



Clinician's Guide to Appropriate Use and Maximizing Safety

Congratulations on choosing the Tenax Laser-Resistant Endotracheal Tube. This tube was developed by clinically practicing surgeons and anesthesiologists, and designed to provide maximum safety against surgical fires during laser surgery of the head and neck. This brief guide will highlight several features of the Tenax Laser-Resistant Endotracheal Tube and appropriate use.

Laser surgery of the head and neck including the airway represents one of the highest risks for surgical fire because of the close proximity of the ignition source (laser) to an oxidizer (oxygen or nitrous oxide) and a flammable fuel (endotracheal tubing). The Tenax Laser-Resistant Endotracheal Tube potentially lowers ignition by mitigating the risk of an inadvertent laser strike violating the tube's lumen. The aluminum-reinforced silicone tubing of the Tenax Laser-Resistant Endotracheal Tube is designed to resist laser penetration and reduce the risk of fire.

While no endotracheal tube can be 100% "laser safe," the Tenax Laser-Resistant Endotracheal Tube's design features and safety improvements include:

1. Wrapped aluminum-reinforced shaft, designed to resist laser penetration;
2. Overlapping wrapping, reducing gaps through which a laser could penetrate the tube during twisting and bending;
3. Made of silicone rather than traditional PVC found in most endotracheal tubes, which provides a soft and atraumatic surface near the vocal cords and related anatomy;
4. Double cuff design, which may provide an extra layer of protection in the event of an inadvertent balloon deflation by laser strike;
5. Both inflation lines contain blue dye, alerting the surgeon if a balloon is inadvertently violated;
6. Aluminum wrapping ends below the second balloon, extending protection.

CLINICIAN'S GUIDE TO USING THE TENAX LASER-RESISTANT ENDOTRACHEAL TUBE

The Tenax Laser-Resistant Endotracheal Tube is placed, connected and used like any other endotracheal tube. Please follow the Instructions for Use and note the following tips:

1. Prior to intubation, inflate both balloon cuffs with saline to ensure that they are intact. Blue dye will give the inflated balloon cuffs a blue color. Once this is confirmed, both balloons should be fully deflated prior to insertion.
2. The Tenax Laser-Resistant Endotracheal Tube is placed transorally into the larynx using standard intubation techniques. For laser airway surgery, traditionally a smaller sized tube is used to increase the space available for surgical instruments.
3. During tube insertion, both cuffs should be placed distal to the vocal folds under direct or indirect visualization. The cuffs should be inflated only after placement is confirmed and the cuff balloons are distal to the vocal cords.
4. The cuffs should be re-inflated with saline after the tube is placed. Care should be taken to minimize air bubbles that may remain in the cuff after inflation with saline.
5. Prior to initiation of laser surgery, all members of the operating team should pause and confirm that the fraction of inspired oxygen being delivered (FiO_2) is at the minimum level necessary. FiO_2 concentrations greater than 30% significantly increase the risk of surgical fires.
6. Appropriate, standard laser safety precautions should be used to protect the patient's skin, eyes and members of the operating team prior to initiation or deployment of the laser.

DURING THE PROCEDURE:

1. **No endotracheal tube is 100% laser safe or fireproof.** While the Tenax Laser-Resistant Endotracheal Tube may represent advances in patient safety, **surgeons should avoid reckless use of CO₂ or KTP lasers near the tube shaft or cuffs.**
2. Clinicians should **avoid repeated, intentional or persistent deployment of the laser against the tube shaft.**
3. Both cuffs of the Tenax Laser-Resistant Endotracheal Tube contain blue dye. **If either cuff is violated, an immediate rush of blue liquid will be noticed. When this warning appears, the procedure must halt immediately.** The tube should be removed, and the patient should be re-intubated with a new Tenax Laser-Resistant Endotracheal Tube.
4. The tube should be replaced immediately if the proximal cuff is violated. Clinicians should not rely on only the distal cuff as protection against surgical fire.

AFTER COMPLETION OF THE PROCEDURE:

1. Fully deflate both balloons prior to removing the Tenax Laser-Resistant Endotracheal Tube.

CONCLUSIONS:

Surgical fires represent a real risk and significant danger to patient safety. There are three essential elements required for fire formation, known as the “fire triad:” an ignition source, a flammable fuel substrate, and an oxidizer. Careful attention to the inherent risks of fire in the operating room and a team approach that emphasizes communication throughout the procedure is critical in preventing serious harm. A more detailed and thorough review of this topic may be found in:

Roy S, Smith LP. Preventing and Managing Operating Room Fires in Otolaryngology-Head and Neck Surgery. *Otolaryngol Clin North Am.* 2019 Feb;52(1):163-171. doi: [10.1016/j.otc.2018.08.011](https://doi.org/10.1016/j.otc.2018.08.011).

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