



# INDUSTRIAL VENTILATION

A Manual of Recommended Practice  
*for Design*

*30th Edition*



**ACGIH®**

Defining the Science of  
Occupational and Environmental Health®

*Signature Publications*

65th  
1958-2023



# North Carolina Industrial Ventilation Conference

Receive the  
**31ST**  
EDITION  
INDUSTRIAL  
VENTILATION  
MANUAL

**May 8-11, 2023**

Hilton Raleigh North Hills, Raleigh, NC

OPTIONAL WORKSHOPS–May 12

**Current Issues in Industrial Ventilation**

- Combustible Dust Technology/Assessing Systems.
- Computational Fluid Dynamics

**Space is  
Limited**

Industrial Ventilation Design or Industrial Ventilation System  
Diagnosis & Troubleshooting Certificate Programs Included!



**North Carolina Industrial Ventilation Course in cooperation with**

University of North Carolina-Chapel Hill, School of Public Health  
North Carolina Occupational Safety & Health Education & Research Center  
NC Department of Labor, Division of Occupational Safety & Health

**Visit [www.ncindustrialventilation.com](http://www.ncindustrialventilation.com)**

## Who should attend?

- Engineers and Designers
- Safety Personnel
- Industrial Hygienists
- Consultants
- Maintenance Personnel





# 65th Annual North Carolina Industrial Ventilation Course

May 8-11 • Hilton Raleigh North Hills • Raleigh, NC

## ELEMENTS OF THE PROGRAM

### CLASSROOM SESSIONS – MAY 8-11

The problem delivered in the classroom sessions will present real world situations and are sequenced in a manner to take advantage of skills the students acquire.

*In order to facilitate computations in the problem sessions, students are required to bring a calculator. Students may find a laptop or other device with Excel software useful in class.*

### OPTIONAL WORKSHOPS – MAY 12 (8 AM-12 NOON)

#### Current Issues in Industrial Ventilation

Each year our planning committee builds a half day optional set of workshops which address current issues in industrial ventilation. This year we will offer two concurrent workshops. You have the option of choosing one of the following to attend if you plan to stay until Friday:

- Combustible Dust Technology/Assessing Systems
- Computational Fluid Dynamics

Please see the agenda on the following page for specific topics to be addressed in each workshop. The workshops are optional and a separate registration fee applies.

### VENTILATION SYSTEM LABS

The Course has several ventilation systems that are used for demonstration purposes. These systems consist of ducts, hoods, variable speed fans, stackcaps, and sound attenuators. These systems are used to deliver 'hands-on' exercises to measure flow and pressure and are a key to the program. Measurement includes: pitot tube traverse to determine flow rate, hood static pressure, duct pressure drop, and simulation of fan and system curves. The Diagnosis and Troubleshooting Section also uses a system to practice basic troubleshooting skills.

### FOUNDERS BANQUET

Is held Tuesday evening after classes and is an opportunity to meet people early in the week.

### INDUSTRIAL VENTILATION CERTIFICATE COURSE

The North Carolina Industrial Ventilation Course in collaboration with the University of North Carolina, Occupational Safety and Health Research Center has established two Certificate courses in Industrial Ventilation. Upon completion of the course individuals will be awarded a **Certificate in Industrial Ventilation Design** or **Certificate in Industrial Ventilation System Diagnosis & Troubleshooting**, and a plaque from the University of North Carolina, Occupational Safety and Health Education and Research Center.

#### Program requirements:

- Successfully complete two levels of courses offered at the North Carolina Industrial Ventilation Course. Each level will be four days in length.
- Step One: Complete the first (Fundamentals) level, a four day course in applied industrial ventilation techniques including Hood & Duct Design, Fan Basics, Introduction to Air Control Devices (Baghouses, Scrubbers, ESP's, etc.) and Fundamental

Industrial Hygiene Issues and how they affect exposure and ventilation system design.

