Certified Occupational Hygienist Candidate Manual (HOC)

Iberoamerican Board of Occupational Hygiene (JIHO)

Vision

The Certified Occupational Hygienist (HOC) is the global standard for the certification of Occupational Hygienists competencies that allows occupational health and safety professionals to have the applied knowledge to be able to anticipate, recognize, evaluate and control chemical, physical, and biological hazards in the work context. The HOC certification program allows you to establish your level of professional knowledge and skills in occupational health and safety in the field of occupational hygiene. The HOC credential is a global standard that is only awarded to those who meet the requirements of education and experience, in addition to successfully completing an exam, requirements established by the Iberoamerican Board of Occupational Hygiene, recognized by the International Association of Occupational Hygiene (IOHA).

Certified Occupational Hygienist (HOC)

The Certified Occupational Hygienist (HOC) certification program allows you to establish your level of professional knowledge and skills in occupational hygiene. The HOC credential is a globally respected standard that is only awarded to those who meet the education and experience requirements, in addition to successfully completing an exam. Professionals who wish to certify also agree to comply with the Code of Ethics.

According to the requirements of the National Accreditation and Recognition Program (NAR) of the International Occupational Hygiene Association (IOHA), a Certified Occupational Hygienist (*Higienista Ocupacional Certificado,* **HOC**) is a person who has met the minimum requirements of education and experience and, through an exam, has demonstrated a minimum level of knowledge and skills in the following subject areas (headings):

- Chemical Contaminants: Sampling Strategies and Sampling and Analysis Methods
- Analytical chemistry
- Basic Sciences
- Biological Agents
- Occupational Epidemiology
- Population Exposure
- Chemical Contaminants: Controls
- Ergonomics
- Health Risk Analysis and Hazard Communication
- Industrial Hygiene Program Management
- Noise & Mechanical Vibrations
- Administrative Controls and Personal Protection
- Ionizing Radiation: Identification, Evaluation and Control
- Non-Ionizing Radiation: Identification, Evaluation and Control
- Thermal Environment: Identification, Evaluation and Control
- Chemical Contaminants: Occupational Toxicology
- Work Environments and Industrial Processes
- Professional Ethics

Implementation Stages

There are two steps in the application process to become certified as HOC. Fully familiarize yourself with the requirements before you begin your application. Please also note that you must meet all current eligibility requirements.

Stage 1. Eligibility for the exam

Eligibility for the exam is based on having one of the following combinations of academic qualifications and professional experience:

Academic Qualification	Duration	Titration	Experience
Doctorado / PhD/ScD	3-5 years	Occupational Hygiene, Occupational Health, Safety & Health at Work; Occupational Risk Prevention or Equivalent	3
PhD/ScD	3-5 years	Pure or Applied Sciences	3
Master Degree	2-3 years	Occupational Hygiene, Occupational Health, Safety & Health at Work; Occupational Risk Prevention or Equivalent	3
Master Degree	2-3 years	Pure or Applied Sciences	3
Specialization	1-2 years	Occupational Hygiene, Occupational Health, Safety & Health at Work; Occupational Risk Prevention or Equivalent	4
Specialization	1-2 years	Pure or Applied Sciences	4
Professional/Bachelor's Degree	4-5 years	Occupational Hygiene, Occupational Health, Safety & Health at Work; Occupational Risk Prevention or Equivalent	4
Professional/Bachelor's Degree	4-5 years	Pure or Applied Sciences	5

Accreditation of the Academic Qualification: Academic accreditations as degrees must be apostilled by the competent authority of each country and sent to the Iberoamerican Board of Occupational Hygiene accompanied by the RECA Academic Qualification Accreditation record. JIHO-01. This can be in the form of official transcripts from a designated university.

Accreditation of Specific Experience: Professional experience can only be claimed for periods in which the applicant was mainly dedicated (more than 50% of each year) to the professional practice of occupational hygiene or closely related activities, to prove the

specific experience the REEE registration must be completed. JIHO-02 to be sent to the Iberoamerican Board of Occupational Hygiene for validation.

Letters of Recommendation: Applications are encouraged to provided two (2) letters of recommendation. At least one of the references will be familiar with the work done by the applicant and will testify about the duties, responsibilities, job performance and duration of the applicant's experience. If two (2) references are not provided, the application will be considered incomplete and will not be processed. Professional references must be provided by persons who meet the following requirements:

• Are an accredited member of an Occupational Hygiene Association and hold an Occupational Hygiene competency certification from a NAR-accredited IOHA member society; or

• Is a competent professional acceptable to the board; and has direct knowledge of the applicant's work in Occupational Hygiene for at least:

· (i) two (2) years in the last five (5) years; or

· (ii) four (4) years in the last ten (10) years; and

• and can attest to:

(i) the professional competence of the applicant; or

(ii) that the applicant has an understanding of the basic principles of occupational hygiene Pa

The letter of recommendation must state that there is no conflict of interest between the person issuing the recommendation and the applicant. Where there may be a potential or perceived conflict of interest, describe the nature of the conflict of interest.

Stage 2. Examination

The HOC examination process is based on harmonized and accepted criteria for assessing the competence of the Occupational Hygienist's current and technical knowledge, as well as technical and problem-solving skills, professional judgment and ethics.

The exam is a one-day written knowledge test given entirely in Spanish. The weight of the components is defined to determine the discrimination of the test for its selectivity. The exam consists of approximately 150 multiple-choice questions, all of equal value. There is only one correct answer for each question and only points are awarded for the correct answers. Candidates must obtain a passing grade on each of the components of the written exam to receive a certification. If a candidate does not pass the exam, he or she must wait one year before retaking the exam again.

Qualifications and Evaluation

The Iberoamerican Board of Occupational Hygiene is responsible for all contact with exam candidates. This includes receiving application forms, reviewing and making decisions regarding eligibility, place/date/time of the exam and selection of proctors. The Iberoamerican Board of Occupational Hygiene is responsible for all inquiries of candidates. The Iberoamerican Board of Occupational Hygiene assigns each candidate a Candidate Identification Number. In order to ensure that the qualification is done "blindly", the members

of the Examination Committee do not have access to these identifiers. Decisions regarding applicant eligibility to sit for the exam will be documented at the end of each applicant registraion form and signed off by a minimum of two JIHO Board members.

