INDUSTRIAL COMMISSION
OF
WISCONSIN

VOYTA WRABETZ, *Chairman*
HARRY J. BURCZYK, *Commissioner*
C. L. MILER, *Commissioner*
HELEN E. GILL, *Secretary*
R. McA. KEOWN, *Engineer*
O. T. NELSON, *Building Engineer*

HEATING, VENTILATION AND AIR CONDITIONING CODE

Effective April 11, 1936
Reprinted 1944

Issued by
INDUSTRIAL COMMISSION OF WISCONSIN
Madison

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HEATING, VENTILATION and AIR CONDITIONING CODE

INTRODUCTION

AUTHORITY

The Heating, Ventilation and Air Conditioning Code has been adopted by the Industrial Commission in discharge of its duties under Section 101.01 to 101.28, inclusive, of the Statutes of Wisconsin.

HISTORY

Prior to the adoption of the Heating and Ventilation Code by the Industrial Commission on July 6, 1923 the general requirements on ventilation of public buildings and places of employment in Wisconsin were enforced as a part of the Building Code and of the General Orders on Sanitation, issued by the Industrial Commission. The Building Code became effective on October 9, 1914, and the ventilation requirements therein were amended only in minor details prior to July 6, 1923.

The General Orders on Sanitation became effective on February 20, 1913. The ventilation requirements contained therein, Orders 2000 to 2017, inclusive, were amended in 1921, effective July 19, 1921. The revised general ventilation requirements were contained in Orders 2000, 2010, 2011, 2012 and 2020 to 2025, inclusive, and were in force until March 18, 1932 when they were repealed and superseded by the General Orders on Dusts, Fumes, Vapors and Gases. These orders are now in effect and apply to all places of employment and public buildings.

In the fall of 1922, the Industrial Commission appointed an Advisory Committee to assist in the preparation of a reasonable code of standards of heating and ventilation for public buildings and places of employment in Wisconsin. The personnel of this committee was as follows:

C. E. Bronson, Kewaunee, Illinois. Representing the American Boiler Manufacturers Association.

Dr. H. E. Dearholt, Milwaukee, Wisconsin. Representing the Wisconsin Anti-Tuberculosis Association.

G. J. DeGelleke, Milwaukee, Wisconsin. Representing the Wisconsin Chapter of American Institute of Architects.

Henry Hotton, Milwaukee, Wisconsin. Representing the National Boiler and Radiator Manufacturers Association.

Prof. G. L. Larson, College of Engineering, University of Wisconsin, Madison, Wisconsin.

Samuel R. Lewis, Consulting Engineer, Chicago, Illinois.

Len F. Sargent, Wausau, Wisconsin. National Heating and Ventilating Company.

H. W. Schmidt, State Department of Public Instruction, Madison, Wisconsin.

E. Worthing, President of Bayley Manufacturing Company, Milwaukee, Wisconsin.

R. A. Small, Ventilation Engineer, Industrial Commission, Madison, Wisconsin.

W. C. Muehlstein, Building Engineer, Industrial Commission, Madison, Wisconsin.

The Heating and Ventilation Code prepared by this committee was adopted by the Industrial Commission on July 6, 1923, and became effective on August 19, 1923. In the enforcement of this code following its adoption by the commission it became evident that there was some dissatisfaction as to the reasonableness of some of the requirements. Publication was therefore postponed and the code again placed in the hands of the Advisory Committee for further consideration. The revised code as submitted to the commission with recommendation for adoption, was adopted by the commission on April 8, 1925, and became effective May 14, 1925.

In order to review this code and to determine whether or not any changes or revisions were necessary to bring the various orders up to date, the Industrial Commission, in March 1935, in cooperation with labor, professions and other interested organizations selected a new advisory committee to study the subject and prepare recommendations for necessary changes. The personnel of this committee is as follows:

A. C. Eschweiler, Jr., State Association of Wisconsin Architects, Milwaukee, Wisconsin.

Edw. A. Jones, Wisconsin Chapter, American Society of Heating and Ventilating Engineers, Milwaukee, Wisconsin.

John Klatt, Wisconsin State Federation of Labor, Milwaukee, Wisconsin.

Prof. G. L. Larson, College of Engineering University of Wisconsin, Madison, Wisconsin.

O. T. Nelson, Industrial Commission of Wisconsin, Madison, Wisconsin. (Secretary for Committee.)

Arthur Olsen, Wisconsin State Federation of Labor, Milwaukee, Wisconsin.

C. H. Randolph, Wisconsin Chapter, American Society of Heating and Ventilating Engineers, Milwaukee, Wisconsin. (Chairman.)

H. W. Schmidt, State Department of Public Instruction, Madison, Wisconsin.

Joseph Volk, Wisconsin Chapter, American Society of Heating and Ventilating Engineers, Milwaukee, Wisconsin.

Dr. W. A. Werrell, State Medical Society of Wisconsin, Madison, Wisconsin.

Consulting and advising with this committee were:

H. R. Cook, Wisconsin Chapter, American Society of Heating and Ventilating Engineers, Milwaukee, Wisconsin.

Chas. W. Miller, Wisconsin Chapter, American Society of Heating and Ventilating Engineers, Milwaukee, Wisconsin.

This Advisory Committee held nineteen meetings during the year 1935 in addition to personal investigations and consultation with outside authorities. The resulting revised code was submitted to the public in a hearing held at Milwaukee on February 6, 1936. After consideration of the criticisms and suggestions received at this public hearing, the revised orders now known as the Heating, Ventilation and Air Conditioning Code were submitted to the Industrial Commission with recommendation for adoption. These orders were adopted by the Commission on March 4, 1936 and became effective on April 11, 1936.

ADMINISTRATION

The Heating, Ventilation and Air Conditioning Code is enforced by the Industrial Commission in cooperation with local officials, who are required by law to enforce all orders of the commission which are germane to their respective duties (Wisconsin Statutes, Section 101.28).

APPEAL

Any person who considers any part of the Heating, Ventilation and Air Conditioning Code, or any interpretation of this code, to be unreasonable may appeal to the commission to modify or suspend the same (Wisconsin Statutes, Sections 101.15 to 101.17, inclusive).

PENALTY FOR VIOLATION OF AN ORDER

Section 101.18 of the Wisconsin Statutes provides that "every day during which any person, persons, corporation, or any officer, agent, or employe thereof, shall fail to observe and comply with any order of the commission, or to perform any duty enjoined by Sections 101.01 to 101.29, inclusive, shall constitute a separate and distinct violation of such order, or of said sections, as the case may be."

Section 101.28 of the Wisconsin Statutes provides that any employer or other person who violates an order, or fails or refuses to comply with the requirements of a legal order of the commission shall forfeit and pay into the state treasury the sum of not less than 10 dollars, nor more than 100 dollars, for such violation.

HEATING, VENTILATION and AIR CONDITIONING CODE

SECTION 1. SCOPE OF HEATING, VENTILATION AND AIR CONDITIONING CODE.

Order 5800. Scope of Code.

1. Public Buildings and Places of Employment.

The provisions of this code shall apply to all buildings used, or to be used, as places of employment or as public buildings, as defined by statutes.

Note. "Place of employment" is defined in Section 101.01 of the statutes as, "every place, whether indoors or out or underground and the premises appurtenant thereto where either temporary or permanently any industry, trade or business is carried on, or where any process or operation, directly or indirectly related to any industry, trade or business, is carried on, and where any person is directly or indirectly employed by another for direct or indirect gain or profit, but shall not include any place where persons are employed in private domestic service or agricultural pursuits which do not involve the use of mechanical power."

The term "public building" is defined as "any structure used in whole or in part as a place of resort, assemblage, lodging, trade, traffic, occupancy, or use by the public, or by three or more tenants."

(a) New Buildings. The provisions of this code shall apply to the heating, ventilation and air conditioning of all new buildings.

(b) Existing Buildings. The provisions of this code shall apply to all alterations or improvements, including the replacement of any major apparatus or device, in existing buildings, other than existing places of industrial employment.

