DEPARTMENT OF LABOR AND INDUSTRY

MNOSHA Instruction **STD 5-1.2A**
March 13, 2014
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SUBJECT: Garage Ventilation

Purpose:

To provide guidelines in the enforcement of Minn. Rules 5205.0200, Subp. 1 through 4 for garage ventilation.

Scope:

This instruction applies MNOSHA-wide.

Cancellation:

This instruction supersedes STD 5-1.2, dated March 9, 2009.

References:

A. **Minn. Rules 5205.0200, Subp. 1 through 4** requires mechanical ventilation systems in garages with six or more vehicles driven by internal combustion engines.

B. 2009 Minnesota State Building Code 1346.0404 Section 404 GARAGES

1. **Subpart 1. Section 404.1.Enclosed parking garages.**
   Mechanical ventilation systems for enclosed parking garages shall provide a minimum exhaust rate of 0.75 cfm per square foot (0.228 m3 per minute per square meter) of floor area. Mechanical ventilation systems are not required to operate continuously where the system is arranged to operate automatically upon detection of a concentration of carbon monoxide (CO) of 25 parts per million (ppm) by approved automatic detection devices.

2. **Subp. 2. Section 404.2. Motor vehicle repair garages**
   Mechanical ventilation systems for motor vehicle repair garages shall provide a minimum exhaust rate of 0.75 cfm per square foot (0.228 m3 per minute per square meter) of floor area.

3. **Subp. 3. Section 404.3. Occupied spaces accessory to public garages**
   Connecting offices, waiting rooms, ticket booths, and similar uses that are accessory to a public garage shall be maintained at a positive pressure and shall be provided with ventilation in accordance with the Ventilation Rate Procedure, Section 6.2 of ASHRAE 62.1-2004.

C. **Minnesota Rules 5205.0110 Subpart 1** requires fresh air ventilation at the minimum rate of 15 cubic feet per minute (cfm)/occupant for all workrooms.

D. **Industrial Ventilation,** (27th ed.) a manual published by ACGIH, sets forth ventilation guidelines for tailpipe exhaust ventilation systems (VS-85-01 and VS-85-02). It also recommends 500 cfm of tempered fresh air per parking space in closed automobile parking garages (Table 13-99-2) and 10,000 cfm of fresh air per operating automobile (Chapter 13.85). This book is available in the MNOSHA library.

E. **Permissible Exposure Limits.** The 8-hour Time-Weighted Average PEL for carbon monoxide (CO) is 35 ppm; the ceiling limit is 200 ppm (5 minutes). The Short Term Exposure Limit (15 minutes) for nitrogen dioxide (NO2) is 1 ppm.

Background:

The intent of the Minnesota Rule is to prevent illness due to inhalation of vehicle exhaust gases (not from other potential garage operations). While carbon monoxide is the most common hazard from gasoline fueled engines, many contaminants may be present in the exhaust from diesel fueled engines. Nitrogen dioxide is commonly measured due to its ease of measurement but research indicates there may be hundreds of gases or particulates present.

The Rule (5205.0200) covers four types of work areas, though they are not exclusive, and requires ventilation when they are large enough to have six or more vehicles. These four work areas are Repair Garages, Service Stations, Body Shops, and Live Storage Garages. Body Shops are considered a form of a Repair Garage. The rule defines a live storage area as any area of a building used to store fire trucks, tractors, automobiles, trucks and other vehicles driven in and out under their own power. While the change from live storage “garage” to live storage “area” may be confusing, they shall be considered the same. No other definitions are given in the Rule. A definition of “full-service stations” may be found in the MN Department of Commerce statutes (MS§80C.146) as “any place of business where motor vehicle fuel is sold and delivered into the tanks of motor vehicles and has an enclosed area where automobile repairs are offered to consumers, including, but not limited to, lubrication, oil change, tire repair, battery charge, replacement of fan belts, hoses, and wiper blades.” It is noteworthy that these types of service tasks should not require the motor to be running. Also, service stations generally have one open-able door for each service bay or work area, therefore more fresh air enters the facility throughout the day.

The general ventilation requirement for Service Stations is 0.5 cfm/ sq. ft. of floor area. All other garages require 0.75 cfm/sq. ft. of floor area. Exhaust ducts shall not be more than 18 inches from the floor, so placed as to remove carbon monoxide gas from the entire garage. An equal amount of tempered fresh supply air shall be provided.

In addition, if the tailpipe from vehicles whose engines are being tested is more than 10 feet from the exterior, then mechanical tailpipe ventilation is needed. If the tailpipes are ten feet or less from an outside wall, the employer may use a hose to direct exhaust gases to the outdoors. Repair pits located in garages covered by the rule are also required to have 12 air changes per hour.

While there are similarities to requirements in state building codes, MNOSHA will only enforce the requirements of 5205.0200.