Written exams are corrected by the JIHO Exam Committee. Multiple choice questions are corrected by the Chair of the Examination Committee. The results are collated by the President and any anomalies or inconsistencies are reviewed. The minimum grade needed to successfully complete is set before the exam. The Chair of the Committee forwards the results to the Board of Directors with the Committee's recommendation on whether the candidate should pass or fail. Only those candidates who have passed the written exam will move on to the interview.

Candidates wishing to appeal the results of an exam must submit their appeal in writing to JIHO within 30 days of receiving the exam results.

To qualify for HOC admission

1. Submit only one application per applicant.
2. Meet the academic requirements accompanied by official transcripts from relevant universities.
3. Meet the requirement of professional experience in occupational hygiene documented by references.
4. Be in the current practice of Occupational Hygiene.
5. Agree to adhere to the JIHO Code of Ethics and accept the board's guidelines.
6. Pay the application and examination fee.

Confidentiality

Original applications and supporting documentation are treated by the JIHO Board of Directors and staff as confidential information. JIHO takes all reasonable precautions to prevent unauthorized access to individual information. JIHO does not disclose personal information obtained from you or any other applicant to third parties, except when you authorize it in writing or if it is necessary to complete the process, for example, to organize your presentation to the exam.

Record Retention

In accordance with JIHO's record retention policy, paper files and electronic documents provided by applicants who have been inactive for three years will be destroyed. Before destroying a file, staff will attempt to notify you using your last known address.

Academic Requirements

To apply to the HOC candidates must have a bachelor’s degree in Occupational Hygiene or Health and Safety from a university that is acceptable to the Board. Preferably, you must have basic training in basic sciences that can be verified.

The Board will consider, and may accept, any other bachelor's degree issued by a university, provided that the degree is based on an appropriate courses and represents at least 60 semester hours of creditable subjects, with at least 15 of those hours at the higher level.

Occupational Hygiene Training Association (OHTA) Allowance: Courses taken for credit and where a certificate is earned though participation and OHTA certification can be

used to satisfy education eligibility requirements for Occupational Hygiene on a case-by-case basis to supplement shortcomings or fill educational gaps. Completion of the complete iCert scheme meets all Occupational Hygiene education requirements for JIHO exam eligibility. This involves completing the four core intermediate courses and two additional elective/optional modules from the intermediate modules.

Ethics requirement

Regardless of any other professional affiliation, the JIHO Code of Ethics applies to every candidate seeking certification and to every individual certified by JIHO's accreditation programs. The Code serves as a minimum ethical standard for your professional behavior and is designed to provide appropriate professional practice guidelines and enforceable standards of conduct. The Code also serves as a professional resource for occupational hygiene professionals. Accordingly, the candidate is obliged to comply with the JIHO Code of Ethics. The document is available in the **CDE document. JIHO-02**

Exam Preparation

Candidates should consider their knowledge and experience within the areas of competence that have been described. This process can help candidates identify their strengths and weaknesses, allowing them to focus their efforts properly during exam preparation. Examples of questions (multiple choice) and a representative list of references are provided.

Examples of Multiple Choice Questions;

The following are examples of the type of questions that can be expected within the multiple-choice component of the exam. These examples are not necessarily indicative of the degree of difficulty of all multiple-choice questions.

1. Which of the following health effects is associated with chronic overexposure to ethylene oxide?

A) Colon tumors
B) Increased frequency of miscarriages
C) Abdominal colic
D) Renal insufficiency
E) Aneurysm.

2. Two separate noise sources of 98 dBA and 96 dBA respectively are installed and operated together. What is the combined noise level?

A) 99 dBA
B) 100 dBA
C) 101 dBA
D) 123 dBA
E) 194 dBA

3. How it classifies chemical compounds, according to their origin

A) Salts and oxides
B) Gases and vapours
C) Organic and inorganic
D) Metals and metalloids

4. If acetone has a specific weight of 0.79, how many milliliters are there in 2.0 g of acetone?

A) 2.53 (ml)
B) 5.0 (mg)
C) 3.9 (ml)
D) 7.5 (mg/l)

5. According to an ANALYTICAL method of NIOSH, the minimum level of detection of a chemical is 50 g, the recommended exposure limit for this chemical is 1.0 mg / m3, and the fraction is set at 0.1. How many liters of air must be collected to obtain the minimum sample volume?

A) 25.5 (ml)
B) 300 (L)
C) 85 (L)
D) 500 (L)

Areas of competence

Chemical Contaminants: Sampling Strategies and Sampling and Analysis Methods

Sampling Strategies for Exposure Assessment: Worst Case Studies, Detailed Randomized Stratified Studies based on GES, Selection of Workers for Random Sampling

Measurement Strategies: Part-Time Measurement, Full-Time Measurement, Consecutive Measurements etc.

Sampling and Analysis Methods.

Advantages and Limitations of Measurement Techniques.

Quality Control and Quality Assurance Criteria

Calculations for Exposure Assessment, Banding Control and Alternative Methods

Analytical chemistry

Qualitative and Quantitative Analytical Techniques: gas chromatography, infrared, visible and ultraviolet spectrophotometry, high-performance liquid chromatography, mass spectroscopy, atomic absorption spectrophotometry, wet chemical methods and microscopy and laboratory and chain of custody quality assurance.

Basic Sciences

General concepts of chemistry, biochemistry, biology, anatomy and physiology, physics, mathematics and statistics. Scientific Notation, Calculations, Powers, Gas Laws, Functions, Distributions, etc.

Biological Agents

Basic concepts about biological risk, from the classification and description of the different agents that can affect the health of workers, to the techniques of prevention and protection against them, taking into account the applicable and reference legislation.

