Zephyr® Endobronchial Valve System
Instructions for Use

CE 2797 UK CA 0086

Description
The Zephyr Endobronchial Valve (Zephyr EBV) is an endobronchial prosthesis that is intended to control airflow. The device consists of a one-way, silicone, duckbill valve attached to a nickel-titanium (Nitinol), self-expanding retainer that is covered with a silicone membrane. It is implanted in the target bronchus using a flexible delivery catheter that is guided to the targeted bronchus by inserting it through the working channel of an adult bronchoscope.

When reduction of trapped air is indicated, the Zephyr EBV allows distal air to vent from the isolated lung segment during exhalation but does not allow refilling of this region during inhalation. With each respiratory cycle, the amount of air in the target lung segment is reduced (pneumoreduction).

The EBV is designed to be a permanent implant when used in patients with emphysema. For air leak patients, the EBV should be removed.

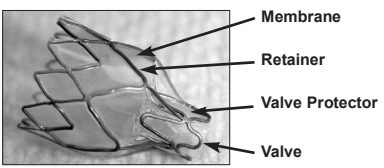


Figure 1 Zephyr Endobronchial Valve

Required Equipment
- Adult flexible bronchoscope (working channel ≥ 2.8 mm)

System Components
- Zephyr 4.0 Endobronchial Valve (Zephyr 4.0 EBV)
- Zephyr 4.0-LP Endobronchial Valve (Zephyr 4.0-LP EBV)
- Zephyr 5.5 Endobronchial Valve (Zephyr 5.5 EBV)
- Zephyr 5.5-LP Endobronchial Valve (Zephyr 5.5-LP EBV)
- Zephyr 4.0 Endobronchial Delivery Catheter (Zephyr 4.0 EDC)
- Zephyr 4.0-J Endobronchial Delivery Catheter (Zephyr 4.0-J EDC)
- Zephyr 5.5 Endobronchial Delivery Catheter (Zephyr 5.5 EDC)
- Zephyr 5.5 Dual Mark Endobronchial Delivery Catheter (Zephyr 5.5 Dual Mark EDC)

Intended Purpose / Indications for Use
The Zephyr EBV is an implantable bronchial valve intended to control airflow in order to improve lung function in patients with hyperinflation associated with severe emphysema with little to no collateral ventilation, and/or to reduce air leaks.

Intended Target Population
Adult patients with hyperinflation associated with advanced emphysema/COPD or patients with persistent air leak (PAL).

Intended Users
The Zephyr System should only be used in a fully equipped bronchoscopy suite or operating room by clinicians who are experienced in bronchoscopy and in managing potential bronchoscopic or anesthesia related emergencies. The treating clinician must be trained on the use of the Zephyr device.

Intended Clinical Benefit
Appropriately selected patients have been shown to experience improvements in lung function, exercise capacity and quality of life.

Contraindications
The Zephyr EBV is contraindicated for:
- Patients for whom bronchoscopic procedures are contraindicated.
- Evidence of active infection in patient's lungs.
- Patients with known allergies to Nitinol (nickel-titanium) or its constituent metals (nickel or titanium)
- Patients with known allergies to silicone.
- Patients who have not quit smoking
- Patients with large bullae encompassing greater than 30% of either lung

If patient is being treated under a Pulmonx clinical trial protocol, eligibility criteria outlined in the Investigational Plan must be adhered to.

Warnings
The Zephyr EBV should be used with caution and only after careful consideration in patients with:
- Prior lung transplant, LVRS, median sternotomy, or lobectomy.
- Congestive heart failure or recent Myocardial Infarction.
- Large bullae in the non-targeted area of lung.
- FEV_1 <15% of predicted value.

Precautions
- Read all labels and instructions prior to use. Use is restricted to a physician trained in the use of this device.
- The Zephyr EBV and EDC are intended for single-patient use only. Do not re-sterilize. No assurance of sterility can be made if devices are re-used.
- Do not attempt to reload a Zephyr EBV.
- Do not use the device if the sterilization barrier has been damaged or if the device is dropped after removal from sterile packaging.
- The Zephyr EDC handle contains permanent magnets. These magnets have strong magnetic fields that may damage magnetic data storage media and electronic equipment if brought within two inches of the delivery catheter. The Zephyr EDC should be kept away from magnetic media such as electronic equipment, computer discs, credit cards and video tapes.
- Performance of the Zephyr EBV has not been assessed in physiological conditions unique to air leak patients with an open thoracic window (also known as a Claggett Window or Eloesser Flap).
- Dispose of used devices per local regulations and guidelines for biohazardous materials.