- Following the completion of the basic course the student has a choice in the second year to continue with more detailed system design (leading to a **Certificate in Industrial Ventilation Design** or to pursue a course of System Diagnosis and Troubleshooting (leading to a **Certificate in Industrial Ventilation System Diagnosis and Troubleshooting**. Each Certificate will be issued from the University of North Carolina-Chapel Hill).

The certificate program is included in the cost of the program. For more information about the Certificate Program please contact Connie McElroy-Bacon at (919) 233-8400 or go to the North Carolina Industrial Ventilation Course web site at [www.ncindustrialventilation.com](http://www.ncindustrialventilation.com).

## PLAN OF INSTRUCTION

### Fundamentals of Industrial Ventilation Design Course (8 Modules)

Requires basic algebra skills to solve problems. Level I Participants: You may find a laptop or other device with Excel software useful in class.

#### Ventilation I: Fundamentals of Ventilation and Industrial Hygiene

Starts the discussion of Industrial Ventilation design with a primer on Industrial Hygiene in a workplace and introduces fundamentals on fluid flow and pressure in ventilation systems. This first module begins illustrating how to measure system conditions and provides an introduction to the effects of air properties on the selection of system components.

#### Hood Design

The second module expands on the concepts from first module by looking at the fundamental of hood design and performance. This module covers: hood classifications and types, capture velocity, and air pattern control over large hood areas. This module also starts discussions on predicting energy and equipment requirements. The student will perform calculation sets on hood "static pressure / losses", and hood air volume requirements with a goal of predicting requirements for horsepower and energy in a system. The module includes hands-on demonstrations of the principles discussed to help students confirm the foundational concepts.

#### Duct Component Design

The third module in this series explores the variety of duct components in a system and how they work together. This includes in-depth discussion on elbows, fittings, and ducts that define the system and will provide guidance on predicting the effects of components on energy requirements. The discussion will include influences on static, velocity, and total pressure, as well as further refinement of hood static pressure calculations. These foundational concepts are demonstrated through a hands-on lab activity.

#### System Design I

This module builds upon the skills introduced in the prior modules. This module explores more complex systems and students will

explore how to achieve a balanced systems which achieves desired performance. This module also introduces the ACGIH Calculation Sheet which students will use to practice system design including early predictions of fan and horsepower requirements.

### System Design II

This module continues to build on skills from the prior modules, with design considerations for more complex systems involving multiple hoods. The students will explore how to balance complex systems to achieve desired performance at each hood. This module also includes practice on predictions of fan size and horsepower requirements.

### System Components - Fans and Collectors

This module provides students with an overview of general Air Control Devices and Fan Designs; including nomenclature and specify parameters students should consider for proper system design.

### System Design III

This module combines foundational skills from prior modules with some additional hood design considerations. Students will look at Industrial Ventilation design as a whole and will design detailed practical systems with the ACGIH calculation sheet and Manual.

### Advanced Industrial Ventilation Design Course (Eight Modules)

**Prerequisite:** for certificate program in Industrial Ventilation Design: Completion of Fundamentals Level taken at N.C. Industrial Ventilation Course. Participants should be able to:

- Utilize *ACGIH Industrial Ventilation Manual*
- Understand the Velocity Pressure Method of design
- Utilize the ACGIH calculation sheet

### Module I: Review of Fundamentals

An intense review of the Fundamentals (First Year) course, this module does a quick revisit of basic formulae of system design ( $Q=VA$ , Hood Static Pressure, Effects of Density), sizing of duct, system pressure, and calculation sheet review. This module is intended for attendees who have completed the Fundamentals Course or have over five years of industrial ventilation design experience.

### Module II: Physics of Non-Standard Conditions

This course covers basic psychrometrics, the perfect gas equation and sample problems explaining both concepts. Subjects include dry bulb and wet bulb temperature, dew point, enthalpy.

### Module III: System Design IV

This module focuses on using the calculation sheet and techniques to solve problems involving non-standard air and mixing of hot and cold or dry and wet air streams.

### Module IV: Fans 201

This segment is a continuation of information provided in the Fundamentals Course module and focuses on system effects and issues that may improve or impede operation. The module includes demonstration and practical problems to solve.

