CAMBRIDGE-LEE INDUSTRIES LLC

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Cambridge-Lee ACR, Ref and Oxygen/Medical Gas Tubing

Cambridge-Lee ACR straight lengths and Refrigeration coils are manufactured to the chemical, mechanical, cleanness and eddy-current test requirements specified in ASTM B280 – Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

Cambridge-Lee Type L and Type K Cleaned and Capped Oxygen/Medical Gas straight length tubing is manufactured to the chemical, mechanical, cleanness and eddy current test requirements specified in ASTM B819 – Standard Specification for Seamless Copper Tube for Medical Gas Systems.

Cambridge-Lee ACR tubing which meets the manufacturing requirements of ASTM B280, has the same wall thickness dimensions as Cambridge-Lee Type L Oxygen/Medical Gas tubing, which is manufactured to the requirements of ASTM B819. As permitted in the ASTM B819 standard, type L OXY/ACR, ACR/MED straight length tubing is ink marked in blue color with a dual stencil that includes both "ACR and OXY/MED". For example, 7/8 ACR is marked **===IUSA CAMBRIDGE-LEE 7/8 ACR OR 3/4 L OXY/MED USA** *date code – time stamp/shift code* **===.** Our permanent incise mark is IUSA CAMLEE L ACR on this product.

Cambridge-Lee Type K Oxygen/Medical Gas tubing is ink marked in green color as “OXY/MED". For example, 3/4 K OXY/MED is marked **===IUSA CAMBRIDGE-LEE 3/4 K OXY/MED USA** *date code – time stamp/shift code* **===.** Our permanent incise mark is IUSA CAMLEE K OXY on this product.

Cambridge-Lee Type Soft Coiled Air Conditioning and Refrigeration Field Service tubing is not ink marked. Our permanent incise mark is IUSA CAMLEE ACR on this product. Refrigeration tubing less than 1/4” OD is not required to be incised.

ASTM B819 states, *“This specification establishes the requirements for two wall thickness schedules of specially cleaned, straight lengths of seamless copper tube, identified as Types K and L, suitable for medical gas systems. The tube shall be installed in conformance with the requirements of the National Fire Protection Association (NFPA) Standard 99 – Health Care Facilities, NFPA Standard 99C - Gas and Vacuum Systems, NFPA Standard 99B - Standard for Hypobaric Facilities, and Canadian Standards Association (CSA) Standard Z 305.1/Z 7396.1, Nonflammable Medical Gas Piping Systems”.*

These copper products, internally cleaned for ASTM B280 and ASTM B819, meet the I.D. cleanness requirements for oxygen service and/or medical gases and exceed the cleanness requirement specified in NFPA 99 or The Compressed Gas Association specification CGA G-4.1 – Cleaning Equipment for Oxygen Service. The internal cleanliness requirement provided in CGA G-4.1 states that the maximum acceptable internal residue level for the tubing, used for oxygen service must be less than **47.5 mg/ft$_2$** (500 mg/m$_2$). ASTM B280 and ASTM B819 both specify a maximum I.D. residue limit of 0.0035 gram/ft2 (3.5mg/ft2), 0.038g/m2 (38 mg/m2). The ASTM B280 and ASTM B819 requirements surpass the requirement specified in NFPA 99 (CGA-G-4.1) of 500 mg/m2 (47.5 mg/ft2) and unquestionably meet the cleanness requirements for oxygen service tube.

ASTM states Cleanness Requirements as *“The tube shall be capable of passing the following cleanness test*, (solvent extraction test), *although actual performance of this test is not mandatory under the terms of this specification unless specified. Cleanness requirements in addition to those of this specification are the responsibility of the user”.*

Cambridge-Lee cleans its Medical Gas tubing in accordance the allowable processes permitted by CGA Pamphlet G-4.1, which is referenced in NFPA 99. CGA Pamphlet G-4.1 provides minimum requirements for the selection of the type of cleaning process to be used, pre-cleaning, steam, or hot water cleaning, caustic cleaning, acid cleaning, solvent washing, vapor degreasing, mechanical cleaning, inspection/quality control procedures, and packing procedures (to keep cleaned pipe clean). Cambridge-Lee Industries, in Reading, PA, employs the Aqueous Caustic Cleaning Process, followed with multiple water rinses, and dry air sources for drying. Our operators manually inspect all tubes for cleanness prior to plugging and packaging.