Note. See General Orders on Dusts, Fumes, Vapors and Gases for requirements pertaining to existing places of industrial employment.

(c) Change in Use. The provisions of this code shall apply to every building, or portion of a building, devoted to new use for which the requirements under this code are in any way more stringent than the requirements covering the previous use.

SECTION 2. DEFINITIONS

Order 5810. Definitions.

1. *Air supply* is the supply and appropriate distribution of the air required for heating, ventilating and air conditioning.

2. *Ventilation* is the production and maintenance of atmospheric condi-

tions conducive to health and comfort indoors, without detrimental drafts, by means of inlets and outlets in conjunction with gravity or mechanical means of moving air.

3. A *ventilation system* is any combination of building construction, machinery, devices or equipment, so proportioned, arranged, installed, operated and maintained as to secure with normal operation the standard of ventilation required by this code.

4. *A heating system* is any combination of building construction, machinery, devices or equipment, so proportioned, arranged, installed, operated, and maintained as to produce and deliver in place the required amount and character of heating service.

5. A *gravity system of ventilation*, is any ventilation, the practical effectiveness of which depends wholly upon atmospheric conditions, such as relative density, temperature or wind motion.

6. A *mechanical system of ventilation* is any ventilation, exhaust or heating system, the effectiveness of which depends upon the operation of power-driven equipment.

7. An *exhaust system of ventilation* is any combination of building construction, machinery, devices or equipment, so proportioned, arranged, maintained and operated, that gases, dusts, fumes, vitiated air, or other materials injurious to health, are effectively withdrawn from the breathing zone of employes and frequenters and disposed of in a proper manner.

8. The term *air conditioning*, for the purpose of this code, shall mean the simultaneous control of temperature, humidity, distribution and purity of air.

9. *Outside air* is air that is taken from outside the building and is free from contamination of any kind in proportions detrimental to the health or comfort of the persons exposed to it.

10. The *outside air intake* includes the ducts and outdoor openings through which outside air is admitted to a ventilation, air conditioning or heating system.

11. A *duct* is any pipe, flue or channel used, or intended to be used, for the conveyance of air, gases or entrained materials pertaining to a heating, ventilation or air conditioning system. An underground duct is any duct wholly, or in part, below the surface of the ground adjacent to the duct.

12. An *inlet* is a duct terminal through which the air supply enters a room, and shall be understood to mean and include only those inlets which are definitely and specifically provided for such purposes.

13. An *outlet* is a duct entrance, or opening from a room, through which the air leaves the room, and shall be understood to mean and include those outlets which are definitely and specifically provided for such purposes.

14. *Outdoor openings* are those actual openings in outside walls of the area or room in question which are arranged and equipped in such manner as to be easily operated and accessible for manipulation.

15. The term *heating surface* applied to boilers, shall be understood to mean and include the total wetted area exposed to combustion of fuel or

in intimate contact with flowing combustion gases on one side and water on the other side.

16. The term *heating surface* applied to furnaces and jacketed stoves, shall be understood to mean and include only the total area of air supply surface exposed to combustion of fuel or in intimate contact with flowing combustion gases on one side and flowing air supply on the other side.

17. An *occupied area* is any room, area or enclosure, the normal use of which involves actual or intended occupancy by one or more persons.

18. The term *new building* used in this code shall be understood to mean and include buildings, additions thereto, and alterations thereof, for which complete plans have not been approved by the Industrial Commission, or construction is not in progress, prior to the effective date of this code.

19. The term *existing building* used in this code shall be understood to mean and include buildings, additions thereto, and alterations thereof, structurally completed, or for which complete plans have been approved by the Industrial Commission, or its authorized local representative, and construction is in progress, prior to the effective date of this code.

SECTION 3. GENERAL REQUIREMENTS

Order 5820. Plans, Specifications and Data.

1. Design and Preparation of Plans.

All plans and data for heating, ventilation and air conditioning, shall be designed and prepared by competent designers.

2. Approval of Plans and Specifications.

Complete plans, specifications and data sheets for heating, ventilation and air conditioning of all buildings and occupancies within the scope of this code shall be submitted to the Industrial Commission for approval. Approval shall be obtained before affected work is commenced and all work shall be executed according to the approved plans and specifications.

Exception. In cities where such plans are examined, and building permits are issued, in a manner approved by the Industrial Commission, this requirement does not apply.

3. Plans and Specifications Required in Duplicate.

All plans and specifications for heating, ventilation and air conditioning shall be submitted in duplicate.

Note. Extra copies of plans may be filed for approval stamp but they should accompany the duplicate plans.

4. Approval of Changes in Plans.

If, after having been approved by the Industrial Commission, building or heating and ventilation, or air conditioning plans or specifications are changed in any respect covered by this, or any other, code, such revised plans shall be submitted to the Industrial Commission for approval.

5. Approved Plans Kept at Building.

A complete set of approved plans and specifications showing identity of approval shall be kept at the building at all times.

6. Information Required on Plans and in Specifications.

The lines, data and information shown on plans for heating, ventilation and air conditioning systems submitted for approval shall be permanent, clear, legible and complete, and shall include all details and data necessary for review of installation, such as:

(a) Building; name, type, location, on each sheet.
(b) Owner; name, on each sheet.
(c) Architect; name, on title sheet.
(d) Engineer or Designer; name, on each sheet.
(e) North points on general plans.
(f) General plans, including attic and roof layouts.
(g) General plan dimensions and height of all rooms.
(h) Intended use of all rooms.
(i) Thickness of walls and type of construction.
(j) Thickness and type of insulation in walls, roofs, ceilings, floors, etc.
(k) Vertical sections and elevations necessary to show profiles of installation.
(l) Size and continuity of all ducts and flues.
(m) Location and type of all principal units of equipment.
(n) Chimney size, shape and height above primary grate of heater.
(o) Specifications shall be properly identified with and completely supplement the plans.

7. Data Required.

All plans or specifications submitted for approval shall be accompanied by data sheets giving the heat loss calculations in B. t. u. per hour calculated in accordance with the heat transmission factors of the current issue of the American Society of Heating and Ventilating Engineers' Guide, the amount of radiation calculated for each room on direct radiation installation, amount of air and delivery temperature calculated for each room for all heating, ventilation and air conditioning systems, amount of indirect radiation, and other data needed to judge the capacity and performance of an installation. There shall also be furnished a statement of sizes and ratings of boilers, furnaces and other heaters, fans and all other equipment.

Note. Heat loss calculations may be based on the standards of the Heating, Piping and Air Conditioning Contractors National Association, or the Standard Code of the National Warm Air Heating and Air Conditioning Association. However, in all cases the total heat loss calculations shall be shown in B.t.u.

8. Fundamental Data Required.

Fundamental date pertaining to design and operation of equipment shall be filed for approval with the Industrial Commission by manufacturers before such equipment is installed or used.

Order 5821. Accident Prevention and Fire Protection.

1. Guards.

All mechanical apparatus shall be guarded in compliance with General Orders on Safety issued by the Industrial Commission.

2. Fire Protection.

All installations under this code shall comply with the precautionary requirements of the Industrial Commission to reduce fire hazards.

Note. The following are references to the Building Code and Electrical Code which contain general safety and fire protection requirements:
Masonry Chimneys, Construction. Order 5210.
Metallic Chimneys, Construction. Order 5211.
Smoke Pipes. Order 5212.
Ducts, General Construction. Order 5214.
Heaters, Fire Protection. Orders 5216, 5217.
Boiler and Furnace Rooms. Orders 5413, 5529, 5615, 5720, 5750.
Steam Piping, Fire Protection. Order 5213.
Grounding of Machinery. Section 103 of State Electrical Code.

Order 5822. Design.

1. Adequacy.

All heating, ventilation and air conditioning installations shall be designed and installed to provide the service and results required by this code.

2. Capacity and Arrangement.

The calculated capacity and the arrangement of all installations for required heating, ventilation and air conditioning shall be based upon simultaneous service to all parts of the building, unless otherwise provided in this code.