### Module V: System Design V

This module adds detailed design issues including the implementation of system effects losses, adiabatic cooling and stack design.

### Module VI: Energy and Cost

Systems use large amounts of horsepower to convey dust and gases. This module provides tools to calculate the initial system

costs as well as operating costs (power, maintenance, replacement air, etc.) and includes sample problems.

### Module VII/VIII: System Design VI (8 hours - two modules)

Includes "real world" examples to combine the techniques in the course. This will use all the tools and techniques taught previously in the week.

### Diagnosis and Troubleshooting Course (Eight Modules)

**Prerequisite:** for the Certificate Program in Industrial Ventilation System Diagnosis and Troubleshooting: completion of Fundamentals Level taken at N.C. Industrial Ventilation Course

- Utilize System Diagnosis and Troubleshooting Manual
- More practical applications with an emphasis on evaluation of existing systems rather than system design theory
- Requires calculator and some problem solving

### Measuring and Monitoring System Performance I

Provides basic insight into requirements including documentation, use of fan performance curves and system measurements to monitor operations. Minimal math required.

### Measuring and Monitoring System Performance II

This module builds on the basic data gathering methods to provide hands on experience on system data comparing baseline information with changes that may occur over the life of the system.

### Monitoring & Maintenance I

This module will cover extensive lab procedures to evaluate fan operation (fan and system curves) as well as effects of varied pressures during operation (i.e. baghouse delta-P, etc.) and an introduction to effects of changes in density on results of measurements.

### Practical System Troubleshooting I

In this module, the participant will look at comparison data to evaluate the changes to a system over operation.

### Practical System Troubleshooting II (8 hours - two modules)

This module is a continuation of the practical problem solving as systems are altered over their operational life.

## PROGRAM STAFF

Ackerson, Ross, Air Solutions, Inc., St. Louis, MO

Boston, Kurt, Donaldson Co., Minneapolis, MN\*

Caporali, Sergio, Filho, University of West Virginia University, Morgantown, WV

Clark, Mike, Fisher-Klosterman, Louisville, KY

Diestler, Matt, IVI North, Greenville, WI

Gilbert, Jonas, Gilbert, AECOM, Raleigh, NC

Giusto, Chris, Hallam ICS, Apex, NC

Gunnell, Douglas L., Gunnell Engineering Services, Winston-Salem, NC\*

Gresham, Neil, Saint-Gobain Corp., Oxford, NC\*

Hale, Jonathan, Air Systems Corp., Clemmons, NC\*

Harrington, Lucinda, Norfolk Naval Shipyard, Portsmouth, VA\*

Herring, Romie, RH Consulting LLC, Raleigh, NC\*

Howarth, Bill, Ventilation & Fan Consulting Service International, Lake Zurich, IL