MRI Information
Non-clinical testing has demonstrated the Zephyr Endobronchial Valve (i.e., 4.0 EBV, 4.0-LP EBV, 5.5 EBV, and 5.5-LP EBV) is MR Conditional. A patient with this valve can be safely scanned in an MR system meeting the following conditions:
- Static magnetic field of 3.0 T, or less
- Maximum spatial field gradient of 4,000 gauss/cm (40 T/m)
- Maximum MR system reported, whole body averaged specific absorption rate (SAR) of 4 W/kg (First Level Controlled Operating Mode)

Under the scan conditions defined above, the Zephyr Endobronchial Valve (i.e., 4.0 EBV, 4.0-LP EBV, 5.5 EBV, and 5.5-LP EBV) is expected to produce a maximum temperature rise of less than 2.7°C after 15 minutes of continuous scanning.
In non-clinical testing, the image artifact caused by the Zephyr Endobronchial Valve (i.e., 4.0 EBV, 4.0-LP EBV, 5.5 EBV, and 5.5-LP EBV) extends approximately 5 mm from the valve when imaged with a gradient echo pulse sequence and a 3.0 T MRI system.
The Endobronchial Loader System (ELS) and the flexible Zephyr Endobronchial Delivery Catheter (EDC) are not tested for their compatibility with MR environment and are MR unsafe.

Summary of Safety and Clinical Performance

The summary will be made available in EUDAMED once available. You may also contact Pulmonx Corporation to obtain the document.

Potential Complications

Potential complications include, but are not limited to, the following:

- Acute respiratory distress syndrome
- Airway stenosis
- Aphonia
- Bowel function impairment
- Bronchospasm
- COPD exacerbation
- Cough
- Death
- Disorientation/anxiety
- Empyema
- Epistaxis
- Fever
- Granulation tissue / ulceration formation
- Headache
- Heart arrhythmia / heart failure/chest pain / myocardial infarction
- Hematoma
- Hemoptysis
- Hemothorax
- Hypotension
- Hypercapnea
- Hypoxemia
- Iatrogenic injuries
- Impaired lung function
- Increased mucus secretions
- Infection
- Insomnia
- Musculoskeletal event
- Nausea/vomiting
- Pain
- Pleural effusion
- Pneumonia
- Pneumothorax
- Pulmonary embolism
- Pulmonary shunting
- Residual volume increase
- Respiratory failure
- Sepsis
- Shortness of breath
- Sore throat
- Stroke/CVA/TIA
- Systemic inflammatory response syndrome (SIRS)
- Valve migration/expectoration
- Vocal cord injury
- Wheeze or whistling
- Migration from the implant site(s) is a known risk of EBV implantation. Implant location can be confirmed using Chest X-ray, CT or Bronchoscopy.
- Physicians are advised to monitor suspected hemoptysis closely and to consider bronchoscopy, a CT scan and/or an evaluation of hypoxemia for any patient that reports expectoration of blood after EBV implantation.

Directions for Use

1. Delivery Catheter Preparation

For delivery catheters packaged in a tray, remove the delivery catheter from the packaging tray as follows (see Figure 2):

Step 1 – press down tab 1 to release the distal end of the catheter

Step 2 – pull tab 2 to free the delivery catheter handle

Step 3 – slide the delivery catheter out of the packaging tube

Figure 2
EDC Package Tray

2. Zephyr EBV Loading

Figure 3
Endobronchial Loader System (ELS)

a. The Zephyr EBV is packaged inside the Endobronchial Loader System or ELS (Figure 3). To load the Zephyr EBV remove the pusher from the side of the ELS (see Figure 4).

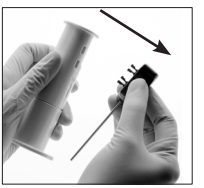


Figure 4
Pusher Removal

b. Pull the Zephyr EBV into the funnel cartridge of the ELS by gently pulling the ends of the ELS apart until the monofilament strand is completely detached (see Figure 5).

