7.4 Laser Generated Airborne Contaminants (LGAC); Plume and Airborne Contaminants (PAC).

PAC (LGAC) produced during surgical and aesthetic procedures are a result of the vaporization or disruption of tissue at the cellular level. Analysis of the plume produced has shown the presence of gaseous toxic compounds, bio-aerosols, dead and live cellular material, and viruses. In orthopedics, dentistry, plastic surgery and other fields, it is also possible to generate particulates and metal fumes. At certain concentrations some PAC (LGAC) can cause ocular and upper respiratory tract irritation, have unpleasant odors, create visual problems for the user, and have been shown to have mutagenic and carcinogenic potential. Finally, hemoglobin oxidation to methemoglobin and carboxyhemoglobin (reactions found in smoke inhalation), have been demonstrated to occur in patients during laparoscopic procedures that generate plume.

NOTE—Electrosurgical devices and other energy based devices, such as ultrasonics and plasma generators, are often used both separately and simultaneously with HCLSs. These devices produce similar types of airborne contaminants as produced during laser-tissue interactions and it is therefore essential to evacuate the resulting airborne contaminants from the treatment site.

7.4.1 PAC (LGAC) Infection Control. Plumes contain aerosolized blood, blood by-products and pathogens. Laser users **shall** be aware of the possible exposure to such products during laser procedures and **shall** use control measures, such as Standard Precautions, that are covered by the Blood-Borne Pathogen Standard (29CFR1910.1030).

The potentially hazardous area for PAC (LGAC) exposures may often exceed the NHZ.

7.4.2 Control Measures. The primary measure to control PAC (LGAC) in HCF for purposes of this standard **shall** be local exhaust ventilation (LEV). PACs **shall** be controlled by the use of a dedicated LEV system designed specifically for this purpose. In order to effectively remove PAC (LGAC), the capture device connected to the LEV **shall** be used as near as practical to the point of generation without compromising laser application procedures, patient safety, or adequate ventilation and oxygenation of the patient.

7.4.2.1 Local Exhaust Ventilation (LEV). There are numerous types of plume evacuation systems available including, portable and mobile systems, disposable pneumoperitoneum systems, local stationary systems, central stationary systems and medical vacuum systems. Regardless of what approach is taken by the HCF, the PAC **shall** be captured as near as practical to the point of production and either be

completely trapped within the system or vented out of the area. Users of wall suction techniques **shall** ensure the use of appropriate filters in the wall suction line are positioned properly, changed as indicated by the manufacturer and disposed of according to proper infection control procedures. LEV devices **should** have a filter-change indicator (e.g., mechanical, electronic or visual).

LEV manufacturers **shall** provide the HCF with information regarding preventative maintenance, filter monitoring effectiveness and procedures for changing and disposing filters, tubing, and capture devices, according to local, state and federal regulations, and HCF P&P. LEV devices may contain one or more types of filters and adsorbers that require monitoring and replacement on a regular basis. Ultra-low penetration air (ULPA) filters having filtration at 0.12 µm at 99.999% efficiency **shall** be used for filtration of PAC. Adsorbers such as activated carbon **should** be used for mitigating harmful gases and vapors.

7.4.2.2 Policies and Procedures. If PAC (LGAC) is anticipated, the HCF **shall** implement P&Ps for the control of this hazard. These P&Ps **shall** be documented, maintained, revised as necessary, and **shall** be incorporated into the education, training, and competency validations of all medical, nursing, and technical personnel (see CSA Z305.13-13).11

7.4.2.3 Respiratory Protection. At present there is limited PPE available for medical use that is engineered specifically to prevent inhalation of PAC (LGAC), bacteria, viruses, gases, vapors, and other irritants. Standard surgical masks are not designed to provide protection from the occupational exposure hazard of PAC, and therefore, are not to be considered PPE for the prevention of inhalation of PAC, bacteria, viruses, gases, vapors, and other irritants. Surgical masks are only intended to protect the patient from contaminated nasal or oral droplets from anyone with access to the treatment room. If HCP utilize N95 masks with proper OSHA compliance, or high filtration masks, as secondary protection in conjunction with an LEV system, they **should** be aware of manufacturer’s indicated time limits for effectiveness, and the masks **should** be changed accordingly. The LSO **shall** ensure that any use of respiratory protection complies with the OSHA Respiratory Protection Standard (29CFR1910.134). HCFs **shall** utilize appropriate LEV equipment and scavenging techniques as the first line of protection for occupational exposure to PAC.

CSA Z305.13-13, Plume Scavenging in surgical, diagnostic, therapeutic, and aesthetic settings, Canadian Standards Association, provides additional detail.