Occupational Epidemiology

Principles of epidemiology, techniques used to study the distribution of diseases and physiological conditions induced by work in workplaces and factors that influence their frequency. It includes concepts from prospective and retrospective studies, morbidity and mortality and experimental animal studies, data and data distribution, as well as basic biostatistics and statistical and non-statistical interpretation of data in hazard assessment.

Population Exposure

Air pollution, air cleaning technology, ambient air quality considerations, sampling of emission sources, atmospheric dispersion of pollutants, monitoring of ambient air, health and environmental effects of air pollutants and related calculations. Other IH-related environmental topics such as emergency planning and response, water pollution, hazardous waste, and environmental fate and transportation are also included.

Chemical Contaminants: Controls

Controls at Source (Substitution & Disposal), Medium (Principles of General Ventilation/Dilution, Exhaustive Local Ventilation, Design Principles, Related Calculations, System Maintenance etc.) Individual (Selection of Respiratory and Dermal Personal Protection Elements, respirator fit tests, breathing air specifications, glove permeability, eye protection and the use of administrative controls etc.)

Ergonomics

Application of principles of anthropometry, human factors engineering, biomechanics, work physiology, human anatomy, occupational medicine and facilities engineering to the design and organization of the workplace in order to prevent injuries and diseases.

Health Risk Analysis and Hazard Communication

Understanding of the principles and requirements for the interpretation and use of guidelines for health risk assessment,

Fundamental stages in industrial hygiene for the prevention of occupational diseases.

ISO, EN, NIOSH, OSHA, HSE, ACGIH resources others

Threshold/Permissible Limit Values

Biological Exposure Values/Indices.

Health surveillance and medical surveillance.

Principles of occupational toxicology.

Articulation of Industrial Hygiene and Medical Surveillance

Industrial Hygiene Program Management

Acquisition, allocation and control of resources to achieve objectives of anticipation, recognition, evaluation and control of industrial hygiene in an effective and timely manner. Topics such as auditing, research methods, data management and integration, policy setting, planning, delegation of authority, accountability, risk communication, organizational structure, decision-making, and the Occupational Hygiene Code of Ethics are included.

Noise & Mechanical Vibrations

Health Effects of Occupational Exposure to Noise and Mechanical Vibrations, Identification, Exposure Assessment, Risk Control (Source, Medium of Transmission and Individual) and Medical Surveillance Associated with the Risk Factor

Administrative Controls and Personal Protection

Personal protective equipment, including principles governing the selection, use, and limitations of respirators and protective clothing. Included are respirator fit tests, breathing air specifications, glove permeability, eye protection, and the use of administrative controls.

Ionizing Radiation: Identification, Evaluation and Control

Physical characteristics and biological and health effects associated with alpha, beta, gamma, neutron, and X-ray radiation, including source characteristics. Includes exposure measurement, evaluation and control.

Non-Ionizing Radiation: Identification, Evaluation and Control

Physical characteristics and health effects associated with electromagnetic fields, static electric and magnetic fields, laser, radiofrequency, microwave, ultraviolet, visible, infrared and illumination radiation. Includes exposure measurement, evaluation and control.

Thermal Environment: Identification, Evaluation and Control

Adverse health effects associated with heat and cold, symptoms of temperature-related health effects, exposure control techniques, and first aid/medical response.

Chemical Contaminants: Occupational Toxicology

Health effects resulting from exposure to chemicals, including single agents and mixtures, and natural and synthetic agents. These include symptoms, pharmacokinetics, mode of action, additive, synergistic and antagonistic effects, entry pathways, absorption, metabolism, excretion, target organs, toxicity testing protocols and deposition and elimination of aerosols in the respiratory tract. Carcinogenic, mutagenic, teratogenic and reproductive risks are also included.

Work Environments and Industrial Processes

Risks associated with specific industrial or manufacturing processes are included. Topics include, but are not limited to, confined space entry, spray painting, welding, abrasive jetting, steam degreasing, smelting operations and remediation of hazardous waste sites, as well as general indoor environmental issues.

Bibliographic Aids

The following list of texts, manuals, journals, regulations, standards and guidelines is provided to give candidates examples of the types of materials they should review in preparation for the exam. The list is not intended to be complete or exhaustive. Candidates are expected to use their professional judgment in selecting other reading material for exam preparation.

Texts

1. Toxicology of Casarette and Doull: the basic science of poisons (5the Edition); CD Klaassen, editor.

2. Ergonomic design for people at work, Volumes I and II; Eastman Kodak Company, New York, 1983 (Volume I), 1986 (Volume II)

3. Fundamentals of Industrial Hygiene (Last Edition); BA Plog and T. Hogan, editors

4. The Occupational Environment: Its Evaluation and Control (Last Edition); S. Dinardi, editor

5. Plant practices for the control of work-related health risks, volumes I and II (latest edition); LV Cralley and LJ Cralley, editor

6. Industrial Hygiene Management; JT Garrett, LJ Cralley and LV Cralley, editors

7. Patty's Industrial Hygiene and Toxicology, Volumes IA and IB, IIA to IIC, IIIA and IIIB (latest edition); GD Clayton and E.F. Clayton, editors (Vol. I and II), L.J. Cralley and LV Cralley, editors (Vol. III)

8. Recognition of health risks in the industry: a review of materials and processes; WABurgess

9. Industrial Toxicology: Occupational Health and Safety Applications; PL Williams and JL Burson, editors

10. Noise and Noise Control; MJ Crocker and FM Kessler, editors

11. Air Monitoring for Toxic Substances, S. Ness, editor 12. Air monitoring instrumentation; CJ Maslansky and SP Maslansky, editors

13. Applications and Occupational Elements of Industrial Hygiene; MB stern and SZ Mansdorf, editors

14. Air Sampling Instruments, ACGIH, 1995

15. Bioaerosols: Evaluation and Control; ACGIH Bioaerosols Committee, J. Macher, editor, 1998

16. Building air quality; U.S. EPA and NIOSH, 1991

17. AIHA Noise and Hearing Conservation Manual

Manuals (latest editions)