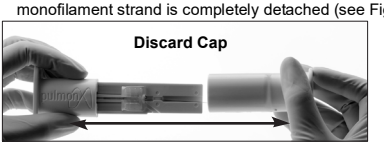


Figure 5 Endobronchial Loader System (ELS) Separation

c. Discard the cap of the ELS. Confirm that the Zephyr EBV is completely pulled into the compression region of the funnel cartridge under the thumb lever and that there are no monofilament strands attached to the valve (see Figure 6).

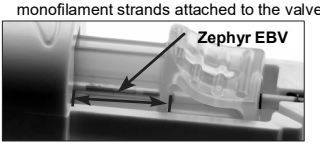


Figure 6
Confirm Zephyr EBV Position

d. Retract the spring-loaded funnel cartridge, and place the EDC housing in the loading groove, sliding the proximal end up to the housing stop (see Figure 7). Verify that the handle actuator of the EDC is fully retracted.

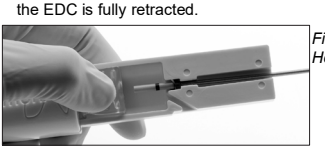


Figure 7
Housing Insertion

e. Slowly release the thumb lever of the funnel cartridge, ensuring that it covers the end of the EDC housing (see Figure 8).

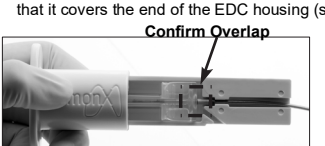


Figure 8
Funnel Cartridge Release

f. Insert the pusher tip into the bottom of the ELS base and gently apply force until the pusher is snug against the ELS body pressing the compressed Zephyr EBV into the EDC housing (see Figure 9).

Figure 9
Zephyr EBV Loading

g. Remove the pusher from the ELS. Retract the funnel cartridge from the EDC housing and remove the catheter from the loading groove. Discard the ELS. Verify that the Zephyr EBV device is seated within the EDC housing (see Figure 10). Verify that the EDC housing is not damaged prior to and after loading. Replace the EDC if the housing appears damaged.

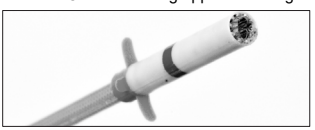


Figure 10
Inspect Zephyr EBV in EDC housing (Standard EDC)

Precaution: Bending the Zephyr EDC when locked in the ELS may damage the Zephyr EDC shaft.

Precaution: Use only moderate force to push the EBV into the housing of the EDC. If resistance is met while loading the Zephyr EBV, do not force the pusher. Discard the valve and EDC. Excessive loading forces may result in damage to the Zephyr EBV.

3. Delivery Catheter Placement

Advance the Zephyr EDC into the working channel of the bronchoscope until the tip of the housing can be seen via the bronchoscope camera. The bronchoscope must be straight before the catheter can be advanced out the tip. This can be performed in or out of the patient. Advance the bronchoscope up to the ostium of the target bronchus. Advance the EDC into the target bronchus such that the minimum depth mark on the housing can be visualized. The minimum depth mark can be used to verify that the target bronchus is long enough to accept the Zephyr EBV device (the minimum depth mark must be distal to the ostium of the target bronchus). When verifying target bronchus length using an EDC with two minimum depth marks, use the distal depth mark for LP EBVs; use the proximal depth mark for standard EBVs (see Figure 11). Next, advance the EDC into the target bronchus such that the diameter gauge located on the proximal end of the EDC housing is flush with the ostium of the target bronchus (see Figure 11). Using the diameter gauge located on the proximal end of the EDC housing, verify that the target bronchial diameter is between the large and small gauges. Locate the housing within the target bronchus such that the proximal minimum depth mark is distal to the ostium.

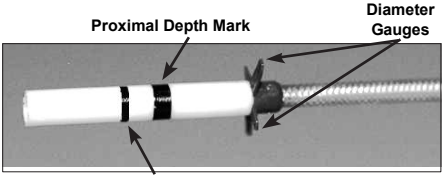


Figure 11 Minimum Depth Marks and Diameter Gauges (Dual Mark EDC)

It is recommended that more tortuous bronchi are treated first. Zephyr EBV device placement can shift the bronchi such that access to tortuous bronchi can be made more difficult.

