

# Heating and Ventilation Code

STATE OF WISCONSIN

Revised May 14th, 1925

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Issued by  
Industrial Commission of Wisconsin

MADISON, WISCONSIN

**STATE PUBLICATIONS COVERING LAWS RELATIVE  
TO BUILDINGS AND BUILDING WORK**

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**AS FOLLOWS:**

1. Building Construction, Safety, Sanitation, etc., Industrial Commission.
2. Schools, Assistance in Layout, Economy and Administration, Supervisor of Buildings, Department of Public Instruction.
3. Electrical Work, Industrial Lighting, etc., Industrial Commission.
4. Fire Prevention, Fire Protection, etc., Industrial Commission.
5. Heating, Ventilating, etc., Industrial Commission.
6. Plumbing, State Board of Health. (Plumbing Division).
7. Water Supply, Sewage Disposal, etc., State Board of Health. (Plumbing Division).
8. Industrial Waste, Sanitary Engineer, State Board of Health.
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## HEATING AND VENTILATION CODE

### INTRODUCTION

During the past several years general requirements on ventilation of public buildings and places of employment in Wisconsin have been 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 September 15, 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 are contained in Orders 2000, 2010, 2011, 2012 and 2020 to 2025 inclusive, are still in force as applied to all places of employment. These requirements have been reprinted in the Appendix to this Code.

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 is 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.

\* Appointed following death of H. L. Williams, Milwaukee, American Foundry and Furnace Company, who was a member of the original committee.

- 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 Advisory Committee met regularly, averaging two meetings per month, for the purpose of preparing a Heating and Ventilation Code. The work of the committee was submitted to the public for criticisms and suggestions in public hearings held at Eau Claire, Oshkosh, Milwaukee and Madison, in February 1923. The Heating and Ventilation Code as revised by the committee on the basis of the public hearings was adopted by the Industrial Commission on July 6, 1923, and became effective August 19, 1923. In the enforcement of this code following its adoption by the commission it soon became evident that there was some dissatisfaction as to the reasonableness of some of the requirements. Publication was, therefore, postponed and the code was placed in the hands of the Advisory Committee for further consideration. The revised code as finally submitted to the commission, with recommendation for adoption, is the result of a conscientious effort to devise a reasonable and beneficial standard of heating and ventilation of public buildings and places of employment. This Heating and Ventilation Code was adopted by the commission on April 8, 1925, and became effective May 14, 1925.

#### ADMINISTRATION

The Heating and Ventilation Code will be enforced in cooperation with local officials, who are required by law to enforce all orders of the commission which are germane to their respective duties (Section 101.28 of the revised statutes). With the State Heating and Ventilation Code as a foundation, city ordinances may go more in detail, if desired, or may contain more stringent requirements than the State Code, but in every case the State Code requirements are required to be enforced as a minimum.

To secure best results plans should be filed with, and be approved by, the city building inspector, as now obtains in the re-

\*\* Resigned Sept. 30, 1924.

quirement for the submission of building plans and the obtaining of a building permit in the cities of Appleton, Beloit, Eau Claire, Fond du Lac, Green Bay, Janesville, Kenosha, Manitowoc, Milwaukee, Oshkosh, Racine, Sheboygan, Shorewood, Superior, West Allis. The requirement for submission of plans for heating and ventilation installations to the Industrial Commission for approval is waived in cities where the code is enforced, and plans are approved in a manner acceptable to the Industrial Commission. Regardless of the size, all cities should require permits for building construction and equipment, using the State Code as a minimum standard in case there is no more restrictive local ordinance.

#### APPEAL

Any person who considers any part of the Heating and Ventilation Code, or any official's interpretation of the code, to be unreasonable, may appeal to the commission to interpret, modify, or suspend the same. (See Sections 101.15, 101.16 and 101.17 of the revised statutes).

The Heating and Ventilation Code Advisory Committee, consisting of those named above, acts as an advisory committee to the commission in all matters pertaining to heating and ventilation of public buildings and places of employment. Any person who is dissatisfied with any technical ruling of any inspector, may appeal to the Heating and Ventilation Code Advisory Committee, whose decision will be submitted to the commission for consideration.

## HEATING AND VENTILATION CODE

### SECTION 1. DEFINITIONS.

#### Order 5800—Definitions.

1. *Ventilation* is the production and maintenance of atmospheric conditions 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.
2. 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.
3. 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.
4. 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.
5. A *mechanical system of ventilation* is any ventilation, exhaust or heating system, the effectiveness of which depends upon the operation of power-driven equipment.
6. An *exhaust system of ventilation* is any combination of building construction, machinery, devices or equipment, so proportioned, arranged, maintained and operated, that noxious gases, dusts, fumes, vapors, vitiated air, or other materials injurious to health, are effectively withdrawn from the breathing zone of employes and frequenters.
7. *Air supply* is the supply and appropriate distribution and disposal of the air required for ventilation.
8. *Fresh air* is air that is stimulating and refreshing and which is free from contamination of any kind in proportions detrimental to the health or comfort of the persons exposed to it.

9. *The fresh air intake* includes the ducts and out-door openings through which outside air is admitted to a ventilation or heating system.

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

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

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

13. *Out-door openings* are those openings in outside walls which are arranged and equipped in such manner as to be easily operated and accessible for manipulation.