Human, Mike, New York Blower, Willowbrook, IL

James, Dylan, Air Systems Corp, Clemmons, NC

Lowe, Eric, RL Kunz, Raleigh, NC

Manning, Chris, Materials Processing Solutions, Inc., Boston, MA\*

Marshall, Brian, The Kelly Group, Decatur, IL

McElroy-Bacon, Connie, McElroy-Bacon Consulting, Cary, NC\*

Price, Dale, M&P Air Components, Huntington Beach, CA

Quiller, Grant, NC DOL-OSH, Charlotte, NC

Sartim, Rafael, Arcelormittal, Federal University of Espirito Santo

Shearer, Robert, KBD/Technic, Inc. Cincinnati, OH

Stallings, Jeff, Air Systems Engineering PC, Winston-Salem, NC

Sullivan, Paul, NC DOL-OSH, Charlotte, NC\*

Tramm, Leo, TRC Environmental Corp., Milwaukee, WI\*

Tipp, Chad, Sanders Lead Company, Troy, AL

\*Planning committee member

**Registration/pick up course materials: MONDAY, MAY 8 | 7:30-8:00 AM | HOTEL LOBBY**

**LUNCH: MONDAY - THURSDAY | 12:00-1:00 PM**

	Monday*	Tuesday	Wednesday*	Thursday
<b>Fundamental Ventilation Design Skills</b>				
<b>8:00 –12 noon</b>	Fundamentals of Ventilation & Industrial Hygiene	Duct Component Design	System Components - Fans and Collectors	System Design III
<b>1:00 –5:00 PM</b>	Hood Design	System Design I	System Design II	System Design III
<b>Advanced Design</b>				
<b>8:00 –12 noon</b>	Ventilation II: Review of Fundamentals	Fans 201	Energy & Cost	System Design VI
<b>1:00 –5:00 PM</b>	Ventilation III: Physics at Non-Standard Conditions	System Design IV	System Design V	System Design VI
<b>Diagnosis and Troubleshooting</b>				
<b>8:00 –12 noon</b>	Ventilation II: Review of Fundamentals	Measuring & Monitoring System II	Monitoring & Maintenance I	Practical System Troubleshooting II
<b>1:00 –5:00 PM</b>	Measuring & Monitoring System Performance I	The Fan and System	Practical System Troubleshooting I	Practical System Troubleshooting II
* <b>Monday Evening:</b> CFD Informational Session + Initial Concept Tutorial			* <b>Wednesday Evening:</b> Stump-the-Staff	

## CONCURRENT WORKSHOPS — **Current Industrial Design Issues** | FRIDAY: 8:00 AM–12 Noon

### WORKSHOP 1:

#### Combustible Dust Technology Session/ Assessing Systems

- Managing Combustible Dust and Collectors
- Additive Manufacturing Issues
- How to do a Dust Hazard Analysis (DHA)
- Efficiency, Emissions, Energy Consumption-Instrumentation and Analysis trends and practices
- System Monitoring and Control | Real-time Data Acquisition and Use
- Drones and their use in audits

### WORKSHOP 2:

#### Computational Fluid Dynamics

- Practical Demonstration and Workshop on CFD in Industrial Ventilation Design
- Session requires participants to bring a laptop for downloading software. Class will provide input on instructions and decisions. SESSION IS LIMITED TO 10 PEOPLE.

## COMPUTATIONAL FLUID DYNAMICS WORKSHOP

This workshop will focus on understanding how the CFD Simulation can be used in the Ventilation field. We will show how this technique can be a powerful tool in the design and troubleshooting of industrial ventilation systems. The purpose of this course is not to make you a CFD expert, but to teach you how to interpret the results and understand how to use it to solve your problem and further understand why using CFD can bring benefits to your market. The objective is to present what this tool is, how it works and the way it can be used in the area of ventilation. The benefits will be shown, and understanding the

results will be highlighted. You will be taught how to perform a CFD simulation through very simple and didactic examples, following the step by step on how to build the simulation using ANSYS FLUENT software. The objective is to teach how to understand and interpret the results and how it describes the flow behavior and system operation. The CFD software (ANSYS FLUENT) has a free download in the student version on its website. You will need to bring a computer with 8GB or more of RAM and 4 physical cores such as Intel i5 8265U or similar.

## GENERAL INFORMATION

This Course was established to promote good ventilation practices and design techniques throughout industry and will help you understand how to evaluate and/or design a ventilation system.

Classroom problems are solved using the Velocity Pressure Method of calculation as outlined in the Industrial Ventilation Manual published by the ACGIH.

Classroom sessions and morning registration on May 8, will be held at the Hilton Raleigh North Hills, 3415 Wake Forest Rd., Raleigh, NC 27609 with the first session beginning at 8:00 am. The half day optional concurrent workshops will be held on Friday, May 12, 8 AM –12 Noon.

## TUITION

The cost for Level I Fundamentals of Ventilation, Level II Advanced Ventilation Design OR Level II System Diagnosis and Troubleshooting is \$2,195 per person. The three levels are taught concurrently May 8-11.

Tuition for either optional half day workshop on Friday, May 12, is \$350 per person.