3. Basis for Heating Calculations.

In the accompanying map, the state has been divided into three zones of coldest weather temperatures recorded for included localities by the U. S. Weather Bureau during a ten year period. Maximum heat losses for a heating system shall be calculated on the basis of cold weather temperature not more than 10 degrees Fahrenheit warmer than the zone average of the zone in which the installation is located.

4. Provision for Cleanliness.

All parts of installations and equipment which house or handle air used for ventilation purposes shall be designed so as to facilitate sanitary maintenance thereof.

Order 5823. Air Supply.

1. Uncontaminated Source.

The outside air shall be taken from a relatively uncontaminated source outside of the building.

2. Maximum Inlet Temperature.

The calculated room inlet temperature of air used for heating and ventilation purposes shall not exceed 120 degrees Fahrenheit unless approved in writing by the Industrial Commission.

MAP OF WISCONSIN SHOWING COLDEST TEMPERATURE ZONES

ZONE AVERAGE OF COLDEST TEMPERATURE RECORDED FOR EACH ZONE ARE AS FOLLOWS:

ZONE 1 ..... 42° BELOW ZERO F.
ZONE 2 ..... 34° BELOW ZERO F.
ZONE 3 ..... 21° BELOW ZERO F.

3. Control.

Adequate control of temperature and other conditions and effects of heating, ventilation, and air conditioning, shall be provided and maintained and operated for all heating, ventilation and air conditioning systems.

Note. See order 5841 for requirements pertaining to the installation of automatic controls.

4. Air Quantity.

The quantity of air used to ventilate the given space during occupancy shall always be sufficient to maintain the standards of air temperature, air quality, air motion and air distribution as herein required. Not less than 10 cubic feet per minute per occupant of the total air circulated to meet these requirements shall be taken from an outdoor source. Systems employing thermal control to admit at least 75 per cent outside air for the purpose of temperature reduction may supply a minimum of 7.5 cubic feet per minute of outside air per occupant.

Order 5824. Heating, Ventilation and Exhaust Systems—General.

1. Heating Systems Required.

Adequate and appropriate heating systems shall be provided, maintained and operated for all occupied areas within the scope of this code. The following winter inside dry bulb temperatures shall be considered as a minimum.

Type of Building	Deg. Fahr.	Type of Building	Deg. Fahr.
Schools—		Theatres—	
Class Rooms	70–72	Seating Space	68–72
Assembly Rooms	68–72	Lounge Rooms	68–72
Gymnasiums	55–65	Toilets	68
Toilet Rooms	65		
Wardrobe and Locker Rooms	65–68	Hotels—	
Kitchens	66	Bedrooms and Baths	70
Dining and Lunch Rooms	65–70	Dining Rooms	70
Playrooms	60–65	Kitchens and Laundries	66
Natatoriums and Bath Rooms	75	Ballrooms	65–68
		Toilets and Service Rooms	68
Hospitals—		Apartments	70–72
Private Rooms	70–72	Offices	68–72
Private Rooms (Surgical)	70–80	Stores	65–68
Operating Rooms	70–95	Factories and Machine Shops	60–70
Wards	68	Foundries and Boiler Shops	50–60
Kitchens and Laundries	66		
Toilets	68		
Bath Rooms	70–80		

Note. The most comfortable dry bulb temperature to be maintained depends on the relative humidity and air motion. These three factors considered together constitute what is termed the effective temperature.

2. Ventilation Systems Required.

Ventilation systems shall be provided, maintained and operated to accomplish required ventilation service for all occupied areas within the scope of this code.

Note. For requirements pertaining to all places of employment or occupancy where smoke, gas, dust, fumes, steam, vapor, industrial poisons, or other detrimental materials, are used, stored, handled or are present in the air in sufficient quantities to obstruct the vision, or to be irritating, or to be injurious to the health, safety or welfare of the employes or frequenters, see the General Orders on Dusts, Fumes, Vapors and Gases issued by the Industrial Commission.

3. Gravity Direct-Indirect Systems, Prohibited.

Gravity direct-indirect systems shall not be considered permissible for installation under this code.

Note. This clause is intended to prohibit the use of so-called direct-indirect radiators whereby the room air supply is supposed to be admitted directly from the outside to the base, and to be delivered at the top, of direct radiators placed in the rooms to be served, without mechanical assistance.

4. Exhaust Systems Required.

Exhaust systems shall be provided, maintained and operated for all occupied areas where machines, vats, tanks, furnaces, forges, salamanders, and any other equipment and processes in such areas produce or throw off dust or particles sufficiently light to float in the air, or which emit heat, odors, fumes, spray, gas or smoke, in such quantities as to be irritating or injurious to the health.

See the General Orders on Dusts, Fumes, Vapors and Gases issued by the Industrial Commission for requirements covering these systems.

5. Exhaust Systems, Clean Discharge.

Exhaust systems shall include adequate dust collectors, air washers, or other machines, contrivances or methods, whereby the discharge from the systems will be prevented from contaminating the breathing zone inside the building, or becoming a nuisance or hazard either inside or outside the building.

See the General Orders on Dusts, Fumes, Vapors and Gases issued by the Industrial Commission.

6. Tempered Air Supply for Exhaust Systems.

Where ventilation is secured by exhaust methods the air which enters to replace that exhausted from the room shall be appropriately tempered.

Note. Taking air out of a room is only part of the service required. This code requires that air exhausted from a room shall be replaced with an adequate supply of air properly warmed or treated before it is admitted to the room served.

7. No Contamination of Adjacent Area.

All equipment and systems service rooms which house sources of odors, fumes, noxious gases, smoke, steam, dust, spray, or other contamination, shall be such as to prevent spreading of any such contamination to any other occupied parts of the building.

8. Final Test Required.

The performance of every heating, ventilation and air conditioning system shall be tested and balanced in place for compliance with the requirements of this code before being turned over to the owner.

Order 5825. Maintenance and Operation.

1. Maintenance.

All heating, ventilation, exhaust and air conditioning systems shall be maintained in good working order and shall be kept clean and sanitary.

2. Operation.

All heating, ventilation and exhaust systems shall be operated in accordance with the requirements of this code during all periods of occupancy.

3. Instructions.

Contractors shall thoroughly instruct the operators of heating, ventilation and air conditioning systems before leaving the job and shall post in a conspicuous place, printed instructions for the efficient and practical operation of the system and equipment.

SECTION 4. GENERAL REQUIREMENTS FOR CLASSIFIED OCCUPANCIES AND AREAS

Order 5840. Occupancy Classification.

The various occupancies to which the provisions of this code apply shall be classified as follows:

A. Require ventilation on an occupancy basis.

B. Require ventilation on an occupancy basis unless otherwise exempted.

C. Require exhaust.

D. Require ventilation on the basis of floor area.

E. Require tempered air supply only.

Note. By "ventilation" is meant a combination of supply and exhaust. See "Definitions," order 5810.

The following table indicates the individual classifications of occupancies within the scope of this code, together with the method to be used in establishing the number of persons for which ventilation is to be provided.