14. The term *heating surface* applied to boilers, shall be understood to mean and include the total wetted area between grate line and normal water line, exposed to combustion of fuel or in intimate contact with flowing combustion gases on one side and water on the other side.

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

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

16. 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 effective date of this code.

17. The term *new building* used in this code shall be understood to mean and include buildings, additions thereto, and al-

terations 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.

## SECTION 2. SCOPE OF HEATING AND VENTILATION CODE.

### Order 5810—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.

2. **New Buildings.** The provisions of this code shall apply to the heating and to the ventilation of all new buildings.

3. **Existing Buildings.** The provisions of this code shall apply to all necessary alterations or improvements in existing buildings, other than existing places of industrial employment.

**Note:** See General Orders on Sanitation for requirements pertaining to existing places of industrial employment.

4. **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 3. GENERAL REQUIREMENTS.

### Order 5820—Plans, Specifications and Data.

1. **Design and Preparation of Plans.** All plans and data for heating and for ventilation shall be designed and prepared by competent designers.

2. **Approval of Plans and Specifications.** Complete plans for heating and for ventilation, together with the specifications applying to contracts for the work involved, for all theatres, assembly halls, schools, colleges, academies, apartment houses, hotels, and places of detention, and for all factories, office and mercantile buildings, having floor or roof spans greater than 30 feet, or which are more than two stories high, or which are two stories high and are more than 5000 square feet in floor area at the second floor level, shall be submitted to the Industrial Commission for approval. Approval shall be obtained before affected work is commenced.



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

3. Plans Required in Duplicate. All plans for heating and for ventilation 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, plans or specifications are changed in any respect covered by this code, such changes shall be submitted to the Industrial Commission for approval. All work shall be executed according to the approved plans and specifications, or the approved alterations.

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 during building construction and installation of equipment.

6. Data Required on Plans and in Specifications. The lines, data and information shown on plans for heating systems and ventilation systems submitted for approval shall be reasonably 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. Vertical sections and elevations necessary to show profiles of installation.
- k. Sizes and continuity of all ducts and flues.
- l. Location and type of all principal units of equipment.
- m. Chimney size, shape and height above primary grate of heater.
- n. Specifications shall be properly identified with plans.

7. Special Data Required. All plans or specifications submitted for approval shall be accompanied by data sheets giving the amount of radiation calculated for each room on direct radiation installation, amount of air and delivery temperature

calculated for each room for furnace installations, amount of air and delivery temperature calculated for all ventilation, 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. Upon demand the Industrial Commission shall be furnished with complete heat loss calculations.

Note: Typical forms for presenting the above information may be obtained from the Industrial Commission.

8. Fundamental Data Required. Fundamental Data pertaining to design and operation of equipment shall be filed 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. Orders 5218-23 inclusive.  
Metallic Chimneys, Construction. Order 5222. Smoke Pipes. Order 5213.

Ducts, General Construction. Orders 5215-17, inclusive.  
Grounding of Machinery. Orders 1033, 1034, 1035, 1313 and 1406, in the State Electrical Code.

Heaters, Location. Orders 5210 and 5527.  
Heaters, Fire Protection. Orders 5210-14 inclusive.  
Heater Rooms. Orders 5527, 5617, 5720.  
Piping, Fire Protection. Order 5214.

#### Order 5822—Design.

1. Adequacy. All heating and ventilation installations shall be designed, installed, maintained and operated adequate for the service required by this code.

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

3. Basis for Heat 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 the last ten years. 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.

Notes:

1. Sheet Metal Ducts. Sheet metal ducts should be provided with plenty of clean-outs so that the piping system can be cleaned by operation of fan or hand-tools. By placing a clean-out at or near each horizontal or vertical turn, at or near the points of minimum normal air pressure and travel, it is often possible by closing most or all of the normal discharges and opening individual clean-outs in turn, to cause enough extra flow of air to remove much of the dust and dirt that has settled in the piping system under normal operation conditions. In this connection it is generally advisable to insert a stop in the pipe beyond the opened clean-out. Hand-tool swabs are sometimes used for cleaning otherwise difficult parts in ducts.

2. Masonry Ducts. Horizontal masonry ducts should be constructed, arranged and equipped for washing down with hose water, and large ones should be provided with sufficient illumination to facilitate both cleaning and inspection services.

Order 5823—Air Supply.