With the 2009 revision, MNOSHA discusses the need for ventilation when an inspector does not directly observe an air quality violation during the course of the inspection. A threshold of one-half the PEL is chosen as the basis for issuing a citation of this rule. This is based on several sources, including federal OSHA's discussion of an action level set at one-half the PEL in the methylene chloride standard (https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=PREAMBLES&p_id=1000) which reads, "In brief, although all employee exposure measurements on a given day may fall below the permissible exposure limit, some probability exists that on unmeasured days the employees actual exposure may exceed the permissible exposure limit. Where exposure measurements are above the action level, the employer cannot reasonably be confident that the employee may not be overexposed on a given day. Therefore, requiring periodic employee exposure measurements to begin at the action level provides the employer with a reasonable degree of confidence in the results of his or her exposure measurement program [Ex. 7-248]. OSHAs decision to set the action level at one-half the PEL is based on its successful experience using this fraction as the action level in many standards, such as arsenic, ethylene oxide, vinyl chloride and benzene."

ACTION:

A. **All Garages or Service Stations with Less Than Six Vehicles.**

Citations will not be issued under Minn. Rules 5205.0200 in garages or service stations of less than 6 vehicles.

B. **When Air Contaminants Exceed PEL(s).**

1. **All Garages or Service Stations with Six or More Vehicle**s.
The OSHI shall verify that the garage or station has had at least six vehicles indoors. Sampling will be done for CO, and if it can be documented that the 8-hour time-weighted average (TWA) of 35 ppm or ceiling limit of 200 ppm is exceeded, the OSHI will cite 1910.1000(a)(3) & (e). Additionally, the OSHI will evaluate mechanical ventilation to determine if it is being provided at the required rate

(0.5 cfm/sq. ft. for Service Stations, or 0.75 cfm/ sq. ft. for all other Garages, plus tailpipe and/or repair pit ventilation). The capacity of tailpipe ventilation systems or spray booth exhaust systems which are in the same contiguous work area may be counted towards the requirements of the general ventilation requirements. See parts E and F for discussion of ventilation measurements. Cite 5205.0200 subp. 2 or 3 if there is no ventilation system or if the ventilation system does not provide the necessary amount of ventilation as determined by measurements and calculations (allowing for error tolerance of the measuring instruments).

C. When Air Contaminants Do Not Exceed PEL(s).

1. **Garages or Service Stations with Six or More Vehicles.** It is anticipated that measurements may not always be taken on the day of worst exposure. The OSHI should document the measured levels and other working conditions which may indicate that higher exposures are probable. Such factors may include the amount of repair work done, the amount of time engines are running, employer measurements, the season, the outdoor weather on days when measurements are taken. If CO or NO2 levels can be expected to exceed half their respective PELs, and the required ventilation is not present, cite 5205.0200 subp. 2, 3, or 4, as appropriate.

2. **Tailpipe Ventilation.** In garages or service stations with six or more vehicles where engines are being tested, cite 5205.0200 subp. 3 if there is no required tailpipe hose or mechanical ventilation system, or if existing hoses or ventilation systems are not used (because the rule requires the exhaust gases to be directed outdoors) or, if the mechanical system does not provide the necessary amount of ventilation as determined by measurements and calculations (allowing for error tolerance of the measuring instruments).

3. **Repair Pits.**
   a. The repair pit must be in a garage that is covered by the scope of this rule (i.e., six or more vehicles).

   b. Check to see if there is an exhaust system in each pit, extending to the floor at the lowest points of the pit. The exhaust air inlet on this system must be on the bottom of the exhaust duct, at a right angle to the floor of the pit.

   c. Determine the pit volume in cu. ft., (L x W x D) then multiply by 0.2 air changes per minute (same as 12 air changes per hour). The result is the total required exhaust ventilation for the pit, in cfm.

   d. Measure the air flow at the exhaust air inlet opening, following the procedure outlined in E.2. This is the total provided exhaust ventilation for the pit, in cfm.

e. Cite Minn. Rules 5205.0200, Subp. 4 if the total provided exhaust ventilation in the pit is less than the total required exhaust ventilation (allowing for error tolerance of the measuring instruments). Ventilation must be provided and used whenever there is an employee in the repair pit.

D. Determine Exposure to Vehicle Exhaust Contaminants:

1. In a gasoline engine repair garage, take and record two or three carbon monoxide samples.

2. In a diesel engine repair garage, take and record several nitrogen dioxide samples.

3. If air contaminants are likely to exceed the PEL, conduct personal sampling.

4. Document interviews with employees and any statements of headaches, nausea, etc.

E. Determine Compliance with Subpart 2, (general exhaust ventilation required and provided), if applicable:

1. Determine total required exhaust ventilation rate:
   a. Determine the garage floor area in sq. ft., excluding isolated work areas, such as parts rooms, show rooms, etc.

   b. Multiply the floor area by 0.75 cfm/ft2 of floor area. The result is the total required exhaust ventilation in cfm.

2. Determine the general exhaust system ventilation rate as follows:
   a. Count and identify the number of exhaust ventilation intakes in the repair garage area.

   b. Measure the intake opening of each intake, in inches.

   c. For each intake, measure the velocity at the center of several equal areas that cover the intake opening. The number of areas chosen depends upon variability of the air flow across the intake opening and the size of the opening (see figure below).

