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Tractors and self-propelled machinery for agriculture—Air quality systems for cabs—Part 2: Cab & HVAC design

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Tractors and self-propelled machinery for agriculture — Air quality systems for cabs — Part 2: Cab & HVAC design

Proposed by the ASABE Environment Within Ag Vehicle Enclosures subcommittee; approved by the Power and Machinery Division October 2010; approved as an American National Standard November 2010; revised June 2013; approved by ANSI June 2013.

Keywords: Air quality, Cabs, Environment, Engineering control, Filters, HVAC, Procedures, Safety, Terminology, Test, Tractor, Ventilation

1 Scope

1.1 This part of the S613 standard series is concerned with the generally accepted design principles that define a robust cab and HVAC system used in contaminated environments as part of an Occupational Health and Safety Management System (OHSMS). This document is intended to be a guide for engineers who are responsible for designs used in agricultural applications. Information provided by this part of the standard series should help engineers provide cab and HVAC system designs that can be used as an engineering control within a program of risk management.

1.2 While this standard provides broad guidance for design of these systems, it is only concerned with current state of the art designs and technologies. It is expected that as new technologies are developed and new insight into the function of these systems are gained, these guidelines may become obsolete and this standard may need to be re-written, revised or replaced.

1.3 This standard should not limit design advancement.

1.4 System performance guidelines will be the primary consideration of this part of this standard series.

1.5 Filter design will be addressed by another part of this standard series.

1.6 This standard will only propose those techniques and technologies that are non-proprietary and in the public domain.

1.7 Cabs for use in poison gas or oxygen depleted environments are not covered by this standard.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies unless noted. For undated references, the latest approved edition of the referenced document (including any amendments) applies.

ASABE/ISO 14269-2 Tractors and self-propelled machines for agriculture and forestry — Operator enclosure environment — Part 2: Heating, ventilation and air conditioning test method and performance

ASABE/ISO 14269-5 Tractors and self-propelled machines for agriculture and forestry — Operator enclosure environment — Part 5: Pressurization system test method

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3 Type of Airborne Contaminants

The cab filtration system design should consider the particular types of airborne contaminates that the tractor or self-propelled machinery will be typically operating in such as soil preparation, pesticide spraying, harvesting, etc.

3.1 aerosols: These are fine sized solids or liquids that remain airborne for extended periods of time.

3.1.1 solid particles: Particle contaminants can be comprised of mineral dusts (silica, clay, etc.), biological dusts (grain, pollen, etc.), and/or combustion products (smoke, diesel soot, etc.). Dusts tend to be larger than 1 µm, while smoke, fumes and engine products tend to be less than 1 µm in size [1-3].

3.1.2 liquid: Liquid contaminants can be comprised of pesticide spray droplets, oil mists and chemical mists. A majority of pesticide spray droplets tend to be larger than the respirable size of 10 µm with some droplets less than 3 µm present from liquid evaporation [4]. Mists tend to contain droplets less than the respirable size of 10 µm [1,2].

3.1.3 gases: Gases are molecular matter dispersed in air in an unrestricted physical state. Airborne gas contaminates can be a product of chemical reactions or a vapor phase of liquids or solids.

4 Sources of Airborne Contaminants

Considerations should be given to the cab as an engineering control for the operating environment of particular tractors or self-propelled machinery. The cab filtration system design should consider several filtration alternatives for the various operational solid, liquid, and/or gas contaminants.

5 Cab as a Physical Barrier

The cab enclosure provides a physical barrier around the operator and a controlled environment inside the cab. The HVAC system should be designed with enough heating, ventilation, and air conditioning capacity to maintain comfortable temperature and air quality for the vehicle operator(s).

5.1 Description. The cab enclosure is the physical nonporous boundary surrounding the operator compartment from the outside environment that the tractor or vehicle operates in. The HVAC system includes all the ductwork, fans, heat exchangers, and interactive control systems to manage temperature and airflow parameters inside the cab enclosure to provide the operator with a comfortable environment. Air purifying devices are integrated into the HVAC system to remove contaminants from the air and control the air quality inside the cab enclosure. The cab system and its components become an engineering control in a managed occupational safety and health program.

5.1.1 Objective. The objective of an enclosed cab is to provide a managed environment for the vehicle operator.

5.1.2 Components and Operation. Enclosed operator cabs have numerous structural, ergonomic, HVAC, and air cleaning design elements that have to be complementary to a vehicle's operator compartment.

5.1.2.1 Enclosure. The enclosure should be a physical nonporous barrier surrounding the operator compartment from the outside environment. This barrier should be integrated with the other operator vehicle compartment safety devises such as roll over protection structure (ROPS) and falling object protection structure (FOPS). Elements of this enclosure should consist of structural materials, windows for outside vehicle observation and door(s) for enclosure access. The enclosure should provide some small openings for the intake airflow to be pushed outside the cab under positive pressure. These openings should be shielded or located away from potential outside air flow velocity infiltration into the cab such as wind or engine fan air currents. The relationship between airflow, orifice area, and static pressure are shown below for uncompressed gases or air. This relationship can be used to estimate the quantity of airflow needed to pressurize a cab

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