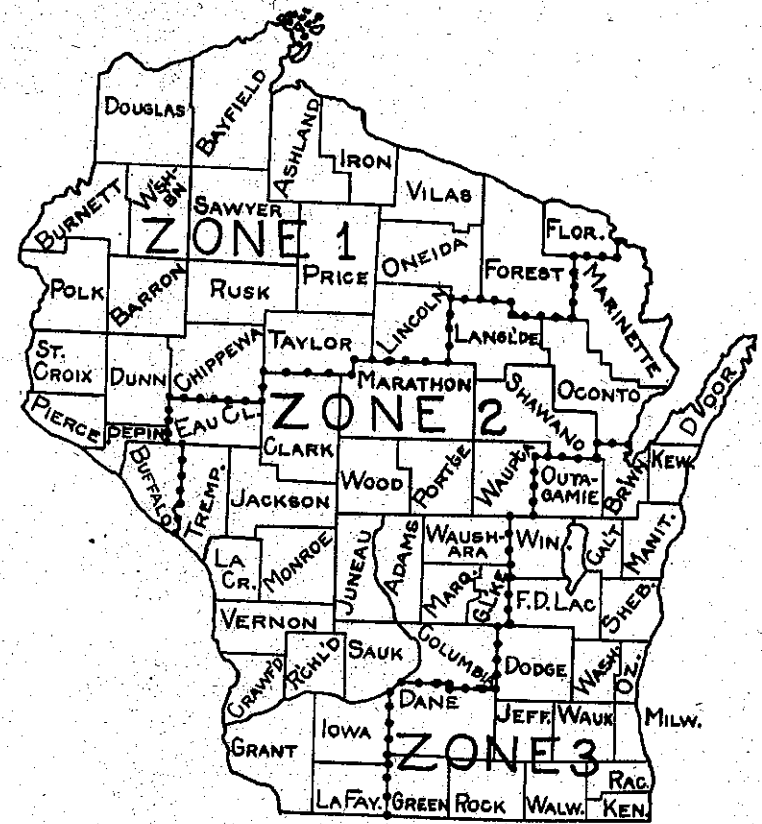
1. Uncontaminated Source. The fresh air shall be taken from a relatively uncontaminated source outside of the building.

2. Maximum Inlet Temperature, 120 Degrees Fahrenheit. 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.

Note: In gravity systems it its intended to base the heater capacity, arrangement and control upon inlet temperatures not exceeding 120°F, although in practice it may sometimes be necessary to heat the air to higher temperatures in order to drive it into the room.

3. Control. Adequate control of temperature and other conditions and effects of heating and of ventilation, shall be

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.....	24° BELOW ZERO F.



provided and maintained and operated for all heating and all ventilation systems.

4. Recirculation. Where the design, equipment and control of a ventilation system in all parts and as a whole is such as to promote, encourage and reasonably assure consistent operation, recirculation will be permitted as follows:—

(A) 50 per cent recirculation, during occupancy, from occupied areas having no other contamination than human occupancy, without special cleansing devices other than screens at intakes;

(B) 75 per cent recirculation, during occupancy, from occupied areas having no poisonous or injurious contamination, where an effective approved dust eliminator is operated in the air supply circuits;

(C) 100 per cent recirculation while building is entirely unoccupied.

#### 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.

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: This includes all places of employment or occupancy where smoke, gas, dust, fumes, steam, vapor, foul air, 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.

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. Critical Outside Temperature for Gravity Systems. Approval tests of gravity systems shall be made when there is not less than 40 degrees Fahrenheit difference between room

temperature and out-door temperature. The critical elevation of tests for room-air temperature, humidities and motions, shall generally be 1 foot above the normal seat line, where seats are used, or 4 feet above the floor where seats are not used.

5. Exhaust Systems Required. Exhaust systems shall be provided, maintained and operated for all occupied areas, for all machines, vats, tanks, furnaces, forges, salamanders, and all equipment and processes in such areas which 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, unless the general ventilation systems keep the air in the breathing zone of every employe or frequenter, pure, fresh and clean.

Note: The intensity of suction necessary in exhaust systems depends on local conditions to such an extent that no definite intensity of suction is specified, except that it shall in all cases be maintained sufficient to accomplish the required service.

6. Exhaust Systems, Clean Discharge. Where necessary, exhaust systems shall include adequate dust collectors, or 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.

7. Tempered Air Supply for Exhaust Systems. Where ventilation is secured by exhaust methods the air which blows in to replace that exhausted from the room shall be appropriately tempered.

Note: Taking foul 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 adequate supply of air properly warmed or treated before it is admitted to the room served.

8. No Contamination of Adjacent Areas. All equipment and systems serving 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.

9. Final Test Required. The performance of every heating or ventilation installation shall be thoroughly tested and balanced in place, throughout, before completion and delivery

to owner. The performance of ventilation systems shall be balanced by metered measurements of air flow at inlets and outlets.

**Note:** 1. **Smoke Test.** It is very important to make a smoke test of an ordinary chimney built into a building before accepting it because a leaky chimney presents a serious fire hazard as well as seriously impairing the usefulness of the entire plant. An active smudge is started at base of chimney or in the heater and then the top of the chimney is closed so that no smoke can escape that way. The chimney and combustion gas passages should be so tight that no smoke will escape from any crack or crevice or loose joint.

#### **Order 5825—Maintenance and Operation.**

1. **Maintenance.** All heating, ventilation and exhaust installations shall be maintained in good working order.

2. **Sanitary Conditions.** All heating and all ventilation installations, equipment, accessories and appurtenances shall be kept clean and sanitary.

3. **Operation.** All heating, ventilation and exhaust installations shall be operated consistently.

**Note:** It is recommended that contractors thoroughly instruct the operators of heating and ventilation systems, and conspicuously post written or illustrated instructions for the efficient and practical operation of the plant, before leaving the job.

It is always desirable to install recording instruments in connection with mechanical ventilation systems. Such instruments demonstrate the consistency with which the systems are operated. A recording air pressure gauge, an odometer, a recording thermometer, or even a speedometer, will be comparatively inexpensive and will be of great assistance to adequate supervision.

In small school buildings, printed memorandum pads provided near the thermometer, are being used with a reasonable measure of success. The teachers are required to make hourly reports of thermometer readings for each day of the week.