1. Manual of Chemistry and Physics (latest edition)

2. ACGIH Industrial Ventilation: A Best Practices Manual

3. NIOSH Guide to Industrial Respiratory Protection

4. NIOSH Analytical Methods Manual 5. ACGIH Air Sampling Instrument Manual

Magazines

1. Journal of the American Industrial Hygiene Association

2. Applied Occupational and Environmental Hygiene

3. Annals of Occupational Hygiene

4. Scandinavian Journal of Work, Environment and Health

5. Journal of Toxicology and Environmental Health

6. Environmental Health Archives

7. Health Physics

8. Journal of Environmental and Occupational Medicine

9. Acoustic magazine

Certification Maintenance Program

Certification Maintenance Requirements and Processes

HOCs are required to recertify every five years in order to maintain their certification. JIHO believes that the five-year cycle allows ample time for the Diplomate to develop new knowledge/skills as well as enhance or refresh on previously-acquired knowledge/skills. This can encompass maintaining technical knowledge and skills in regulations and standards and updating their knowledge and skills related to improvements and current developments in practice, procedures, and techniques.

The purpose of the Certification Maintenance (CM) program is to ensure that COHs continue to develop and increase their professional occupational hygiene knowledge and skills as certified by the JIHO. The CM program primarily emphasizes technical advancement and considers professional areas that support technical learning such as (but not limited to) environment, management- systems, safety or leadership.

In order to maintain certification a certified occupational hygienist MUST accumulate

40 Certification Maintenance points over 5 years

including a minimum of 10 of which must be in core occupational areas in Category 3 Attendance at approved Meetings and Educational Programs. Certificants must provide attendance at a minimum of 2.0 hours of training in Professional Ethics during the 5-year period. Teaching courses or seminars on professional ethics will count at the same level. And writing articles on professional ethics for publication in professional newsletters will also count towards credit.

The certification cycle commences January 1st of the year following awarding of or renewal of COH® status and ends December 31st, 5 years later. Any Applicant who receives COH status during the year will have their cycle rounded to the nearest calendar year with any CM points adjusted accordingly.

There is no ceiling on CM points that may be accrued per year. The points for certification maintenance are divided into six categories:

- Category 1 - Active Occupational Hygiene Practice
- Category 2 - Technical & AIOH Professional Committee Service
- Category 3 – Attendance at Approved Meetings and Educational Programs
- Category 4 – Publication or Review of Papers, Book Chapters
- Category 5 – Teaching, Lecturing and Mentoring
- Category 6 – Successful Completion of other Certification Courses
- Category 7 – Professional Ethics

There may be other professional activities not covered under Categories 1-6 which you believe should be considered by JIHO for re-certification. Please contact the JIHO President to discuss such activities to determine CM value.

Activities Over Five-Year Period

Activity	Category	Max Points
100% work in occupational hygiene	1	10 (or ratio thereof)
Technical & Professional Committee Service	2	1 per committee per year
Attendance at Meetings and Training	3	0.5 per ½ day
Publication of Papers or Chapters	4	1 per article
Training or Presenting	5	0.5 per ½ day or per presentation
Attendance in Professional Development Coursework	6	1 per day
Professional Ethics	7	2 (required)

The following Certification Maintnance (CM) Worksheet must be completed for all relevant activities undertaken within each 5-year accreditation cycle.

Completed CM Worksheets are due by March 31st (following year or 3 months after cycle ends), reviewed through April and finalised by May. Renewed stamps are issued from June.

Certification Maintenance Worksheet

Activity Description	Category	Points
	1	
	2	
	3	
	4	

	5	
	6	
	7 (required)	
	Total	40 or greater

All worksheets must be submitted no later than 3 months after the CM cycle end date or the COH is subject to decertification. Worksheets are reviewed and approved by June of that same year.

To the greatest extent possible, JIHO will keep a running list of conferences and training sessions that would be acceptable sessions where attendance would earn CM credit.

The JIHO maintains a schedule for maintenance of certification and sends courtesy reminders by email to COHs who are due to report. Typically, they are sent in October and December of the 5th year of a CM cycle. Additional reminders may be sent through January to March after Year 5. Reminders may also be sent by the newsletters and other sources.

CM worksheets may be submitted to the JIHO Office from September 1st of the 5th year of the CM cycle but must be received by March 31st of the year following the 5th year of the certification maintenance cycle.

Supporting documentation is required when submitting the CM Worksheet and will be required if a COH is selected for audit so must be kept for all claims made for certification maintenance. Supporting documentation for each category is described below and may include:

- certificates of attendance for seminars and conferences, hotel and travel receipts, lecturing timetables, committee meeting minutes, conference programs, session attendance confirmation certificates, and conference papers/posters/presentations.

CM Worksheets received after March 31st of the year following the 5th year of the certification maintenance cycle may incur a late fee or result in delays in COH renewals.

After receiving a 5-year completed CM Worksheet, the JIHO will send an acknowledgement email.

When the JIHO finds that a COH has submitted an acceptable CM Worksheet a written notice that certification has been maintained will be sent. This will be sent by the June 30th of the following year.

The new certification shall expire on 31st December in the fifth year of the certification maintenance cycle.

The Certificate shall be marked “This certificate is scheduled for renewal by June 30th, [YEAR]”. The [YEAR] shall be the year following the 5th year of the certification maintenance cycle.

Interface with related discipline professional certification

The JIHO Board of Directors is comprised of numerous professionals from a broad variety of educational backgrounds, area of expertise, and geographical regions. Many of the Board members are executives of their national occupational hygiene professional organizations that are also members of IOHA. Many of the Board members are themselves IOHA Board representatives from their respective IOHA member organizations. Board members professors in occupational hygiene university programs, government workers, consultants in general industry and mining, and employees of national and international companies and organizations. Many board members participate in other occupational hygiene philanthropic organizations as volunteers and board members such at the Occupational Hygiene Training Association and Workplace Health Without Borders. Some Board members are members of the International Commission on Occupational Health and sit on technical committees in that organization including the Education Committee and the Industrial Hygiene Committee.

On a continuous and regular basis JIHO Board members conduct training seminars, symposia, and presentations at national and international conferences held by IOHA and national professional organizations. On a regular basis JIHO Board members write articles for the IOHA Global Exposure Manager and other professional publications. JIHO Board members also publish peer-reviewed articles, books, and white papers on occupational hygiene topics on a regular basis.

As a certification body only, and not an occupational hygiene professional organization such as many IOHA NAR recognition orgnaizations, JIHO does not conduct professional society meetings or training courses on occupational hygiene or ethics themselves. JIHO supports such conferences and training by providing speakers and program development and review on a regular basis. JIHO Board members participate in International Labor Organizations such as the Task Force for Safety in Higher Education supporting SDG 8. JIHO Board members are also part of the technical committee for the ILO Global Summit on Occupational Health and Safety.

Useful equations for JIHO - HOC exams

The following list of equations is intended to help candidates prepare for the JOHO HOC exam. It will also be provided for use during the completion of the exam as a hard paper copy. This list is not intended to be complete or exhaustive. Consequently, the use of any or all of these equations will not necessarily result in the successful completion of the HOC exam. The variables used or the same as found in the reference sources for the equation. No attempt has been made to standardize variables. [Metric (SI) equations are in brackets.] While the SI system may use both decimal dots and decimal commas as a

decimal marker, the decimal marker (decimal point) in this exam will always be a dot. Unless otherwise noted, cfm is presumed to be acfm. acfm is cfm at actual conditions and scfm is cfm at standard conditions and nm3/s is m3/s at actual conditions and sm3/s is m3/s at normal conditions. (Equations shown here are use at the permission and courtesy of the Board of Global Credentialling).

VENTILATION

$$Q = VA \quad V_1A_1 = V_2A_2 \quad TP = VP + SP \quad SP_1 + VP_1 = SP_2 + VP_2 + \sum losses_{1-2} \quad SP_h = -((F_h + 1)\mathrm{VP}_d)$$

$$V = 4005\sqrt{\frac{VP}{df}} \quad [V = 1.29\sqrt{\frac{VP}{df}}] \quad VP = \left(\frac{V}{4005}\right)^2 df \quad [VP = \left(\frac{V}{1.29}\right)^2 df] \quad hood\ entry\ loss = F_h x VP_d$$

$$C_e = \sqrt{\frac{VP}{|SP_h|}} \quad VP_r = \left(\frac{Q_1}{Q_3}\right)VP_1 + \left(\frac{Q_2}{Q_3}\right)VP_2 \quad Q = 4005(Ce)\sqrt{\frac{|SP_h|}{df}}(A) \quad [Q = 1.29(Ce)\sqrt{\frac{|SP_h|}{df}}(A)\ ]$$

$$Q = 4005C_eA\sqrt{|SP_h|} \quad Q_{corr} = Q_{lower}\sqrt{\frac{SP_{gov}}{SP_{lower}}} \quad Q' = \frac{Q}{m_i} \quad t_2 - t_1 = -\frac{V_r}{Q'}ln\left(\frac{C_{g2}}{C_{g1}}\right)$$

$$ln\frac{(G - Q'Cg_2)}{(G - Q'Cg_1)} = -\frac{Q'(t_2 - t_1)}{V_r} \quad Q = \frac{(403)(SG)(ER)(S_f)(m_i)(10^6)}{(MW)(C_g)} \quad [Q = \frac{(24)(SG)(ER)(S_f)(m_i)(10^6)}{(MW)(Cg)}]$$

$$Q = \frac{(403)(SG)(W)(k)(10^6)}{(MW)(L)}$$

$$N_{changes} = \frac{60Q'}{V_r} \quad C_{g2} = G\frac{\left(1 - e^{-\left(\frac{Q'\Delta t}{Vr}\right)}\right)}{Q'} \quad C_{g2} = C_{g1}e^{-\left(\frac{Q'\Delta t}{V_r}\right)} \quad C = \left(\frac{G}{Q'}10^6\right) + C_{supply} \quad Q_2 = Q_1\left(\frac{d_2}{d_1}\right)^3\left(\frac{RPM_2}{RPM_1}\right)$$

$$P_2 = P_1\left(\frac{d_2}{d_1}\right)^2\left(\frac{RPM_2}{RPM_1}\right)^2 \quad PWR_2 = PWR_1\left(\frac{d_2}{d_1}\right)^5\left(\frac{RPM_2}{RPM_1}\right)^3 \quad FSP = SP_{out} - SP_{in} - VP_{in} \quad FTP = TP_{out} - TP_{in}$$

NOISE

$$SPL\ or\ L_p = 20\ log\left(\frac{P}{P_0}\right) \quad L_I = 10\ log\left(\frac{I}{I_0}\right) \quad SPL_2 = SPL_1 + 20\ log\left(\frac{d_1}{d_2}\right) \quad L_w = 10\ log\left(\frac{W}{W_0}\right)$$

$$W_0 = 10^{-12} watts \quad L_{eq} = 10\log\left(\frac{1}{T}\sum_{i=1}^{N}\left(10^{\frac{L_i}{10}}t_i\right)\right) \quad LPT = 10\ log\left(\sum_{i=1}^{N}10^{\frac{L_{P_i}}{10}}\right) \quad TL = 10\log\left(\frac{1}{\tau}\right)$$

$$L_p = L_w - 20\log r - 0.5 + DI + CF \quad [L_p = L_w - 20\log r - 11 + DI + CF] \quad DI = 10\log\ Q$$

$$\%D = 100\left(\frac{C_1}{T_1} + \frac{C_2}{T_2} + \cdots + \frac{C_i}{T_i}\right) \quad T_p = \frac{T_c}{2^{(L_{AS} - L_C/ER)}} \quad TWA_{eq} = 10\ log\left(\frac{\%D}{100}\right) + 85dBA$$

$$TWA = 16.61\ log\left(\frac{\%D}{100}\right) + 90dBA \quad f = \frac{(N)(RPM)}{60} \quad f = \frac{C}{\lambda} \quad f_2 = 2f_1 \quad f_c = \sqrt{f_1 f_2} \quad f_2 = \sqrt[3]{2} f_1$$