Precaution: EBV placement using the distal depth mark on a dual mark EDC could potentially result in valve misplacements.

Precaution: Placement of the Zephyr EBV in bronchi of insufficient length may compromise valve function.

Warning: Iatrogenic injury from the Zephyr EDC may occur if excessive forces are applied during use especially in more tortuous bronchi when the delivery catheter housing is partially retracted into the bronchoscope.

Precaution: Under-sizing or over-sizing of the Zephyr EBV device may impair the ability of the Zephyr EBV device to completely occlude the airway.

Precaution: Confirm free movement of the Zephyr EDC within the bronchoscope. If movement in the bronchoscope appears too constrained, change to a larger working channel bronchoscope.

Precaution: Advancing a Zephyr EDC through an articulated bronchoscope may result in damage to the bronchoscope and delivery catheter.

4. Zephyr EBV Deployment

To ensure that the Zephyr EBV is not misplaced in a segment distal to the target bronchus, partially deploy the Zephyr EBV by slowly advancing the actuator on the EDC handle by 6 to 12 mm (see Figure 12). Position the EDC such that the flared distal end of the partially deployed Zephyr EBV is positioned against the carina distal to the target bronchus and complete deployment by slowly advancing the EDC actuator fully forward (see Figure 12).

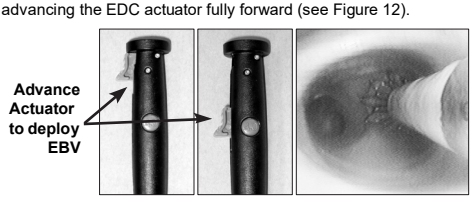


Figure 12 Actuator Advancement and Partial Deployment

If the length of the target bronchus can accommodate the Zephyr EBV without risking misplacement in a distal segment, confirm that the Zephyr EDC proximal depth mark is distal to the ostium of the target bronchus (see Figure 13). Slowly advance the actuator on the EDC to deploy the EBV.

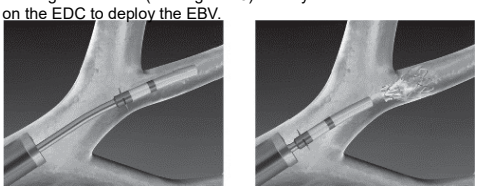


Figure 13 Deployment in Bronchus with Sufficient Length

Note that the housing retracts as the Zephyr EBV is deployed; thus, positioning the catheter housing distal to the bronchoscope tip facilitates retraction of the housing and precise deployment of the Zephyr EBV.

Precaution: Use only moderate force to deploy the Zephyr EBV. If resistance is met while deploying, stop and remove the system. Replace the system with a new Zephyr EBV and Zephyr EDC.

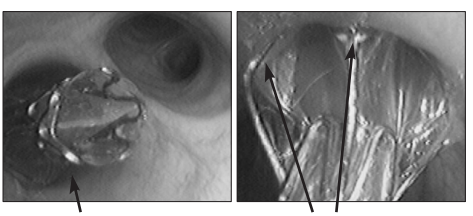
Warning: Do not place the Zephyr EBV such that the distal end of the retainer is placed beyond the distal carina of the target bronchus thereby leaving a side branch untreated. This position may also result in proximal migration of the implanted Zephyr EBV.

Prior to withdrawing the EDC, retract the bronchoscope into the patient's trachea and straighten the tip.

Precaution: The Zephyr EDC may be loaded and used for deployment four times before discarding.

Clinical results have indicated that in patients with markedly heterogeneous disease distribution, the most significant improvements have occurred when entire target lobes are treated. It is recommended that all bronchi leading to the targeted lobe be treated.

Following placement, verify that the EBV is intact and functioning properly. The retainer of the deployed EBV device should be seated distal to the ostium such that none of the large retainer tips project out of the target bronchus (see Figure 14). Verify that the duckbill valve is not inverted or wedged open following deployment. If it is inverted, attempt to revert the valve using bronchoscopic suction. If the EBV is not positioned correctly or if the valve does not appear to be functioning properly, remove and replace with a new Zephyr EBV.