4. **Thermometers Required.** A reasonably accurate thermometer shall be provided and maintained for each 1000 square feet or fraction, in all occupied areas having more than 350 square feet floor area, and shall be easily accessible and properly located to show temperature of the zone served.

#### **SECTION 4. GENERAL REQUIREMENTS FOR CLASSIFIED OCCUPANCIES AND AREAS.**

##### **Order 5840—Places of Assembly With Seats.**

1. **Scope.** This classification shall be understood to include theaters, picture theaters, school auditoriums (not classrooms), public lecture halls, and similar close-seated areas usually provided with seats, whether seats are used or not.

2. **Ventilation Required.** Ventilation shall be provided and maintained for all occupied areas of this class having a seating capacity of 50 or more.

3. **Minimum Air Supply.** The air supply provided and maintained for occupied areas of this class shall be not less than 3 cubic feet per minute per square foot of floor area between main walls, not including the stage but including the gross floor area of balconies and galleries. The stage shall be supplied with sufficient air to equalize the air pressure thereat so as to avoid deflecting the curtain, but this volume of air need not be in addition to the volume calculated for the auditorium.

The air supply for foyers and lobbies used in conjunction with occupied areas of this class shall be not less than 2 cubic feet per minute per square foot of floor area.

4. **Inlet Air Currents.** In areas used for fixed occupancy, the inlets shall be so located, arranged or equipped as to prevent direct inlet air currents from striking the backs of the occupants.

##### **Order 5841—Motion Picture Booths.**

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

**Note:** See order 5539 of Building Code issued by the Industrial Commission.

2. **Exhaust Ventilation Required.** Exhaust ventilation shall be provided and maintained for every occupied area of this class, and such exhaust ventilation shall be independent of the auditorium ventilation system.

3. **Minimum Air Movement.** The air movement provided and maintained in occupied areas of this class shall be not less than 1½ cubic feet per minute per square foot of floor area in booth.

4. **Minimum Size of Gravity Outlet Ducts.** The effective area of gravity outlet ducts serving occupied areas of this class shall be not less than equivalent to 12 inches inside diameter, for each picture machine, unless adequate approved mechanical exhaust is provided; and all such ducts shall extend directly to the outside of building.

**Note:** Gravity outlet ducts from picture booths should be as nearly vertical as possible.

5. Mechanical Exhaust Systems Independent. Mechanical exhaust systems provided for occupied areas of this class shall be independent of all other ventilation systems in the building.

**Order 5842—Places of Assembly Without Seats.**

1. Scope. This classification shall be understood to include lodge rooms, dance halls, dining and banquet rooms, skating rinks, gymnasiums, playrooms and similar areas not normally provided with seats.

2. Ventilation Required. Ventilation shall be provided and maintained for occupied areas of this class wherever such occupied areas are in, or are used in connection with, school or college buildings, and in all other cases where the total window sash area is less than 10 per cent and the total of out-door opening there through is less than 5 per cent of the floor area, respectively.

**Note:** Where ventilation is not required, because of excess window area and out-door openings, such window area and out-door openings should preferably be all above grade. No window or out-door opening below grade will be counted unless there is a clear space outside of the windows, having width of not less than  $1\frac{1}{2}$  times the distance below grade at bottom of window.

3. Minimum Air Supply. The air supply provided and maintained for occupied areas of this class shall be not less than  $1\frac{1}{2}$  cubic feet per minute per square foot of the floor area served.

4. Dining Room Ventilation. Where dining rooms and similar occupied areas are used in conjunction with adjacent or nearby kitchens or other sources of objectionable odors, the spread of such odors throughout the dining rooms shall be prevented by appropriate exhaust of a portion of the dining room air through the kitchens or other sources of odors.

**Order 5843—Kitchens.**

1. Scope. This classification shall be understood to include all occupied areas housing the preparation of food, or other culinary operations, in all buildings within the scope of this code, except areas classified under order 5846.

2. Exhaust Ventilation Required. Exhaust ventilation shall be provided and maintained for every occupied area of this class having a floor area of more than 100 square feet.

3. Minimum Air Movement. The air movement provided and maintained for areas of this class, wherein exhaust ventilation is required, shall be not less than:

(A) Two cubic feet per minute per square foot of floor area for kitchens used intermittently;

(B) Four cubic feet per minute per square foot of floor area for all commercial kitchens.

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

5. Kitchens Adjacent to Dining Rooms. Where areas of this class are located adjacent to dining rooms and similar areas, not less than one half of the air exhausted shall be drawn from the dining room in order to prevent spread of odors.

**Order 5844—Places of Assembly for Worship.**

1. Scope. This classification shall be understood to mean and include only those auditoriums, social assembly rooms, Sunday schoolrooms, and similar areas, which are contained in churches or houses of worship.

2. Ventilation Required. Ventilation shall be provided and maintained for all occupied areas of this class where the total window sash area is less than 10 per cent of the floor area served and the total out-door openings there through is less than 2 per cent of floor area.

**Note:** Where ventilation is not required, because of excess window area and out-door openings, such window area and out-door openings should preferably be all above grade. No window or out-door opening below grade will be counted unless there is a clear space outside of the windows, having width of not less than  $1\frac{1}{2}$  times the distance below grade at bottom of window.