Use or Occupancy	Classification	Basis of Capacity
Arenas and Field Houses	A	4 sq. ft. per person. Use seated areas only.
Armories	A	Depends on usage.
Assembly Halls	A	6 sq. ft. per person.
Asylums	A	Depends on usage.
Banquet Halls	A	15 sq. ft. per person.
Bath and Shower Rooms	C	
Barber Shops	B	40 sq. ft. per person.
Beauty Parlors	B	20 sq. ft. per person.
Billiard Rooms	A	15 sq. ft. per person.
Bowling Alleys	A	Seating capacity plus 6 persons per alley.
Brokerage Board Rooms	A	6 sq. ft. per person.
Cafeterias	A	15 sq. ft. per person.
Churches and other places of worship	B	6 sq. ft. per person.
Club Rooms	A & B	Depends on usage.
Dance Halls	A	15 sq. ft. per person.
Dining Rooms	A	15 sq. ft. per person.
Dormitories	B	40 sq. ft. per person.
Factories and Machine Shops	B	See General Orders on Dusts, Fumes, Vapors and Gases.
Foundries and Boiler Shops	B	See General Orders on Dusts, Fumes, Vapors and Gases.
Funeral Homes, Public Rooms	B	6 sq. ft. per person.
Garages	D	
General Offices	B	75 sq. ft. per person.
Gymnasiums	A	6 sq. ft. per person for seated space. 15 sq. ft. for space not seated.
Hospitals	A & B	Depends on usage.
Kitchens	C	
Laboratories	A & C	25 sq. ft. per person. (See General Orders on Dusts, Fumes, Vapors and Gases.)
Laundries	C	See General Orders on Dusts Fumes, Vapors and Gases.
Lecture Halls	A	6 sq. ft. per person.
Library Reading Rooms	A	20 sq. ft. per person.
Library Stack Rooms	C	
Locker Rooms	E	
Lodge Halls	A	6 sq. ft. per person for seated space. 15 sq. ft. per person for space not seated.
Motion Picture Booths	C	See Building Code.
Penal Institutions	A	Depends on usage.
Places of Employment, General	B	Depends on usage.
Playrooms	A	18 sq. ft. per person.
Printing Establishments	B	See General Orders on Dusts, Fumes, Vapors and Gases.
Restaurants	A	15 sq. ft. per person.
Retail Establishments and Shops	B	Basement—20 sq. ft. per person.
(a) Department stores and similar occupancies		1st flr.—30 sq. ft. per person. 2nd. flr. and above—60 sq. ft. per person.

Use or Occupancy	Classification	Basis of Capacity
(b) Shops and other retail establishments		Basement—40 sq. ft. per person. 1st. flr. and above—60 sq. ft. per person.
Safety Deposit Vaults		See Places of Employment.
School Auditoriums	A	6 sq. ft. per person.
School Class Rooms	A	18 sq. ft. per person.
School Lecture Rooms	A	6 sq. ft. per person.
School Project Rooms	A	18 sq. ft. per person.
School Study Rooms	A	16 sq. ft. per person.
Skating Rinks	A	15 sq. ft. per person.
Swimming Pools	C	
Taverns	B	20 sq. ft. per person.
Tenement or Apartment Houses Kitchens and Toilets (Two or more families)	C	See Building Code.
Theatres	A	6 sq. ft. per person.
Theatre Lobbies	A	6 sq. ft. per person.
Theatre Lounge Rooms	A	15 sq. ft. per person.
Toilet Rooms	C	See Building Code.
Vocational Instruction and Research	A & C	40 sq. ft. per person. See General Orders on Dusts, Fumes, Vapors and Gases.
Wardrobes, Lockers and Cloak Rooms	C	

Order 5841. General Requirements for Occupancies Under A and B Classifications.

1. Scope.

These requirements shall apply to all occupancies listed under Classifications A and B in order 5840 unless otherwise exempted herein.

2. Air Movement.

The total primary air circulation for all occupancies in this classification shall not be less than 30 cubic feet per minute per occupant, or 6 air changes per hour. The larger of these quantities to govern. See order 5840 for method to be used in determination of capacity.

3. Outside Air Supply.

The outside air supply during occupancy shall be not less than 10 cubic feet per minute per occupant except as noted in paragraph (4) of order 5823, or otherwise exempted in this code.

4. Air Distribution.

All air inlets shall be so located, arranged or equipped as to provide proper distribution of air and to eliminate drafty conditions within the occupied space. Floor registers or grilles are not permitted under any conditions.

5. Mechanical Supply Systems.

Mechanical installations are permitted in all occupancies under these classifications.

6. Gravity Supply Systems.

Gravity installations are not permitted in arenas, armories, laboratories, skating rinks and theatre auditoriums, lobbies and lounges.

7. Inlet and Outlet Locations.

The locations of all room inlets and outlets as well as the locations of the outside air supply are required to be definitely shown on all plans.

8. Temperature Control.

Automatic temperature control shall be provided for all arenas, armories, assembly halls, banquet halls, gymnasiums, laboratories, lecture halls, library reading and stack rooms, school auditoriums, class, lecture, project and study rooms, swimming pools, theatre auditoriums, lobbies and lounges and vocational instruction rooms.

9. Air Cleansing Devices.

Approved air cleansing devices shall be installed in connection with all mechanical heating and ventilation systems, except in garage occupancies. This requirement applies to both outside and recirculated air.

10. Recirculation.

No air contaminated by other than human occupancy shall be used for general recirculation.

Order 5842. Places of Assembly.

1. Scope.

This classification shall be understood to include all occupancies such as arenas, armories, assembly halls, banquet halls, billiard rooms, bowling alleys, cafeterias, club rooms (for gatherings), dance halls, dining rooms, gymnasiums, lecture halls, lodge halls, playrooms, restaurants, school auditoriums, skating rinks and theatres, where persons gather for entertainment, instruction or dining purposes.

2. Air Movement, Supply and Distribution.

The air movement, supply and distribution for all occupancies under this classification shall conform to the requirements of order 5841, except that for auditoriums, gymnasiums and similar occupancies having a ceiling height in excess of 20 feet, the air supply shall be based on 6 air changes per hour; and except further, that for theatres having a ceiling height in excess of 20 feet the total air supply shall be not less than 20 cubic feet per minute per occupant.

3. Stages.

The stage in any theatre or assembly hall, for which a fire curtain is required, shall be supplied with sufficient air to equalize the air pressure thereat so as to avoid deflecting the curtain.

4. Playrooms—Rural Schools.

Occupancies in this classification where used exclusively as pupils' playrooms need only be provided with a positive exhaust directly from the occupied area.

5. Alternate Service and Capacity.

Heating and ventilation systems installed in so-called community buildings may be arranged for selective delivery of the entire service to either the first floor areas or to the basement floor areas, if approved in writing by the Industrial Commission.

Order 5843. Motion Picture Booths.

1. Scope.

This classification shall be understood to include all motion picture booths other than portable booths.

2. Exhaust Ventilation.

Fumes, gases and other harmful contamination shall be effectively removed by mechanical exhaust ventilation directly from their source, including projectors, spotlights, stereopticons and similar equipment, and discharged to the outside air or to an approved disposal system. A single exhaust system, including the exhaust unit and connecting ducts, shall be arranged to serve all the sources of harmful contamination in a booth or area, and there shall not be more than one exhaust system in such booth or area. The pressure in the ducts within 12 inches of the exhaust hood shall be not less than 2 inches of water, as measured by a U-tube or equivalent device.

3. Air Supply.

In every booth or room which is required to have mechanical exhaust ventilation, provision shall be made for a supply of fresh tempered air to replace the vitiated air exhausted. The supply of air to a booth or room shall be accomplished in one of, or by a combination of, the following methods:

(a) The ventilation system for the building may be arranged to supply air for the booth or room if the inlet opening is protected with an approved shutter having quick acting fusible links, or other approved heat release devices, which will automatically and quickly close the inlet opening simultaneously with the openings in the front of the booth.

(b) A separate supply system, such as a unit ventilator, if the equipment is arranged so that the air supply will be stopped automatically and simultaneously with the closing of the openings in the front of the booth.

(c) Gravity intake, from a source of outside air, arranged so that the air will be properly tempered before it reaches the booth or room.

(d) Where approved in writing by the Industrial Commission, the air may be taken through openings in the booth walls, from the auditorium or other space adjoining the booth.

Note. For relief outlets in addition to exhaust ventilation, see order 5545 of the Building Code issued by the Industrial Commission.

Order 5844. Places of Assembly for Worship.

1. Scope.

This classification shall be understood to mean and include auditoriums, social assembly rooms, Sunday school rooms, and similar areas which are contained in churches or houses of worship. It shall also include chapels used in connection with funeral homes, as well as those in parochial schools, convents and similar occupancies.