Main body of retainer completely engaged within target bronchus

Main body of retainer not completely engaged within target bronchus

Figure 14 Zephyr EBV Device Positioning

Warning: Airway occlusion may be impaired if the Zephyr EBV device retainer extends proximally beyond the ostium. Furthermore this position may result in proximal migration or dislodgment of the implanted Zephyr EBV especially in short airways such as the superior bronchus of the lower lobes.

Following implantation, if the Zephyr EBV retainer is migrating within the airway during respiration, the Zephyr EBV is too small for the bronchus. Remove the device and select a larger size or implant devices in the next distal airways. Removal may be accomplished by using rat-tooth graspers to grip the valve protector portion of the retainer (via the bronchoscope working channel) (See Figure 15).

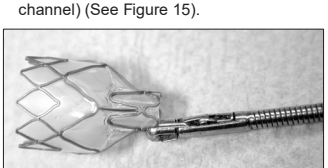


Figure 15 Grasping the Retainer

5. Post-Procedure

Post-procedure, it is recommended that patients with radiographic evidence of atelectasis be kept in-hospital under observation for at least 2 days post-procedure.

Warning: Pneumothorax is an expected response to atelectasis. The user should be prepared to observe and/or treat a pneumothorax that develops subsequent to atelectasis.

It is recommended that bronchoscopic aspiration of mucus be considered if there is evidence of an increase in mucus production post-procedure.

It is recommended that a Zephyr Implant Card be completely filled out by a medical professional and provided to the patient. Apply the Zephyr EBV lot labels from each implanted valve to the designated area on the Implant Card.

Any serious incidents or serious adverse events that occur due to the use of the Zephyr EBV should be reported to Pulmonx (the manufacturer) and any relevant regulatory bodies (e.g., the European Competent Authority in the relevant EU Member State).

6. Information Related to Implant

The Zephyr EBV device is comprised of medical-grade nitinol, a nickel-titanium alloy, (i.e., 32 - 54 mg of nitinol per device depending on the product model), medical-grade silicone (i.e., 17 - 43 mg of silicone per device depending on the product model), and human implant-grade silicone adhesive (i.e., 1 mg of adhesive per device, ingredients include CAS No. 68909-20-6 and CAS No. 68037-59-2). Typically, a patient will have a total of 3 – 5 valves implanted.

7. Storage

Store the packaged Zephyr system and accessories at room temperature. Do not expose to extreme heat or moisture.

Graphic Symbols Contained in Device Labeling

LOT	Batch Code	STERILIZE	Do Not Re-sterilize
REF	Catalog Number		Do Not Reuse
	Single Sterile Barrier System with Protective Packaging Inside		Single Sterile Barrier System
CONT	Contents	RANGE	Diameter Range
	Non-Pyrogenic		Date of Manufacture
STERILE EO	Sterilized Using Ethylene Oxide		Manufacturer
	Consult Instructions for Use		Caution, consult accompanying documents
	Use By		Do Not Use if Package Is Damaged or Opened
	Keep Dry	MR	MR Conditional
MD	Medical Device	60°C -18°C	Temperature Limit
EC REP	Authorized European Representative	UK REP	United Kingdom Responsible Person
	Importer	CH REP	Authorized Representative in Switzerland

Patent Information

Endobronchial Valve (EBV): This product and/or its use are covered by one or more of the following United States patents: 5,954,766; 6,527,761; 6,632,243; 6,679,264; 6,840,243; 6,901,927; 6,904,909; 6,941,950; 7,011,094; 7,033,387; 7,165,548; 7,276,077; 7,662,181; 7,670,373; 7,798,147; 7,854,228; 8,136,520; 8,251,067; 8,357,139; 8,474,460. Other U.S. patents pending. This product and/or its use are covered by one or more of the following international patents: AU2001243416; AU2001260840; AU2002347900; DE60221139; DE60323502.6; EP1434615; EP1524942; FR1434615; FR1524942; GB1434615; GB1524942; IR1524942; IT1524942. Other international patents pending.

Endobronchial Loader System (ELS): This product and/or its use are covered by one or more of the following United States patents: 7,771,472; 7,717,115; 7,814,912; 8,100,959; 8,388,682; 8,409,168. Other U.S. and international patents pending.

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