3. Minimum Air Supply. The air supply provided and maintained for occupied areas of this class shall be not less than 1 cubic foot per minute per square foot of floor area.

**Note:** This means not less than 1 C. F. M. per square foot total occupied floor area including basement, first floor, balconies, and auxiliary rooms and areas.

4. Alternate Service. All heating and all ventilation systems installed in occupied areas of this class shall be arranged for selective delivery of entire service to either the auditorium floor areas or to the basement floor areas, unless the air supplied thereby is more than  $1\frac{1}{2}$  cubic feet per minute per square foot of the greater of the two floor areas.

5. Alternate Capacity. Where heating or ventilation systems serve auditoriums and basement floor areas in this class, the capacity of such system may be based upon alternate service to auditorium floor areas alone when the air supply furnished thereto exceeds  $1\frac{1}{2}$  cubic feet per minute per square foot of floor area.

#### Order 5845—Schoolrooms.

1. Scope. This classification shall be understood to include class, recitation, study, and library rooms, in all school and college buildings, and similar areas used for educational purposes.

2. Ventilation Required. Ventilation shall be provided and maintained for all occupied areas of this class, except those which are used for open-air or out-door treatment.

3. Minimum Air Supply. The air supply provided and maintained for occupied areas of this class where ventilation is required, shall be not less than 2 cubic feet per minute per square foot of floor area.

The air supply for corridors and halls used in conjunction with occupied areas of this class shall be not less than  $\frac{1}{2}$  cubic foot per minute per square foot of floor area.

4. Alternate Service and Capacity. The capacity of heating systems and of ventilation systems installed in school buildings having not more than two classrooms, may be based upon service to classroom floors only; provided that where basement apparatus is used, appropriate arrangement shall be made for alternate service to basement areas if used for occupancy. In school buildings having more than two classrooms the capacity of heating and ventilation systems shall be based upon simultaneous service throughout, except that where an auditorium is used for public assemblage the additional ventilation required because of such use may be secured by alternate service.

5. Humidity Required. All air used for ventilation purposes in school buildings shall be appropriately humidified.

#### Order 5846—Places of Vocational Instruction and Research.

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

2. Ventilation Required. Ventilation shall be provided and maintained for all occupied areas of this class where the avail-

able floor space is less than 50 square feet per normal occupant, or where heat, smoke, gas, dust, spray, fumes, vapor, steam, foul air, or other contamination would otherwise be 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 employes and frequenters.

3. Minimum Air Supply. The air supply provided and maintained for occupied areas of this class shall be not less than an amount sufficient to make up for contamination of air due to the nature of the work being carried on, plus 2 cubic feet per minute per square foot of floor area.

#### Order 5847—Wardrobes and Locker Rooms.

1. Scope. This classification shall be understood to include all wardrobes and locker rooms and similar 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. 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 and maintained for all halls and corridors containing lockers for clothing, or which are used as wardrobes or cloakrooms. 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 Cloakrooms in School Buildings. Where necessary in order to insure practical results in wardrobes or cloakrooms adjacent to or within occupied areas covered by order 5845, the required ventilation shall be accomplished by use of inlets admitting air from adjacent classrooms 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.

**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. 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.

**Note:** Conditions in this class of areas are such that sometimes floorline vent openings are necessary and at other times the outlet should be at the ceiling. Therefore both floorline and ceiling line outlets should be provided and they should be equipped with operative louvre dampers interlocked so only the floorline or ceiling line outlet is open at any one time.

See orders 5250 to 5265 inclusive of the Building Code issued by the Industrial Commission.

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

**Order 5849—Private Rooms.**

1. Scope. This classification shall be understood to include private rooms, such as offices, bedrooms and similar areas, other than in penal institutions.

2. Window Ventilation Permissible. Window ventilation shall be considered permissible for occupied areas of this class.

**Order 5850—General Offices.**

1. Scope. This classification shall be understood to include all offices and similar occupied areas, other than those included in order 5849, wherein the air conditions and nature of occupancy do not involve reasonable inclusion in any other classification in this code.

2. Ventilation Required. Ventilation shall be provided and maintained for all occupied areas of this class:

(A) where the total window sash area is less than 6 per cent of the floor area, or the total areas of out-door opening is less than 3 per cent of floor area; or

(B) where the available floor area is less than 50 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 affected.

**Note:** Where ventilation is not required, because of excess window area and out-door openings, such window area and out-door openings should preferably be all above grade. No window or out-door opening below grade will be counted unless there is a clear space outside of the windows, having width of not less than  $1\frac{1}{2}$  times the distance below grade at bottom of window.

3. Minimum Air Supply. Where ventilation is required, the minimum air supply for occupied areas of this class shall be not less than  $\frac{1}{2}$  cubic foot per minute per square foot of floor area.

**Order 5851—Salesrooms.**

1. Scope. This classification shall be understood to include all salesrooms and other occupied areas of similar character.

2. Ventilation Required. Ventilation shall be provided and maintained for all occupied areas of this class unless the aggregate of out-door openings is more 3 per cent of the floor area served, provided such out-door openings are arranged so as to cause air circulation throughout the respective rooms.

3. Minimum Air Supply. Where ventilation is required, the air supply provided and maintained for occupied areas of this class shall be not less than 1 cubic foot per minute per square foot of floor area on the first floor, with a cumulative decrease of 10 per cent for each floor above the first floor, and a cumulative increase of 10 per cent for each floor below the first floor.