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NFPA 99C, Gas and Vacuum Systems, 5.1.10.10.11 states, *"The installation of medical gas and vacuum systems shall be made by qualified, competent technicians who are experienced in making such installations. Installers of medical gas and vacuum systems shall meet the requirements of ASSE 6010, Professional Qualification Standard for Medical Gas Systems Installers".*

Standard ASSE Series 6000 states, *"Installers shall be certified to the standard ASSE Series 6000 through a recognized third party certification agency. Certification shall include the successful completion of a minimum 32-hour training course including a written and a practical examination covering all facets of ASSE Standard #6010, NFPA 99, NFPA 99C and NFPA 50; and the candidate shall have a minimum of four (4) years of documented practical experience in the installation of piping systems."*

Tubing assembly per ASSE 6000, 10-4.7 states*, "**Purpose** - The purpose of this section is to join the tube and fittings in the medical gas and vacuum pipeline system. **Requirement** - Pipeline materials shall be cleaned, checked for internal cleanliness, and assembled in an approved manner with the tubing inserted to full depth of the fitting. **Procedure** – Soldering is limited to vacuum line systems only. After cutting, the tube ends and fitting cups shall be abraded with clean, non-shedding scouring pads, to remove oxides from the tube and fitting surfaces to be brazed or soldered. Do not allow copper dust to enter the tube. A visual check for cleanliness shall be made just prior to assembly. Do not touch the cleaned surfaces of the tube or fittings. Re-clean all surfaces that have been contaminated. Where flux is used to braze dissimilar metals and for soldering, it shall be applied sparingly to minimize contamination of the inside of the tube with flux. Do not force the tube past the fitting shoulder. Braze or solder all joints within one hour of assembly".*

NFPA 99C states in section 5.1.10.5.3.9, *"Tubes, fittings, valves, and other components shall be visually examined internally before being joined to verify that they have not become contaminated for oxygen service and that they are free of obstructions or debris".*
The visual check for cleanliness and obstruction, by the installer, prior to joining, is detailed in ASSE 6000 and NFPA 99C as stated above, and by these definitions of the trade certification, installers are held accountable for this task.
NFPA 99C states*, "The interior surfaces of tube ends, fittings, and other components that were cleaned for oxygen service by the manufacturer, but became contaminated prior to being installed, shall be permitted to be re-cleaned on-site by the installer by thoroughly scrubbing the interior surfaces with a clean, hot water-alkaline solution, such as sodium carbonate or tri-sodium phosphate 450 g to 11 L (1 lb to 3 gal) of potable water and thoroughly rinsing them with clean, hot, potable water. Other aqueous cleaning solutions shall be permitted to be used for onsite re-cleaning provided that they are as recommended in CGA G-4.1 pamphlet, and are listed in CGA O2-DIR, Directory of Cleaning agents for Oxygen Service".*

*"**Materials that has become contaminated internally and is not clean for oxygen service shall not be installed,** "per* section 5.1.10.5.3.12, NFPA 99C.

"Piping Purge Test – In order to remove any traces of particulate matter deposited in the pipeline as a result of construction, a heavy, intermittent purging of the pipeline shall be done," per section 5.1.12.3.6, NFPA 99C.
"Piping Particulate Test – For each positive-pressure gas system, the cleanliness of the piping system shall be verified. A minimum of 1000 L (35 ft_3) of gas shall be filtered through a clean, white 0.45-micron filter at a minimum flow rate of 100 Nl/min (3.5 SCFM). Twenty-five percent of the zones shall be tested at the outlet most remote from the source. The filter shall accrue no more than 0.001g (1mg) of matter from any outlet tested. If any outlet fails this test, the most remote outlet in every zone shall be tested. The test shall be performed with the use of oil-free, dry Nitrogen, NF," per section 5.1.12.3.7, NFPA 99C.