GENERAL SCIENCES, STATISTICS, STANDARDS

$$ppm = \frac{V_{contam}}{V_{air}} x10^6 \quad ppm = \frac{P_v}{P_{atm}} \quad x10^6 \quad ppm = \frac{mg/m^3 \times 24.45}{m.w.} \quad \frac{P_1V_1}{nRT_1} = \frac{P_2V_2}{nRT_2} \quad V_{TS} = \frac{g\ d_p^2(p_p - p_a)}{18\eta}$$

$$Re = \frac{p\ dv}{\eta} \quad log\ \frac{I_0}{I} = abc \quad pH = -log_{10}[H^+] \quad K_a = \frac{[H^+]x[A^-]}{[HA]} \quad K_b = \frac{[BH^+]\times[OH^-]}{B}$$

$$P_{total} = X_1P_1 + X_2P_2 + \ldots + X_iP_i \quad vapor/hazard\ ratio = \frac{sat.concentration}{exopsure\ guideline} \quad TLV_{mix} = \frac{C_1}{TLV_1} + \frac{C_2}{TLV_2} + \ldots + \frac{C_n}{TLV_n}$$

$$TLV_{mix} = \frac{1}{\frac{F_1}{TLV_1} + \frac{F_2}{TLV_2} + \cdots + \frac{F_n}{TLV_n}} \quad RF = \frac{8}{h} \times \frac{24-h}{16} \quad RF = \frac{40}{h_w} \times \frac{168-h_w}{128} \quad C_{asb} = \frac{(C_s - C_b)A_c}{1000A_f v_s}$$

$$C_{asb} = \frac{EA_C}{1000V_s} \quad E_{fiber\ density} = \frac{\frac{f}{N_f} - \frac{B}{N_b}}{A_f} \quad d = \frac{0.61\lambda}{\eta \sin\alpha} \quad SD = \sqrt{\frac{\sum(\bar{x} - x_i)^2}{n-1}} \quad GM = \sqrt[n]{(x_1)(x_2)\ldots(x_n)}$$

$$GM = 10^{\frac{\sum(log_x)}{n}} \quad GSD = \frac{84.13\%\ tile\ value}{50\%\ tile\ value} \quad GSD = \frac{50\%\ tile\ value}{15.87\%\ tile\ value} \quad SAE = 1.645CV_{total}$$

$$CV = \frac{SD}{\bar{x}} \quad E_c = \sqrt{E_1^2 + E_2^2 + \cdots + E_n^2} \quad t = \frac{\bar{x}_1 - \bar{x}_2}{SDpooled\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \quad SD_{pooled} = \sqrt{\frac{(n_1 - 1){SD_1}^2 + (n_2 - 1){SD_2}^2}{n_1 + n_2 - 2}}$$

$$LCL = \frac{C_A}{PEL} - \frac{SAE\sqrt{T_1^2C_1^2 + T_2^2C_2^2 + T_n^2C_n^2}}{PEL(T_1 + T_2 + \cdots + T_n)} \quad RWL = LCxHMxVMxDMxAMxFMxCM \quad LI = \frac{L}{RWL}$$

$$90\%Conf\ Interval = \overline{X} \pm 1.645\frac{SD}{\sqrt{n}} \quad One\text{-}sided\ 95\%UCL\ on\ mean = \overline{X} + 1.645\frac{SD}{\sqrt{n}}$$

$$V_x = \frac{C \times MW \times 273 \times P \times V_T}{\rho \times 22.4 \times T \times 760 \times 10^6}$$

HEAT STRESS

$WBGT = 0.7t_{nwb} + 0.2t_g + 0.1t_{db}$ $WBGT = 0.7t_{nwb} + 0.3t_g$ $\Delta S = (M - W) \pm C \pm R - E$

RADIATION

$I_2 = I_1\left(\frac{d_1}{d_2}\right)^2$ $Rem\ (RAD)(QF)$ $D = \frac{\Gamma A}{d^2}$ $A = A_i(0.5)^{\frac{t}{T_{1/2}}}$ $A_i = \frac{0.693}{T_{1/2}}N_i$ $A = A_i e^{\frac{-.693t}{T_{1/2}}}$

$I = \left(\frac{1}{2}\right)^A I_0$ $I = \left(\frac{1}{10}\right)^B I_0$ $I_2 = \frac{I_1}{2^{\frac{X}{HVL}}}$ $I_2 = \frac{I_2}{10^{\frac{X}{TVL}}}$ $x = 3.32log\left(\frac{I_1}{I_2}\right)(HVL)$ $I = I_0 Be^{-ux}$

$\frac{1}{T_{1/2eff}} = \frac{1}{T_{1/2rad}} + \frac{1}{T_{1/2bio}}$ $T_{1/2eff} = \frac{\left(T_{1/2rad}\right)\left(T_{1/2bio}\right)}{T_{1/2rad} + T_{1/2bio}}$ $S = \frac{E^2}{3770}$ $S = 37.7H^2$ $S = \frac{4P}{A}$

$r = \left(\frac{PG}{4\pi EL}\right)^{\frac{1}{2}}$ $r_{NHZ} = \frac{1}{\emptyset}\left(\frac{4\Phi}{\pi EL} - a^2\right)^{\frac{1}{2}}$ $r_{NHZ} = \frac{f_0}{b_0}\left(\frac{4\phi}{\pi EL}\right)^{\frac{1}{2}}$ $r_{NHZ} = \left(\frac{\rho\Phi cos\theta}{\pi EL}\right)^{\frac{1}{2}}$

$D_s = \frac{1}{\emptyset}\left(\frac{4\Phi}{\pi TL} - a^2\right)^{\frac{1}{2}}$ $spatial\ ave = \left(\frac{\Sigma_{i=1}^{N} FS_i^{\,2}}{N}\right)^{\frac{1}{2}}$ t= $\frac{0.003J/cm^2}{E_{eff}}$ t= $\frac{EL}{ML}$ x $0.1h$ O.D.= $\log\frac{I_0}{I}$

$D_L = \sqrt{a^2 + \emptyset^2 r^2}$ $G = 10^{g/10}$

CONSTANTS AND CONVERSIONS

°F=9/5(°C)+32 °R=°F+460 K=°C+273.15 molar volume at 25°C, 1 atm=24.45L $1ft^3$ =28.32L=7.481 U.S. gal

1L=1.0566 qt 1 inch = 2.54 cm 12 inch = 1 ft 1 lb=453.6 grams 1 gram=15.43 grains 1 qt = 2 pt 4 qt = 1 gal

1 atm=14.7 psi=760 mm Hg=29.92 in Hg=33.93 ft water=1013.25 mbar=101,325 pascals

1 Curie=$3.7x10^{10}$ disint/sec (Becquerel)= $2.2x10^{12}$ dpm 1 Gray=100 Rad 1 Sievert=100 Rem

1 Tesla=10,000 Gauss 1 BTU=1054.8 joules=0.293 watt hr 1 cal=4.184 joules

speed of sound in air at 68°F (20°C)=1130 fps (344 m/s) speed of light=$3x10^8$ m/s

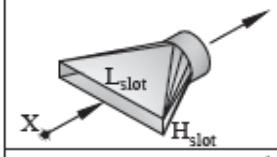
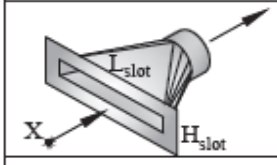
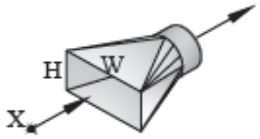
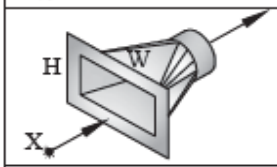
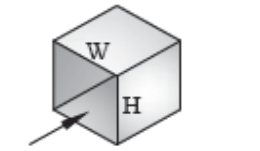
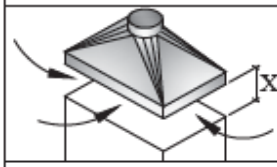
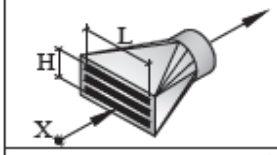
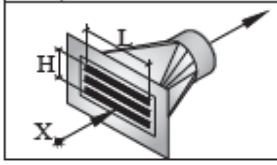
Planck's constant=$6.626x10^{-27}$ erg sec Avogadro's number=$6.024x10^{23}$

gas constant, R=8.314 J/mole K=0.082 L atm/mole K density of air=1.29 g/L at atm, 0°C

g=981 cm/sec^2 =32 ft/sec^2 A_c =385 mm^2 for 25 mm filter Af=0.00785 mm^2 $A = \pi r^2$

The density (ρ) of air at standard (normal) conditions is 0.075 lbm/ft^3 (1.25 kg/m^3) at sea level, 407" wg (101,325 Pa), 70°F (21°C) dry bulb temperature and zero moisture

Table 6-2. Summary of hood airflow equations

HOOD TYPE	DESCRIPTION	ASPECT RATIO, H/L	AIRFLOW
	Slot	0.2 or less	$Q = 3.7LV_xX$
	Flanged Slot $W_f \geq H_s$	0.2 or less	$Q = 2.6LV_xX$
	Plain Opening	0.2 or greater and round	$Q = V_X(10X^2 + A_f)$ $A_f = WH$
	Flanged Opening $W_f \geq \sqrt{A_f}$	0.2 or greater and round	$Q = 0.75V_X(10X^2 + A_f)$ $A_f = WH$
	Booth	To suit work	$Q = VA = V_f\ WH$
	Canopy (recommended for hot processes)	To suit work	$Q = 1.4\ PVX$ P = Perimeter of work or tank X = Height above work
	Plain multiple slot opening (2) or more slots	0.2 or greater	$Q = V_x\ (10X^2 + A_s)$ $A_s = HL$
	Flanged multiple slot opening (2) or more slots	0.2 or greater	$Q = 0.75V_x\ (10X^2 + A_s)$ $A_s = HL$

Store - Industrial Ventilation: A Manual of Recommended Practice for Design, 31st Edition - ACGIH Portal

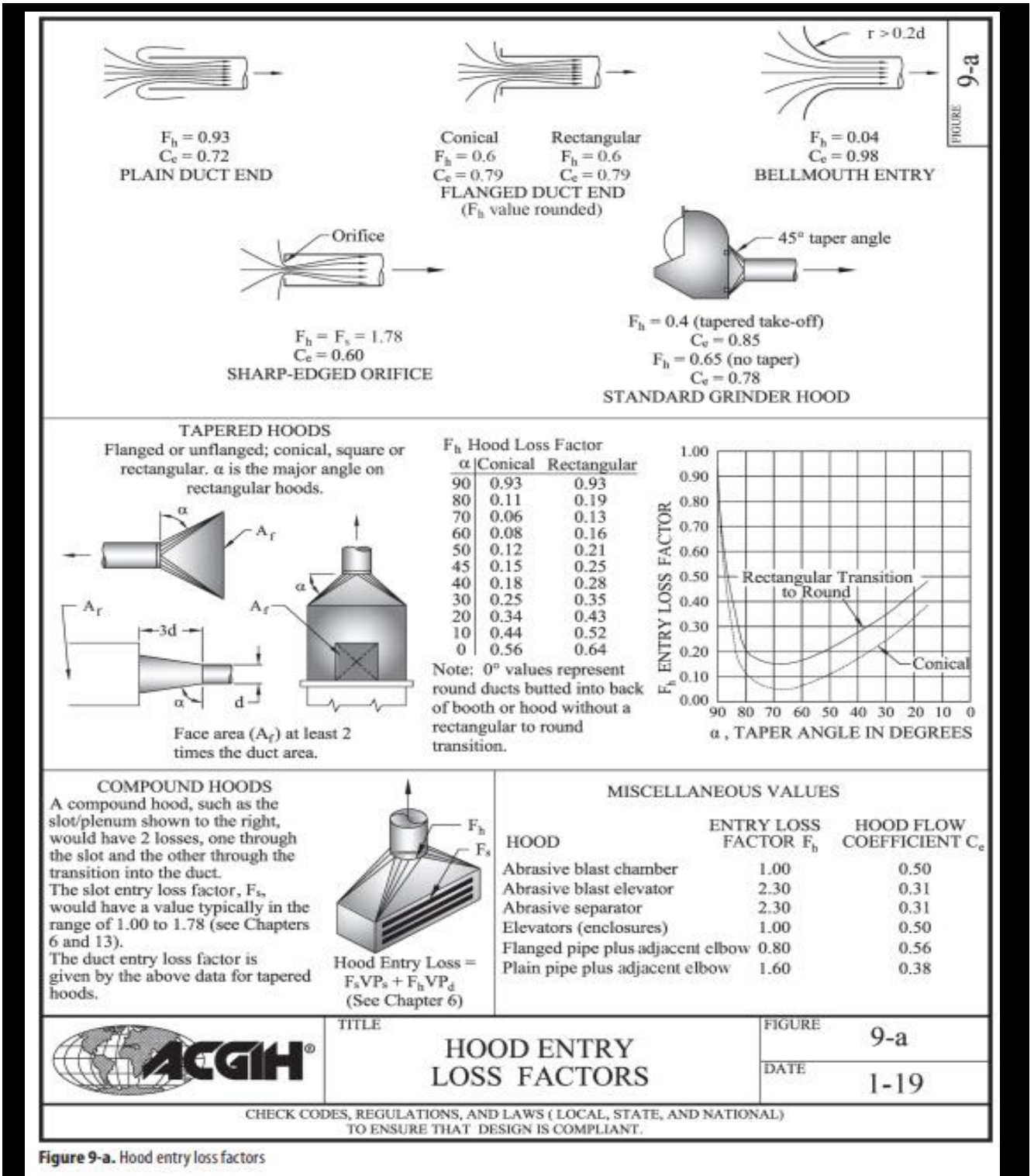


Figure 9-a. Hood entry loss factors

Store - Industrial Ventilation: A Manual of Recommended Practice for Design, 31st Edition - ACGIH Portal

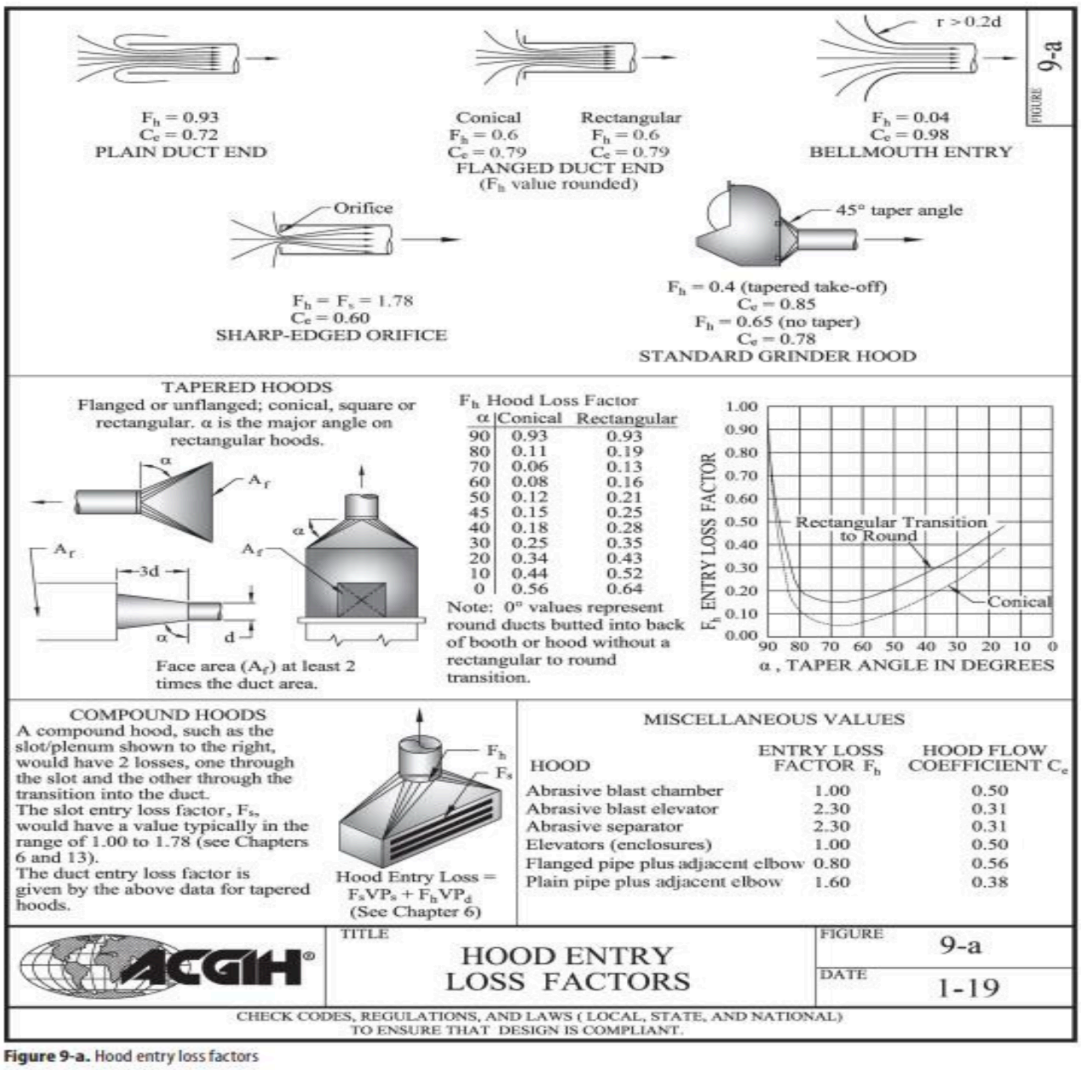


Figure 9-a. Hood entry loss factors