**Order 5852—Garages.**

1. Scope. This classification shall be understood to include all public garages, and all employment areas in any building housing three or more motor-driven vehicles.

**Note:** See Building Code, order 5240, for definition of public garage.

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

3. Minimum Air Supply. Where the ventilation is secured by the displacement of contaminating gases the air supply provided and maintained for occupied areas of this class shall be not less than  $1\frac{1}{2}$  cubic feet per minute per square foot of live



storage area and 3 cubic feet per minute per square foot of repair area.

Where ventilation is secured by dilution of the contaminating gases the air supply provided and maintained for occupied areas of this class shall be not less than 15 cubic feet per minute per square foot of live storage area and 30 cubic feet per minute per square foot of repair area.

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 carried on, the air supply provided and maintained shall be not less than 0.75 cubic feet per minute per square foot of floor area.

4. General Requirements. The products of combustion, and vapors or gases from fuel or batteries, shall be removed promptly and effectively from the breathing zones of employes and frequenters; and there shall be at all times not less than 2500 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. Ventilation Required. Ventilation shall be provided and maintained for all occupied areas of this class:

(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, foul air or other contamination would otherwise be 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 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. Minimum Air Supply. The air supply provided and maintained for occupied areas of this class shall be not less than an amount sufficient to make up for contamination of air due to the nature of the work being carried on, plus 1 cubic foot per minute per square foot of floor area; but in no case shall the air supply be less than 30 cubic feet per minute per normal occupant.

4. Exhaust Systems Required. Exhaust systems shall be provided and operated at all sources of air-contamination in occupied areas of this class, unless the air which any employe or frequenter must breathe is otherwise kept pure, fresh and clean.

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

#### Order 5854—Dormitories and Wards.

1. Scope. This classification shall be understood to include rooms equipped with more than two beds.

2. Window Ventilation. Window ventilation may be relied upon for occupied areas of this class, wherein the available window sash area is more than 10 per cent of the floor area and the out-door opening there through is more than 5 per cent of floor area.

Note: Where ventilation is not required, because of excess window area and out-door openings, such window area and out-door openings should preferably be all above grade. No window or out-door opening below grade will be counted unless there is a clear space outside of the windows, having width of not less than  $1\frac{1}{2}$  times the distance below grade at bottom of window.

#### Order 5855—Penal Institutions.

1. Scope. This classification shall be understood to mean and include areas of compulsory occupancy in penal institutions, such as cells and corridors and similar areas.

2. Ventilation Required. Ventilation shall be provided and maintained for all occupied areas of this class.

3. Minimum Air Supply, Mechanical Ventilation. Where mechanical ventilation is required for occupied areas of this class the air supply shall be not less than  $\frac{1}{2}$  cubic foot per minute per square foot of cell area.

4. Gravity Ventilation Permitted. Gravity ventilation, wherein direct gravity inlets and direct gravity outlets, and ducts are used, shall be considered permissible for occupied areas of this class where each cell, or individual part of a cell, comprises more than 100 square feet of floor area, or there is a total direct out-door opening area equal to not less than 10 per cent of the floor area.

Note: Properly arranged windows opening direct from cell to out-of-doors may be relied upon as direct gravity inlets under this order.



5. Mechanical Ventilation Required. Mechanical ventilation shall be provided and maintained for all occupied areas of this class having less than 100 square feet of floor area, or total direct out-door opening area equal to less than 10 per cent of the floor area, for each cell or individual part of a cell.

#### SECTION 5. HEATING AND VENTILATION EQUIPMENT.

##### Order 5860—Fresh Air Intakes.

1. Location. 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 fresh air intakes shall be above the finished grade, not less than 2 feet for gravity systems, or 6 feet for mechanical systems, and shall preferably be in a side wall and below the roof of the building.

3. Screens. Fresh air intakes shall be suitably screened against admission of birds, leaves and other foreign materials.

4. Weather Protection. All fresh air intakes shall be suitably protected against weather and water.

5. Accessibility and Cleanliness. All fresh 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 of Opening for Intakes. There shall be not less than 1 square foot of net free area in fresh air intakes, for each:

(A) 300 cubic feet per minute of air supply to be provided by gravity ventilation systems; or

(B) 1000 cubic feet per minute of air supply to be provided by mechanical ventilation systems.

7. Wood Intake Ducts Metal Lined. Fresh air intake ducts constructed of wood, or similar material, shall be tightly lined throughout on inside with sheet metal.

##### 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. No Dirty Spray Water. 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 water 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. Auxiliary Water Supply. Where the heating system condensate is returned to the boiler as feed water, there shall be an auxiliary supply of water to the boiler, preferably from the community water supply system, capable of furnishing continuously at least 50 per cent more water than is circulated in the system.

3. Valves Required. Every such heating system shall have stop valves on the system supply and return mains. If a safety loop is provided, all valves shall be outside of such loop. There shall be a stop valve and a check valve on the auxiliary water supply pipe, with stop valve between the check valve and the boiler return header. All such heating systems shall be provided with adequate air valves.

4. Mechanical Returns. In every heating system in which a mechanical device is used for returning condensate to the boiler, and which is so designed that condensate may return by gravity, the mechanical return device shall be by-passed with valves so that it can be removed or repaired, if necessary.

