of the machine, particularly when used for adult patients or with flow splitters.

---

**Testing & repairing the flow splitter outlet ports**

Over time, oxygen outlet ports may accumulate deposits or debris that block oxygen flow from the concentrator. Ports should be visually inspected using a penlight and may be cleaned using cotton buds or forceps wrapped in gauze soaked in 70% alcohol *(7.1)*

> ![Image](image.png)

**7.1 Clean debris from outlet ports with an ear swab soaked in 70% alcohol.**
Testing, reconnecting & replacing the tubing components

Leaks or displaced tubing may contribute to both low oxygen flow delivery and increased flow meter fluctuation. Open the device and assess all tubing for loose or detached fittings. Tubing can be assessed for leaks by running soapy water or foam along the suspected tubing, pipes and fittings during operation and checking for bubbles or movement of the liquid.

Testing & replacing the flow meter

The flow meter may be damaged through user error or through lack of use and preventive maintenance over time. User error is design dependent; if the flow meter is not designed to prevent the flow meter bead from falling into the regulating knob channel, the flow meter bead can be damaged or crushed as the flow meter is closed. In most cases, the flow meter bead is not a spare part and this damage will require the entire flow meter assembly to be replaced.

The flow meter may also develop debris or deposits that affect the movement of the flow meter bead within the flow meter channel. This can be repaired by disconnecting, disassembling and cleaning the flow meter. (7.2 – 7.4)

7.2 Open housing to access internal tubing.
7.3 Disconnect flow meter at inlet and outlet barbed connectors.
7.4 Remove flow meter and clean or replace.

Alert 7.1 Repurposing Parts

In some cases, parts on the unit may be replaced with a repurposed or recycled part from another piece of equipment being used for parts. Repurposed parts should be considered with caution and guidance from the manufacturer to ensure specifications of the repurposed part is compatible with the equipment. This includes spare parts and accessories that may not be compatible with multiple systems.
8 References


2. World Health Organization, Regional Office for the Western Pacific, World Health Organization, & Regional Office for South-East Asia. Practical guidelines for infection control in health care facilities. (World Health Organization, Regional Office for Western Pacific; World Health Organization, Regional Office for South-East Asia, 2004).