2. Air Movement, Supply and Distribution.

The air movement, supply and distribution for all occupancies under this classification shall conform to the requirements of order 5841, except that no ventilation will be required where the total window sash area is more than 10 per cent of the floor area and the total outdoor openings there through are more than 2 per cent of the floor area of the occupancy to be served, except that for funeral homes the required window opening shall be more than 5 per cent of the floor area. Where such ventilation is not required, the window area and outdoor openings shall preferably be all above grade. No window or outdoor opening below grade will be considered unless there is a clear space outside of the windows having a width of at least 1½ times the distance below grade at the bottom of the window.

Note. By width is meant the horizontal distance measured at right angles to the plane of the window.

3. Alternate Service and Capacity.

Heating and ventilation systems installed in occupied areas of this class may be arranged for selective delivery of the entire service to either the auditorium floor area or to the basement floor area.

Order 5845. Schools.

1. Scope.

This classification shall be understood to include class, recitation, study, lecture and project rooms in all school and college buildings, and similar areas used for educational purposes, as well as all library reading rooms. (See also order 5842.)

2. Air Movement and Supply.

The air movement and supply for all occupancies under this classification shall conform to the requirements of order 5841. For corridors and halls used in conjunction with occupied areas of this class, the air supply shall not be less than 10 cubic feet per minute per lineal foot of corridor of hall.

3. Alternate Service and Capacity.

The capacity of heating and ventilation systems installed in school buildings having not more than 2 class rooms, may be based upon service to class room floors only; provided that where basement apparatus is used, appropriate arrangement shall be made for alternate service to basement areas if used for occupancy.

Order 5846. Places for Vocational Instruction and Research.

1. Scope.

This classification shall be understood to include all places for vocational instruction and research, such as laboratories, school shops, domestic science rooms and similar occupied areas.

2. Air Movement and Supply.

The air movement and supply for all occupancies under this classification shall conform to the requirements of order 5841.

3. Special Ventilation.

Exhaust ventilation shall be provided in connection with all equipment and processes which create any dusts, fumes, vapors or gases which may be injurious to the health of any frequenter exposed thereto. This exhaust ventilation shall be installed in accordance with the requirements of the General Orders on Dusts, Fumes, Vapors and Gases, issued by the Industrial Commission.

4. Separate Exhaust Systems.

Exhaust systems serving this class of occupied areas shall be separate from, and independent of, all other services and systems in the building.

Order 5847. Wardrobes and Locker Rooms.

1. Scope.

This classification shall be understood to include all wardrobe, cloak rooms, lockers, locker rooms and similar areas in all buildings within the scope of this code, except as noted herein.

2. Ventilation Required.

Ventilation shall be provided and maintained for all areas of this class. Wherever practicable, such ventilation shall be accomplished by exhaust methods, and in any case the effectiveness of the outlets shall be greater than that of the inlets.

3. Minimum Air Movement.

The air movement provided and maintained for areas of this class shall be not less than 2 cubic feet per minute per square foot of floor area.

4. Combination Rooms.

Air movement of not less than 5 cubic feet per minute per locker or individual hanger space, in addition to the air supply required for use as halls or corridors, shall be provided for all halls and corridors containing lockers for clothing. Inlets and outlets shall be provided and maintained for such areas, and the effectiveness of the outlets shall be greater than that of the inlets.

5. Wardrobes and Cloak Rooms in School Buildings.

Where necessary in order to insure practical results in wardrobes or cloak rooms adjacent to or connected with occupied areas covered by

order 5845, the required ventilation shall be accomplished by use of inlets admitting air from adjacent class rooms, or corridors, or similar areas, in conjunction with outlets and ducts discharging direct to outside atmosphere. The movement of air in such areas shall be such as to promote thorough aeration of clothing therein.

6. Locker Rooms in Conjunction With Bath and Swimming Rooms.

Occupancies in this classification are required to have a positive tempered air supply only, exhausting through the adjoining bath, shower or swimming room.

Order 5848. Toilet, Bath and Swimming Rooms.

1. Scope.

This classification shall be understood to include all toilet, bath and swimming pool rooms, and other similar occupied areas, in all buildings within the scope of this code.

2. Ventilation Required.

Ventilation shall be provided and maintained for all areas of this class. Such ventilation shall be accomplished by exhaust methods with the effectiveness of the outlets greater than that of the inlets. For all swimming pool rooms and for multiple toilet and bath installations, mechanical exhaust shall be provided.

3. Minimum Air Movement.

The air movement provided and maintained in occupied areas of this class shall be not less than 2 cubic feet per minute per square foot of floor area.

4. Separate Exhaust Systems.

Exhaust systems serving this class of occupied areas shall be separate from, and independent of, all other services and systems in the building except in places of industrial employment.

Note. See orders 5250 to 5262, inclusive, of the Building Code, issued by the Industrial Commission.

Order 5849. Kitchens.

1. Scope.

This classification shall be understood to include all occupied areas housing the cooking of food in all buildings within the scope of this code, except those classified under vocational instruction.

2. Exhaust Ventilation Required.

Exhaust ventilation shall be provided and maintained for every occupied area of this class.

3. Minimum Air Movement.

The air movement provided and maintained for areas of this class shall not be less than 4 cubic feet per minute per square foot of floor area.

4. Hoods.

Where single hoods are provided for kitchen exhaust, the velocity of air motion over the face area of the hood shall not be less than 100 feet per minute. For double hoods, the velocity over the area between the inner and outer hoods shall not be less than 250 feet per minute, using a 4 inch width of opening as a basis.

5. Separate Exhaust Systems.

Exhaust systems serving areas of this classification shall be separate from, and independent of, all other services and systems in the building.

Order 5850. General Offices.

1. Scope.

This classification shall be understood to include all offices and similar occupied areas, other than private offices, wherein the air conditions and nature of occupancy do not involve reasonable inclusion in any other classification in this code.

2. Air Movement, Supply and Distribution.

The air movement, supply and distribution for all occupancies under this classification shall conform to the requirements of order 5841:

(A) Where the total window sash area is less than 6 per cent of the floor area, or the total areas of outdoor opening is less than 3 per cent of the floor area; or

(B) Where the available floor area is less than 75 square feet for each normal occupant; or

(C) Where heat or odors would otherwise be present in sufficient quantities to be injurious to the health, safety or welfare of the employes and frequenters.

Order 5851. Retail Establishments.

1. Scope.

This classification shall be understood to include barber shops, beauty parlors, brokerage board rooms, taverns and all retail establishments where goods and commodities are bought and sold.

2. Air Movement, Supply and Distribution.

The air movement, supply and distribution for all occupancies under this classification shall conform to the requirements of order 5841 unless the aggregate of outdoor openings is more than 3 per cent of the floor area served, provided such outdoor openings are arranged so as to cause air circulation throughout the respective rooms.

Order 5852. Garages.

1. Scope.

This classification shall be understood to include all repair garages, and also all storage garages housing 6 or more vehicles driven by inter-

nal combustion engines, except that a building housing vehicles which do not contain volatile inflammable liquid need not be included in this classification.

2. Ventilation Required.

Ventilation shall be provided and maintained for all occupied areas in this class.

3. Live Storage Areas.

All areas providing live storage for such motor-driven vehicles shall be provided with not less than ¾ cubic feet per minute of outside air supply per square foot of floor area.

4. Repair Areas.

All areas in which repairing of motor-driven vehicles is customarily done shall be supplied with not less than 1½ cubic feet per minute of outside air per square foot of floor area. All such areas shall also be provided with sufficient flexible hose connections to provide for the full capacity of the vehicles in the repair area. Hoses shall be provided with suitable devices for connecting to exhaust pipes, shall be provided with shut-off valves which may be closed when not in use, and shall be conducted to approved pipe stacks which shall extend to the outside air.

Note. In addition to these requirements it is recommended that all repair areas be provided with exhaust fans for flushing purposes having a minimum capacity of 5000 cubic feet of air per minute for the first 2 car capacity in repair areas plus 1000 cubic feet per minute for each additional car capacity.

No basement or sub-basement garage shall be used for repairing of any kind nor for the storage of volatile inflammable liquids, except as provided in orders 816 and 818 of the Flammable Liquids Code issued by the Industrial Commission.