##### Order 5864—Furnaces.

1. Location. All furnaces shall be located so that the air supply circuits leading to and from them will be as short and

direct as practicable; where fans are used with furnaces, the furnaces shall be located in the discharge circuits of the fans.

2. Gravity Systems, Fresh Air Below Grate Level. In gravity systems, the fresh air inlets to furnace air-ways shall be such as will insure distribution of fresh 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 shall be considered permissible for schools having not more than two classrooms; also for portable schools and for other occupied areas having a gross floor area not greater than 1000 square feet, and for temporary installations elsewhere provided written permission is granted by the Industrial Commission.

**Note:** Jacketed stoves are best suited for areas of sparse occupancy such as in many standard size schoolrooms having only a few pupils in attendance. Such installations are intended to recirculate about 75 per cent of the air handled thereby and are thus not suitable for occupied areas having more than a few people present, unless the percentage of recirculation is proportionately reduced. Jacketed heater installations should generally be avoided where a cold basement occurs under the room to be served.

2. Location. All jacketed stoves shall be located in north-west portions of the principal rooms to be served thereby, unless the local weather conditions are unusually peculiar and are so stated to the Industrial Commission, and shall be well clear of all walls, alcoves, or other obstructions to the free and rapid distribution of heat and circulation of air in the room.

3. Setting, Dimensions. The casings, shields, or jackets, of jacketed stoves shall be set according to the following limiting dimensions:

(A) not less than 6 inches nor more than 10 inches clear of the stove proper;

(B) not less than 8 inches nor more than 12 inches clear above the room floor, except at intake;

(C) shall extend up to levels not lower than the highest parts of such stoves;

(D) shall be not less than 12 inches clear of the nearest

walls and not less than 3 feet from the nearest intersecting walls.

4. Setting, Construction. The casings, shields, or jackets of jacketed stoves shall be appropriately constructed double, with not less than  $\frac{1}{4}$  inch air cell, or horizontally interrupted air spaces intervening and shall shield adjacent occupants from undue radiant heat and unequal distribution of heat.

5. Fresh Air Intake Required. At least one fresh air intake shall be provided, maintained and operated for each jacketed stove installed, and such intake shall be adequately shown on plans submitted for approval, and shall include:

(A) ample elbow outside the building wall with screened opening turned down, or other equivalent weather protection.

(B) appropriate direct connecting duct near the floor of room served, having a net inside area of not less than 0.4 square inches per square foot of floor area.

(C) the intake duct shall be joined to the heater casing and air-way in a manner to prevent cold air from spreading over the floor, and to insure proper and adequate contact of fresh air with heater surfaces.

**Note:** The intake duct may be fan-shaped, if desired, with large end at heater casing, in order to prevent necessity for large hole through building wall.

6. Outlets. Gravity outlet openings in rooms served by jacketed stoves shall be located at floorline not less than 7 feet clear of stove casings, and shall have net free areas not less than 0.44 square inches per square foot of floor area.

7. Smoke Flues and Outlet Flues Combined. Where suitable and effective devices are used for mixing of smoke and foul air in conjunction with jacketed stoves the smoke flue and outlet duct may be combined, provided the net free area of combined flue is not less than the sum of the required outlet duct and smoke flue areas.

#### 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, where ever 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 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;
- (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: In the following table allowance has been made for possible 50% overload capacity. 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.	Equiv. Direct Radiation Sq. Ft.	B. T. U. per Hour	Size Diam. In.	Equiv. Direct Radiation Sq. Ft.	B. T. U. per Hour
8	350	84,000	40	28750	6,900,000
9	520	125,000	41	30500	7,320,000
10	700	168,000	42	32500	7,800,000
11	880	211,000	43	34500	8,280,000
12	1100	264,000	44	36500	8,770,000
13	1320	317,000	45	38750	9,300,000
14	1580	379,000	46	41000	9,840,000
15	1900	457,000	47	43500	10,450,000
16	2270	545,000	48	45750	10,960,000
17	2680	643,000	49	48250	11,600,000
18	3160	753,000	50	50500	12,120,000
19	3700	888,000	51	53250	12,800,000
20	4270	1,025,000	52	56000	13,450,000
21	4900	1,175,000	53	58750	14,100,000
22	5580	1,340,000	54	61500	14,750,000
23	6320	1,515,000	55	64250	15,440,000
24	7100	1,701,000	56	67000	16,100,000
25	7900	1,895,000	57	70000	16,800,000
26	8770	2,105,000	58	73000	17,550,000
27	9730	2,310,000	59	76000	18,250,000
28	10750	2,580,000	60	79000	18,950,000
29	11920	2,860,000	61	82250	19,760,000
30	13150	3,140,000	62	85500	20,500,000
31	14500	3,480,000	63	89000	21,350,000
32	15750	3,780,000	64	92500	22,200,000
33	17200	4,130,000	65	96000	23,050,000
34	18750	4,500,000	66	99500	23,900,000
35	20250	4,860,000	67	103000	24,700,000
36	21750	5,220,000	68	106750	25,600,000
37	23500	5,640,000	69	110500	26,500,000
38	25250	6,100,000	70	114500	27,500,000
39	27000	6,480,000	71	118500	28,500,000
			72	122500	29,400,000

Chimney heights are measured from primary grate level upward at rate of 200 feet for each inch-of-water draft required at base of chimney. This is figured on basis of average Wisconsin altitude of 1000 feet above sea level.