Please call about company discounts for 3 or more registrants.

Course registration fees include the 31st edition ACGIH Industrial Ventilation Manual or System Diagnosis & Troubleshooting Manual (depending on course selected), all course materials (problems, calculations sheets), breaks, four continental breakfasts, four lunches, and the Founders Dinner on Tuesday, May 9. The Friday workshop registration fee includes handouts, continental breakfast and break.

The two year Certificate Program is included in the course cost.

**MAINTENANCE POINTS** —The NC Ventilation Course contains 30 hours of technical contact time and is eligible for an estimated

4.0 ABIH CM Points. The optional workshop contains an additional 4 hours of technical contact time and is eligible for an estimated .5 ABIH CM Credit.

**PROFESSIONAL DEVELOPMENT HOURS (PDHs)** — The Industrial Ventilation Course (S-0213P) is an approved sponsor of continuing competency activities for North Carolina Professional Engineers and Registered Land Surveyors (30 Contact Hours).

**ACCOMMODATIONS** — Rooms have been set aside at Hilton Raleigh North Hills for participants of this course, but their availability cannot be guaranteed past April 7. Lodging is NOT included in your registration fee. Please make your own reservation directly with the hotel to receive your special rate of \$144/day plus tax. Reservations may be made [here](#).

**Hilton Raleigh North Hills, 3415 Wake Forest Rd., Raleigh, NC 27609 919.872.2323**

**PARKING** — Free parking is available for Industrial Ventilation Course participants who are overnight guests at the Hilton as well as for those who drive in.

**CANCELLATION** — The full registration fee or an organization purchase order is due at the time of registration. In the event the participant cancels, a written notice is required. A fifty dollar (\$50.00) fee will be charged for cancellation. No reimbursement can be made if cancellation occurs within 7 business days of the program, or if the participant fails to attend. Substitutions can be made at any time.

## OTHER VENTILATION COURSES

The Annual Michigan Industrial Ventilation Conference will be held in Michigan in February 2023 For information please call **517-204-3687**.

The West Coast Industrial Ventilation Conference. For information, call **714-960-0684**.

# 65th N.C. Industrial Ventilation Course Registration Form

Hilton Raleigh North Hills, Raleigh, NC | May 8-11, 2023

Register Online: [www.ncindustrialventilation.com](http://www.ncindustrialventilation.com)  
OR fill out this form and mail to address below.

Name \_\_\_\_\_

Job Title \_\_\_\_\_

Firm/Org. \_\_\_\_\_

Work Phone \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

E-mail \_\_\_\_\_

**Please choose one level (May 8-11). Sign me up for:**

- ☐ Level I-Fundamentals of Industrial Ventilation..... \$2,195  
☐ Level II Advanced Vent Design..... \$2,195  
☐ Level II System Diagnosis & Troubleshooting..... \$2,195

**Enroll me in one of the Friday, May 12 workshops**

- ☐ Combustible Dust Technology/Assessing Systems..... \$350  
☐ Computational Fluid Dynamics..... \$350

Total \$ \_\_\_\_\_

**PLEASE CALL ABOUT PRICE BREAKS FOR 3 OR MORE REGISTRANTS!**

**Payment must accompany registration**

Payment Method:

- ☐ Visa ☐ MasterCard ☐ AmericanExpress  
☐ Check (Make check(s) payable to: Industrial Ventilation Course) ☐ PO

Card Account # \_\_\_\_\_

Exp. Date \_\_\_\_\_

Three (or four) Digit Security Code on Back of Card \_\_\_\_\_

Amount \$ \_\_\_\_\_

Signature \_\_\_\_\_

Cardholder's Name (please print) \_\_\_\_\_

Credit Card Billing Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

**Mail to:** Industrial Ventilation  
P.O. Box 37492  
Raleigh, NC 27627-7492  
Attn: Connie McElroy-Bacon

**For Information:**  
Phone/Fax: 919 233 8400  
Cell: 919 608 1606  
E-mail: cbacon@mindspring.com