X	X	X	X	X
X	X	X	X	X

   i. Total the measured velocities and divide by the number of readings taken (this gives the average velocity).

ii. Determine the total area of the intake in square feet (square inches divided by 144).

iii. Multiply the area in square feet by the average velocity in ft/min, determined from step (i). This will equal the exhaust ventilation rate of that particular intake, in cfm.

iv. Repeat (i) through (iii) for each intake and add together to obtain the total exhaust ventilation rate in cfm.

v. Determine the total provided exhaust ventilation by adding this to the total cfm of the tailpipe ventilation capacities (see F.5.e).

vi. If there is other ventilation, such as spray booths, which are contiguous to the garage area, its capacity may also be added to the amount of general ventilation being provided.

F. Determine Compliance with 5205.0200 Subp. 3 (tailpipe exhaust from engines being tested), if applicable:

1. Document engine testing work is occurring.

2. Check to see if the tailpipes of all vehicles whose engines are being tested are within 10 feet of an exterior wall, and if so, whether hoses are available AND being used when engines are being tested. If more than 10 feet from an exterior wall, then a mechanical ventilation system is needed.

3. Check to see if there is an overhead or underground tailpipe ventilation system.

4. Document, through observations or interviews, whether the existing tailpipe ventilation system is used by employees.

5. Determine tailpipe exhaust system capacity by the following procedure:

   a. First count and identify the number of tailpipe exhaust tubes normally in use.

   b. The TSI Model 8340 velometer will measure up to 2000 fpm, a range which is generally insufficient for small diameter ventilation systems. Instead use a TSI VelociCalc 8352, or equivalent sampling means, to measure the velocity at the center of each tailpipe exhaust hose.

   c. Measure the inside diameter of each tailpipe exhaust hose in inches and record the diameter and corresponding measured velocity. (Floor exhaust systems should be measured at the end of the length of hose normally used.)

d. Refer to Appendix A which computes the tailpipe exhaust cfm based upon the inside diameter of the hose and the measured velocity.

e. Total all tailpipe exhaust capacities.

G. **Determine Compliance with 5205.0200 Subp. 4 (inspection and repair pits), if applicable:**

1. There does not have to be six repair pits, but the garage must be covered by the scope of this rule (i.e., six or more vehicles).

2. Check to see if there is an exhaust system in each pit, extending to the floor at the lowest points of the pit. The exhaust air inlet on this system must be on the bottom of the exhaust duct, at a right angle to the floor of the pit.

3. Determine the pit volume in cu.ft. (L x W x D) then multiply by 0.2 air changes per minute (same as 12 air changes per hour). The result is the total **required** exhaust ventilation for the pit, in cfm.

4. Measure the air flow at the exhaust air inlet opening, following the procedure outlined in D.2.b above. This is the total **provided** exhaust ventilation for the pit, in cfm.

James Krueger, Director MNOSHA Compliance
for the OSHA Management Team

Distribution: OSHA Compliance and WSC Director.

Attachments: Appendix A - GARAGES - REQUIRED VENTILATION (CFM)

NOTICE: Minnesota OSHA Directives are used exclusively by MNOSHA personnel to assist in the administration of the OSHA program and in the proper interpretation and application of occupational safety and health statutes, regulations, and standards. They are not legally binding declarations and they are subject to revision or deletion at any time without notice.

APPENDIX A: Garages – Required Ventilation (CFM)

CFM EXHAUST VS. LFPM VELOCITY

Measured at center of hose opening for various hose inside diameters (D) in inches.

$$CFM = \frac{\pi D^2}{(4)(144)} \times (.9)\ LFPM$$

Exhaust (CFM) vs Velocity (Linear Feet per Minute, LFPM)
Measured at center of hose opening for various hose inside diameters (D) in inches,

$$CFM = \frac{\pi D^2}{144\ (4)} \times (0.9) \times LFPM$$

	Citations	
	> PEL	> half the PEL (but equal to or below the PEL)
A. Service Stations & Garages	1910.1000(a)&(e); and (possibly) Separately…	
B. Service Stations (≥ 6 vehicles)		
1. general ventilation	5205.0200 subp. 2 – 0.5 cfm/sq ft	5205.0200 subp 2 – 0.5 cfm/sq ft if exposure >half the PEL
2. tailpipe ventilation	5205.0200 subp. 3, per table	5205.0200 subp 3 – if exposure >half the PEL
C. Garages (≥ 6 vehicles)		
1. general ventilation	5205.0200 subp. 2 – 0.75 cfm/sq ft is required	5205.0200 subp 2 – 0.75 cfm/sq ft if exposure >half the PEL
2. tailpipe ventilation	5205.0200 subp. 3, per table	5205.0200 subp 3 – if exposure >half the PEL
3. repair pit ventilation	5205.0200 subp. 4 – 12 ACH is required	5205.0200 subp 4 – 12 ACH if exposure > half the PEL