It is assumed that all furnaces, boilers, and other solid fuel type heaters, will operate at fair efficiency under maximum load, and since it requires about so much air to burn a pound of fuel, the amount of air and gas to be handled will vary approximately as the amount of heat to be delivered by the heater. The chimney cross section area should therefore be of such size as will permit reasonable velocity for escape of the combustion gases and entrained air. The table has been worked out for minimum chimney sizes where the fuel is hand-fired coal. The chimney sizes for forced draft coal burning installations and for oil burners may be somewhat smaller than for the hand-fired coal installations. These tabulations show diameter corrected for Wisconsin altitude and are based on smooth round type. Since rectangular flues are generally of somewhat rougher construction inside it is recommended that 80 per cent of rectangular flue area be considered equivalent to circular flue area and that the long side of rectangular flue shall in no case be considered in excess of 1.5 times the short side. It may be well to note that these chimney sizes are based upon long experience and calculated requirements from 100 per cent excess air, giving 9 per cent  $\text{CO}_2$ , which is equivalent to 90 pounds of gases per H. P. per hour; friction loss of 0.1 inches of water per 100 feet; 500° F. temperature of gases in 60° weather; 60 per cent over-all efficiency of heater, and 50 per cent over-load drive capacity of heater.

Breeching Details. Smoke pipes should preferably slope upward at least 1 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 of breeching more than 10 feet long. Smoke pipes should enter the chimney sloping upward at about 45° from horizontal, and if the chimney cross section is oblong the smoke pipe should enter the narrow side; where necessary to enter the long side, the vertical dimension of breech opening should exceed the vertical dimension of breeching by not less than the short dimension of chimney cross section. Every smoke pipe or breeching should have a damper for each heater connected thereto and for heaters of ordinary or small size there should also be a draft-check damper between the positive damper and the chimney, preferably near the bottom side of smoke pipe but never on top.

Chimney Height Allowances for Breeching Resistance. To offset friction and draft losses in smoke pipes or breechings, the normal chimney heights should be increased 1 foot for each 5 feet length of horizontal smoke pipe in excess of 10 feet, and 5 feet of chimney height for each 90° 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.

Chimney Height Allowances for Heater Resistance. It is expected that data furnished on test log-sheets for heaters under Order 5823-5 will contain accurate draft requirements for the respective individual heaters. In lieu thereof, and to approximate the draft requirements for warm air furnaces on which dependable data of this nature does not seem to be obtainable from the manufacturers, the following assumed allowances will be made.

## Heater Details

## Chimney Heights Allowed

For each—

- 180° horizontal turn of flue gases between fuel bed and smoke collar Allow 5 feet chimney height  
 180° vertical turn of flue gases between fuel bed and smoke collar Allow 7 feet chimney height  
 Draft loss through fuel bed under normal operation Allow 20 feet chimney height  
 For each 1 percent overload (up to 10 per cent) Allow 1 per cent chimney height

Chimney Height Allowances for Aspiration Flues. At least 5 per cent of the total chimney height otherwise required should be added for smoke flues used for aspiration purposes.

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

Note: See also orders 5218 and 5219 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 of suitable thickness.

Notes: So many failures have been reported for vitrified tile aspiration smoke flues that such material cannot be recommended. Ordinary flue lining is not at all acceptable for this purpose because the joints cannot be made permanently tight.

Cast iron smoke flues may be constructed of manufactured smoke pipe or Class "A" water pipe, or of cast iron sewer pipe.

4. Clean-Outs. All chimneys and flues shall be provided with adequate clean-outs, readily accessible, and tight when closed.

## Order 5868—Fans

1. Type and Capacity. All fans shall be of appropriate type for service under conditions of pressure or suction to be encountered in practice, and shall be selected on a basis of performance against the resistance of the system as installed.

2. Extra Capacity For Draw-Through. Fans installed to handle heated air for ventilation purposes, such as in draw-through arrangements, shall have excess capacity of not less than 1 per cent for each 5 degrees Fahrenheit above 70 degrees Fahrenheit of temperature of air handled.

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

4. Engine Out of Air-Ways. Exposed engines and similar motive power and apparatus, except electric motors, for fan drives shall be kept out of air-ways.

Note: All bearings should be kept out of fresh air-ways whenever possible. Single inlet overhung fans are generally preferable.

5. Gravity By-Pass for Fan-Furnace Installation. Fans used in conjunction with furnace installations shall be equipped with suitable gravity by-passes, preferably automatic, 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, and to facilitate easy access for cleaning.

Notes: Ventilation ducts and equipment should generally be of such sizes that the velocities through free areas thereof will not exceed the following limits. No vent duct should be less than equivalent to 6 inches in diameter. In mechanical systems where rooms such as kitchens, toilets and wardrobes are ventilated by air movement from adjacent rooms or corridors, the vent ducts should be proportioned on a basis of gravity size unless directly connected to exhaust fan.

Part of System	Mechanical System	Gravity System
1. Intake Opening	1000 F. P. M.	300 F. P. M.
2. Blast Coils (steam)	1000 F. P. M.	
3. Gravity Indirect (steam)		300 F. P. M.
4. Furnace Air-Ways		600 F. P. M.
5. