April 25, 2017

Clemson University
310 Klugh Avenue
Clemson, South Carolina 29634

Attn: Mr. W. Robert Newberry, IV
E-mail: wnewber@clemson.edu

Re: Limited Local Exhaust Assessment Report
Freeman Hall – Room B007
Clemson, South Carolina
Terracon Project No. 86127158 – Task 89

Dear Mr. Newberry:

Terracon Consultants, Inc. (Terracon) conducted a limited local exhaust assessment in Freeman Hall, Room B007 on the Clemson University campus in Clemson, South Carolina after concerns regarding ventilation were expressed to your office by Dr. Todd Anderson of the Clemson Department of Art. This service was conducted in general accordance with our Master Service Agreement with Clemson University.

PROJECT DESCRIPTION

Scope of Services

At the request of Clemson University, Terracon representative Mr. Benjamin Hestir conducted a limited assessment of the local exhaust from a Universal Laser Systems Model X-660 laser cutter recently installed in Room B007 at Freeman Hall. The assessment included a visual inspection of the device connections to the room exhaust and interviews with Dr. Anderson and with Cris Wilson of Clemson CCIT.

In addition to assessing the connections to the room exhaust, Terracon made measurements of the velocity across the profile of the exhaust duct with a TSI Velocicheck Model 8330 hotwire anemometer in order to estimate the volumetric flow rate of the local exhaust system.

Standard of Care

This limited local exhaust assessment was conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions in the same locale. Terracon did not attempt to assess every device with a local

exhaust present in the subject building. The results, findings, conclusions and recommendations expressed in this report are based on conditions observed during our sampling. Many factors, such as building occupancy and ventilation patterns can affect the conditions observed. The information contained in this report should not be relied upon to represent conditions that existed prior to or after this sampling. Terracon does not warrant the services of regulatory agencies, laboratories or other third parties supplying information that may have been used in the preparation of this report.

ASSESSMENT AND AIR VELOCITY

Visual Assessment/Interviews

The visual assessment was conducted to determine how the device was connected to the existing local exhaust system in Room B007. An interview with Cris Wilson, the Clemson employee who assisted Dr. Anderson with the recent X-660 install identified that he was the original inventor and current patent holder for the X-660 device and as part of his work at Clemson he provides technical support to both Lee and Freeman Halls.

In addition, a call was made to the technical support line for Universal Laser Systems of Scottsdale, Arizona to discuss specifications for the device and to obtain additional documentation.

Air Velocity Measurement

Direct air velocity measurements were made within the metal exhaust duct above the X-660 in Room B007 using a TSI Model 8330 thermal anemometer velocity meter provided and calibrated by Pine Environmental Instrument Rentals of Lilburn, GA.

FINDINGS

Visual Assessment/Interviews

Room B007 is a space used by the art department for various devices used by art students in the creation of their artworks. The X-660 device now installed in B007 Freeman Hall (originally manufactured in August 2004) was previously installed in Lee Hall and had been claimed from university surplus by Dr. Anderson after a newer model was installed in Lee Hall. The volumetric flow rate specified by the manufacturer was 500 CFM.

The X-660 has two 4-inch circular ports on the back for exhaust. These ports were connected to the main room exhaust as follows. The exhaust ports were connected via reported flame resistant flexiduct to a small shop vacuum and then to a five-gallon bucket with water in the bottom and a limestone deflector on the inlet. Dr. Anderson explained this was an attempt to intercept any

sparks that might come down the exhaust. The five-gallon container was then connected with the flexiduct to the ceiling level metal duct room exhaust above the X-660. The main room exhaust reportedly has its outlet and fan units at roof level on Freeman Hall.

Air Velocity Measurement

Five traverse measurements were made across the profile of the duct with the TSI 8330 instrument through a port pre-installed in the main room exhaust duct located above the X-660 and downstream from the vacuum and 5-gallon bucket configuration. Minimum and maximum measurements (approximately 700 and 900 feet per minute, respectively) of the velocity across the profile were noted and the average reading of 850 feet per minute was used to calculate a volumetric flow rate of approximately 290 cubic feet per minute (CFM) for the 4-inch duct. Based on his long term experience with the laser cutter, Cris Wilson felt that the current flow rate of 290 CFM was appropriate as Dr. Anderson stated that he planned to limit the materials cut by the X-660 to wood and paper products only in order to minimize the potential for hazardous gases, fumes, and particulate.

CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are provided based on our assessment and measurements:

- Current volumetric flow (290 CFM) in the local exhaust system is below the recommended value provided by the manufacturer (500 CFM). Cris Wilson (inventor and patent holder of the X-660) stated that he was of the opinion that the volumetric flow rate measured was appropriate if the device was limited to cutting wood and paper only.
- Typical laser cutting systems utilize a dedicated exhaust blower (not typically including a vacuum cleaner) with rigid or flexible metal ducting (not typically fire resistant flexiduct). This configuration may not meet current fire codes and should be additionally reviewed by the University Fire Marshal. Additionally the connection to the existing exhaust system in the building should be reviewed by facilities engineering as other systems attached may exhibit flow loss.
- This system should be included in Clemson's Laser Safety Program.
- General Safety: Operators of the laser cutter (both employees and students) should be trained as to its use and how to use it safely. Training should also include materials to avoid due to hazardous by-products produced. Written procedures should be present and reviewed by operators. Operators should understand the limitations and types of materials to be used in the laser cutter.
- The unit should be entered in a periodic maintenance program to insure the laser cutter is operating in accordance with the manufacturers recommendations.
- Cleaning of the laser cutter after each use to prevent debris from creating a fire hazard should be strongly emphasized in the training sessions.

Terracon appreciates the opportunity to provide this service to Clemson University. If you have any questions regarding this limited local exhaust assessment report, please contact the undersigned at 864-292-2901.

Sincerely,
Terracon Consultants, Inc.

Benjamin Hestir, P.E.
Project Industrial Hygienist

Jeffrey A. Gurrie
Senior Industrial Hygienist

Attachments: Photographs

Photographs



Photo #1 The Universal Laser Systems Model X-660 in B007 Freeman Hall



Photo #2 A view of the exhaust connects at the back of the X-660



Photo #3 Single connection from the spark arrester to the room exhaust

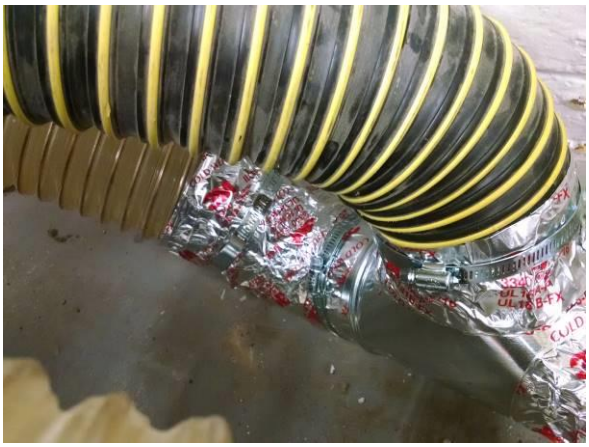


Photo #4 Junction of the two 4-inch lines before the shop vacuum and the spark arrester



Photo #5 Connection from the shop vacuum to the spark arrester



Photo #6 Shop vacuum and spark arrester