In buildings or rooms isolated from the rest of the building in an approved manner, where accessories are applied, upholstering done, or similar work not involving engines is being done, the provisions of order 5853 shall apply. Provided, however, that where windows are available in at least two outside walls with openings there through equal to at least 5 per cent of the floor area, that such ventilation will not be required.

5. General Requirements.

Where showrooms or offices are located adjacent to repair or storage areas, a part of the positive air supply shall be introduced through the showroom or office. Vent outlets shall not be placed in such showrooms or offices.

The products of combustions from vapors or gases from fuel or batteries shall be removed promptly and effectively from the breathing zone of employes and frequenters. There shall be at all times not less than 10,000 cubic feet of fresh air for each cubic foot of carbon monoxide in such breathing zones.

For ventilation where spray coating is done, see General Orders on Spray Coating issued by the Industrial Commission.

Order 5853. Places of Employment.

1. Scope.

This classification shall be understood to include all places of employment not classified elsewhere in this code.

2. Air Movement, Supply and Distribution.

The air movement, supply and distribution for all occupied areas under this classification shall conform to the requirements of order 5841:

(A) Where the available floor space is less than 75 square feet per normal occupant; or

(B) Where heat, smoke, gas, dust, spray, fumes, vapor, steam, or other contamination would otherwise be present in the air in sufficient quantities to obstruct the vision, or to be irritating or injurious to the health, safety or welfare of employes and frequenters; or

(C) Where industrial poisons are to be used, stored, or handled, or would otherwise be present in the breathing zone.

3. Special Exhaust Systems Required.

Special exhaust systems shall be provided and operated at all sources of harmful contamination in occupied areas of this class as required by the General Orders on Dusts, Fumes, Vapors and Gases, issued by the Industrial Commission.

Order 5854. Dormitories and Wards.

1. Scope.

This classification shall be understood to include rooms in hospitals, asylums, dormitory buildings and similar occupancies, equipped with more than two beds.

2. Air Movement, Supply and Distribution.

The air movement, supply and distribution for all occupancies under this classification shall conform to the requirements of order 5841 unless the window sash area is more than 10 per cent of the floor area and the outdoor opening there through is more than 5 per cent of the floor area. Where an outside air supply is not required the window area and outdoor opening shall preferably be all above grade. No window or outdoor opening below grade will be considered unless there is a clear space outside of the windows having a width of at least 1½ times the distance below grade at the bottom of the window.

Note. By width is meant the horizontal distance measured at right angles to the plane of the window.

Order 5855. Penal Institutions and Places of Detention.

1. Scope.

This classification shall be understood to mean and include areas of compulsory occupancy, corridors and stair halls, in penal institutions, asylums and places of detention.

2. Air Movement, Supply and Distribution.

The air movement, supply and distribution for all occupancies under this classification shall be accomplished by mechanical means and shall conform to the requirements of order 5841. In general, exhaust ventilation shall be through the corridors.

3. Overnight Lock-ups.

Where cells are provided for not more than 6 occupants for purposes of overnight detention only, ventilation will be accepted without a tempered fresh air supply, providing the window sash area direct to the cells is equal to, or greater than, 10 per cent of the floor area.

SECTION 5. HEATING AND VENTILATION EQUIPMENT.

Order 5860. Outside Air Intakes.

1. Location.

All outside air intakes shall be located as far as possible from chimneys and vent outlets, but this distance shall in no case be less than 20 feet. Fresh air intakes for all gravity heating systems and all gravity ventilation systems shall be located on the side, or sides, of the building exposed to the prevailing winds.

2. Height Above Grade.

All outside air intakes shall be located not less than 2 feet above the outside grade and above roofs and similar areas.

3. Screens.

All outside air intakes shall be suitably screened.

4. Weather Protection.

All outside air intakes shall be suitably protected against weather and water.

5. Accessibility and Cleanliness.

All outside air intakes shall be made and maintained easily accessible for cleaning, and shall be kept clean and sanitary in use throughout the circuit to the heater.

6. Size and Opening for Intakes.

Consult order 5869 for allowable velocities to be used in the design of outside air intakes.

Order 5861. Air Purification Apparatus.

1. General.

The construction, design and control of all air purification apparatus shall be such as to insure consistent maintenance and operation.

2. Air Washers.

Dirty water shall not be recirculated through sprays affecting air used for ventilation purposes, and not less than 20 per cent of air washer water used shall be renewed during each day of operation exclusive of make-up water; and the reservoir shall be emptied and thoroughly cleaned and refilled with fresh water after each week of operation.

Order 5862. Heaters.

1. Arrangement.

Where more than one heater is required, or provided, for service to the same piping or duct system, or group of systems, they shall be set in battery form and shall be cross connected so that any one may be used alone, or any combination of them may be used simultaneously.

Order 5863. Boilers.

1. General.

The construction, equipment, connections, etc., of all boilers installed hereunder shall comply in every way with the Boiler Code issued by the Industrial Commission.

2. Rating.

All low pressure heating boilers shall be of capacities as required by the American Society of Heating and Ventilating Engineers' Boiler Code, or the Net Load Recommendations for Heating Boilers as issued by the Heating, Piping and Air Conditioning Contractors' National Association.

Order 5864. Furnaces.

1. Fan-Furnace Installations.

Draw through fans, except auxiliary fans, are not permitted in connection with any fan-furnace installation.

2. Gravity Systems.

All furnaces shall be located so that the air supply circuits leading to and from them will be as short and direct as practicable. The outside air inlets to furnace air-ways shall be such as will insure distribution of air to relatively unheated portions of the furnace proper and throughout the furnace air-ways. The top of such inlets shall not be higher than 2 inches below the top of the grates.

Order 5865. Jacketed Stoves.

1. Where Permitted.

The installation of jacketed stoves or cabinet heaters shall be considered permissible for schools having no basement or sub-floor heater spaces; also for portable schools and for other areas having a gross floor area not greater than 1200 square feet, and for temporary installations elsewhere, provided written permission for the latter is granted by the Industrial Commission.

2. Location.

All jacketed stoves and heaters shall be located in that portion of the schoolroom most exposed to cold weather, usually the northwest portion. They shall be set well clear of any obstruction which may prevent the free and rapid distribution and circulation of heat and air.

3. Shields.

The casings or shields of jacketed stoves or heaters shall be constructed so as to shield adjacent occupants from undue radiant heat. The clear air space between shield and stove shall average 6 inches and the shields themselves are to extend well above and below all heat radiation surfaces of stoves, but in no case more than 12 inches clear of the floor.

4. Outside Air Intake.

(a) Every jacketed stove or heater shall have an outside air intake. The outside wall opening shall be properly and adequately protected from the weather and screened. The intake duct shall be joined to the heater casing and air-way to prevent cold air from spreading over the floor, and to insure proper contact of the air with heater surfaces. Under-floor ducts are not permitted.

(b) The area of the outside air duct shall not be less than 0.25 square inches per square foot of floor area.

5. Vents.

(a) Vent outlets in rooms served by jacketed stoves and heaters shall be located at the floor line and not less than 6 feet from the heater casing.

(b) The area of auxiliary metal vent flues used in connection with smoke pipes shall not be less than 150 square inches.

(c) Where suitable and effective devices for mixing smoke and vented air are used, the smoke flue and outlet duct may be combined, provided that the free area of the vent duct shall not be less than 144 square inches.

Order 5866. Stack Heaters.

1. Minimum Grate Area.

The grate areas of stack heaters shall be not less than 30 square inches for each 1000 cubic feet per minute air supply required for the rooms served, but in no case less than 50 square inches.

2. Location in Flue.

Stack heaters shall be located so that the vertical center lines of heaters and flues will coincide, wherever possible.

3. Diaphragm Required.

Where a single stack heater serves two or more vent circuits, the circuits shall be kept separate up to a point not less than 4 feet above the stack heater, such as by a tight diaphragm.

4. Accessibility.

Stack heaters shall be arranged conveniently accessible from the furnace firing space.

Order 5867. Chimneys.

1. Height and Effective Area.

Chimneys and smoke flues shall be of ample effective area and height for the calculated maximum duty, and shall include sufficient additional height to compensate for:

(A) horizontal length of breeching or smoke pipe;

(B) extra internal resistance of heater, or economizer;

(C) smoke flue heat losses, where smoke flues are used for aspirating effect in vent flues;

(D) such further heights as may be necessary to extend above high point of building served and as much higher as may be necessary to attain free wind action at top.

Note. Recommended actual sizes and heights of chimneys for hand firing are listed in the following table. For rectangular chimney areas divide circular area by 0.80. In rectangular chimneys the long side of cross section should not be greater than 1.5 times the short side.

Size Diam. In.	Height, Feet	Bldg. Loss B.t.u. per Hr.
10	30	115,000
12	35	192,000
16	40	384,000
18	45	460,000
20	50	614,000
22	55	864,000
22	60	1,000,000
24	55	1,152,000
24	60	1,228,000
26	65	1,574,000
28	65	1,844,000
30	70	2,304,000
32	70	3,072,000
34	80	3,648,000
34	90	4,032,000
38	90	5,000,000
40	100	6,528,000

For direct fired warm air furnaces the chimney capacity above may be reduced 20 per cent.

Chimney heights are measured from primary grate level.

Chimney sizes for oil, stoker and gas firing, also for sizes other than listed shall be in accordance with accepted standards.

Breeching Details. Smoke pipes should preferably slope upward at least one inch per foot and should be made of not less than 16 gauge metal full

size of total smoke collar areas connected thereto, with 20 per cent excess area for smoke pipes or breeching more than 10 feet long.

Chimney Height Allowances for Breeching Resistance. To offset friction and draft losses in smoke pipes or breechings, the normal chimney heights should be increased one foot for each 5 feet length of horizontal smoke pipe in excess of 10 feet, and 5 feet of chimney height for each 90 degree turn, horizontal or vertical, in smoke pipe or breeching between heater smoke collar and the chimney, but not including the turn where smoke pipe enters the chimney. These figures are intended for smoke pipe 20 per cent larger than the required area of chimney. If the smoke pipe is made equal to the required area of chimney, the foregoing figures should be increased 20 per cent.

2. Smooth Inside.

Chimneys shall be constructed substantially, true and plumb, and shall be tight and smooth inside.

Note. See also order 5210 of the Building Code, issued by the Industrial Commission, for general construction requirements.

3. Smoke Flues in Vent Flues.

All smoke flues used for the purpose of aspirating effect in vent flues, shall be securely stayed and supported at the centers of the vent flues, shall be made tight at all joints and shall extend not less than 8 inches above the vent flue. Where such flues are 12 inches or less in diameter, they shall be made of substantial cast iron. Where such flues are more than 12 inches in diameter they may be constructed of steel plate not less than 14 gauge in thickness.

4. Clean-Outs.

All chimneys and flues shall be provided with substantial and adequate clean-out doors and frames readily accessible, and tight when closed.

Order 5868. Fans and Blowers.

1. Type and Capacity.

All fans and blowers shall be of appropriate type and size and shall be selected on a basis of performance against the resistance of the system as installed. All fans shall be rated in accordance with the latest standard test requirements for fans and blowers as adopted by the American Society of Heating and Ventilating Engineers.

2. Quiet Operation.

Fans and blowers installed in buildings where noisy operation would be objectionable, shall be located and set, and shall be of such type and outlet velocity in practical use, that reasonably quiet operation is assured.

Note. This order will be understood to prohibit the use of unit heaters and other equipment with a similar degree of noise in occupied areas where such noise would be objectionable.

3. Engine Out of Air-Ways.

Exposed engines and similar motive power and apparatus, except electric motors in self-contained ventilating units, shall be kept out of

air-ways. Electric motors for fan drives may be located in air-ways if placed in rooms or spaces approved by the Industrial Commission.

Note. All bearings should be kept out of fresh air-ways whenever possible. Where this is impossible, provision should be made for outside oiling and for access to the bearings for inspection.

4. Gravity By-Pass for Fan-Furnace Installation.

Furnace installations not equipped with automatic fan control from bonnet temperature shall be equipped with automatic gravity by-passes so that adequate air supply to furnaces will be assured when fans are not in operation.

Order 5869. Ducts.

1. Design.

All ducts shall be designed to promote the unrestricted flow of air, with long sweep or turning vanes. In gravity systems all ducts shall be as direct as possible and heat ducts shall have a rise of not less than one inch per foot in the direction of flow.

2. Air Velocities.

For the purpose of calculation and design the velocities in any air-ways shall not in general exceed the following limits; except that for mechanical systems these velocities may be exceeded where properly designed in accordance with the best accepted engineering practice and satisfactory data submitted thereon.

Part of System	Mechanical System	Gravity System
1. Intake Opening	1000 F. P. M.	300 F. P. M.
2. Blast Coils (Steam) (Net free area)	1000 F. P. M.	
3. Trunk Ducts	1200 F. P. M.	300 F. P. M.
4. Branch Ducts	750 F. P. M.	250 F. P. M.
5. Vertical Inlet Flues	500 F. P. M.	300 F. P. M.
6. Vertical Vent Flues	500 F. P. M.	250 F. P. M.
7. Return Air Flues	800 F. P. M.	250 F. P. M.
8. Roof Ventilators	500 F. P. M.	300 F. P. M.
9. Inlets and Outlets (Net free area)		300 F. P. M.

3. Use.

All ducts and air-ways shall be used only for the transmission of air, and shall not be designed or used for any other purpose.

4. Underground Air Supply Ducts.

Underground ducts shall not be considered permissible for conveying air supply, including return and outside air, unless they are constructed and equipped as follows:

(A) Thoroughly waterproof;

(B) Provided with ample free drainage to a lower room of the building so that no water may stand anywhere in the ducts;

(C) Without direct sewer connections;

(D) Not less than 3 feet in the clear vertically and 2½ feet horizontally; except that branch underground ducts not more than 16 feet in length may be reduced to 2 feet in the clear vertically and horizontally if the top of the branch duct is flush with the top of the main duct, and the drainage pitch of the branch duct is not less than one inch in 8 feet toward the main duct;

(E) Provided with appropriate access for inspection and cleaning service.

5. Construction.

All ducts shall be substantially made, with locked seams, and shall be made and maintained smooth on the inside and shall be substantially air tight. Ducts or air-ways of wood or other combustible or rough material shall be tightly lined on the inside with sheet metal.

No ducts shall be lined with any material which will support combustion or which will present a rough surface to the flow of air.

Note. For construction and protection of hot air pipes, registers, and hot air and ventilating flues, see the Building Code issued by the Industrial Commission.

6. Sheet Metal Piping.

The gauges and construction of sheet metal ducts and flues shall be appropriate for their specific use and location. They shall be securely stayed and supported to insure permanence.

The following table of U. S. standard sheet metal gauges shall be considered the minimum for the construction of ducts and flues.

Round Ducts Diam. in Inches	Gauge	Rectangular Ducts Width in Inches	Gauge
1—19	26	4—18	26
20—29	24	19—30	24
30—39	22	31—60	22
40—49	20	61—96	20
50 & above	18	97 & above	18
For lining purposes, not less than 28 gauge			

All rectangular ducts having one dimension over 18 inches shall be constructed with standing seams, or angles, not more than 33 inches on centers and shall be cross broken diagonally to stiffen the sheets. When this construction cannot be obtained the sheet metal in the ducts or flues shall be at least one gauge heavier than specified in the table above.

All ducts with one dimension over 90 inches shall be reinforced with angles of proper sizes.

Plenum chambers and fan rig housings shall be constructed of not less than 20 gauge metal and shall be reinforced with standing seams or angles.

Ducts used in connection with kitchen ranges, etc., where greasy fumes are exhausted shall be constructed of not less than 20 gauge metal and shall be provided with a damper arranged to close automatically in case of fire.

7. Gravity Outlet Ducts.

Outlet ducts for gravity systems shall be so located or heated that the required or calculated air currents will be reasonably assured.

8. Insulation of Ducts.

Where heat supply ducts are so located or exposed so as to be subject to excessive or undesirable heat losses, they shall be covered with not less than ½ inch of suitable insulating material.

9. Separate Vent Ducts.

Vent ducts shall not be combined anywhere between room vent openings and gathering chambers or outside atmosphere unless direct-connected to an exhaust fan. However, gravity vent ducts serving similar occupancy classifications may be combined immediately below the point of final delivery to the outside atmosphere, such as at the base of a roof ventilator.

Note. Wherever exhaust or vent ducts are installed leading to the outside atmosphere, provision should be made for condensation.

10. Termination of Outlet Ducts.

Outlet ducts used in conjunction with mechanical ventilation system inlets may terminate in air tight incombustible gathering chambers, which may be the general attic space if the attic floor is fireproof and smoothly finished. Such ducts shall terminate in incombustible 90 degree elbows with horizontal outlets at least one diameter in length, not less than 2 inches above the attic floor.

11. Vent Ducts, Horizontal Run in Gravity Systems.

Horizontal runs in vent ducts of gravity ventilation systems shall be avoided wherever possible, and maximum practicable inclination shall be provided in all cases. Where horizontal runs are unavoidable they shall be not less than 20 per cent larger in free area than the required area of the connected vertical runs. In no case, however, shall the horizontal run exceed 50 per cent of the vertical run, unless connected to an exhaust fan.

12. Vent Ducts Above Roof.

Final delivery of all vent circuits shall be protected from weather, and shall be so located and constructed as to prevent contamination of air supply for or in any occupied area. Gravity vent ducts shall extend not less than 2 feet above the high portion of the roof or parapet wall, and shall be surmounted with an approved type of siphon hood.

Order 5870. Volume Dampers and Deflectors.

Necessary volume dampers, splitters and deflectors, shall be provided for all ducts to permit accurate balancing of the system, and such dampers, splitters and deflectors shall be properly set according to metered tests of the system, and shall then be securely locked in place or otherwise made reasonably meddleproof.

Order 5871. Inlets and Outlets.

1. Number and Arrangements.

The capacity, number and arrangement of inlets and outlets shall be such as to insure a uniform distribution of air throughout the areas served during all periods of occupancy.

2. Elevator Shafts and Stair Wells.

Elevator and stair shafts shall not be considered or used for ventilation purposes nor shall they be allowed to interfere with the effectiveness of installations hereunder.

Note. See also Elevator Code issued by the Industrial Commission.

3. Inlets and Outlets for Gravity Systems.

Gravity inlets and outlets shall be suitably arranged in room walls in such a manner as to use every possible natural advantage to provide proper and effective air movement and distribution.

Where foot warmers are installed in the main heat flue wall, they are to be provided with suitable dampers which shall not obstruct more than ⅔ of the free area of the heat flue when fully open.

4. Inlet Grilles or Diffusers Required.

All inlets, except outdoor openings, shall be equipped with suitable grilles or devices, which promote uniform distribution of air.

5. Heat, Smoke, Gas and Odor Removal.

Where ventilation involves removal of heat or smoke, or relatively light gas or odor, upward ventilation shall be provided wherever practicable. Where normal upward ventilation is impracticable appropriate auxiliary outlets shall be provided in, at, or near the ceiling. Where removal of relatively heavy air, gas, or odor, or other substances is similarly involved, the outlets therefor shall be at or near the floor.

6. Corridor Ventilation.

Air from occupied areas uncontaminated by other than human occupancy may be discharged into corridors and the latter vented through auxiliary spaces such as built-in lockers, toilet rooms, etc. Provided, however, that where the vent capacity of such auxiliary spaces is insufficient, additional direct vent flues shall be installed.

In cases of multiple story buildings each floor shall be independently vented.

Where lockers are installed in recessed walls and used for venting purposes, they shall have a net free inlet and outlet area each, of not less than 15 square inches per lineal foot of locker width.

Order 5872. Direct Radiation.

1. Radiators Recessed or Elevated.

Direct radiation installed in gymnasiums, playrooms, auditoriums and similar occupied areas shall be fully recessed and protected, or elevated not less than 7 feet above the floor. Radiators in passageways and corridors shall not project into the minimum width required by the Building Code.

2. Shields Required.

Direct radiators and other sources of radiant heat, installed within 2½ feet of fixed seats shall be provided with suitable insulated shields constructed and arranged to effect convective air currents and at the same time protect the adjacent occupants from direct radiant heat. In general, such shields shall be not less than 6 inches above the floor nor more than 4 inches further from the floor than the bottom of the radiator.

Order 5873. Humidifiers.

1. Location.

Where humidifiers are used, they shall be so located and arranged that they will effectively treat all the air handled by the ventilation system, unless otherwise permitted by the Industrial Commission.

2. Capacity.

Humidifiers shall be calculated and maintained on the basis of not less than 30 per cent relative humidity, measured at 70 degrees Fahrenheit for total air supply, unless otherwise approved by the Industrial Commission.

3. Automatic Control.

Where humidity is supplied, proper automatic control must be provided.

Note. Where evaporating pans in a furnace are used, constant level float devices are acceptable for this purpose.

Order 5874. Piping.

1. Pipe Sizes and Arrangement.

All steam and hot water supply and return piping, air line piping and auxiliary equipment shall be of appropriate sizes, elevations and arrangements in accordance with standard engineering practice to accomplish the calculated services in practical operation, without undue noise, stress or other detriment. They shall be adequately shown on plans submitted for approval.

2. Expansion and Contraction.

Appropriate anchors, expansion swings or joints, supports and similar trade essentials shall be provided in every piping system.

3. Pipe Insulation.

Where steam and hot water supply, and return piping pass through occupied areas where their heat emission might be objectionable or where such piping is subjected to the danger of freezing, it shall be properly covered with not less than one inch of suitable insulating material.

See the Building Code issued by the Industrial Commission for additional requirements.

Order 5875. Refrigerants.

1. Scope.

This order covers the use of refrigerants in heat transfer apparatus for temperature reduction or dehumidification as a function of air conditioning of occupied areas.

Note. For regulations covering refrigerating machinery, condensers, pressure tests, machinery room enclosures, etc., see the Refrigeration Code and the Building Code issued by the Industrial Commission.

2. Classification of Refrigerants.

Refrigerants used in connection with this code shall be classified as follows:

Class I. Non-toxic and non-inflammable refrigerants. Included in this list are:

Water or Water Vapor	H_2O
Carbon Dioxide	CO_2
Dichlorodifluoromethane	CCl_2F_2
Dichlorotetrafluoroethane	$C_2Cl_2F_4$

Class II. Relatively non-toxic and non-inflammable refrigerants having a sufficiently high boiling point to prevent rapid evaporation in event of release. Included in this list are:

Dichlorethylene	$C_2H_2Cl_2$
Methylene Chloride	CH_2Cl_2
Monofluorotrichloromethane	$CFCl_3$
Trichlorotrifluoroethane	$C_2Cl_3F_3$

Class III. Irritant and flammable refrigerants. Included in this list are:

Ammonia	NH_3
Methyl Chloride	CH_3Cl
Ethyl Bromide	C_2H_5Br

3. Uses, Where Permitted.

Only the refrigerants included in Class I may be used for cooling air by direct expansion or circulation in coils or extended surface cooling apparatus.

Refrigerants included in Classes I and II may be used for the purpose of cooling water to be circulated through air washers.

Refrigerants included in Classes I, II and III may be used for the purpose of cooling brine or water in a closed system where such brine or water is not circulated directly through the air to be conditioned.

4. Refrigerants Prohibited.

The following toxic and inflammable refrigerants shall not be used for air conditioning purposes:

Butane	C_4H_{10}
Iso Butane	C_4H_{10}
Propane	C_3H_8
Ethane	C_2H_6
Ethyl Chloride	C_2H_5Cl
Methyl Bromide	CH_3Br
Methyl Formate	$C_2H_4O_2$
Sulphur Dioxide	SO_2

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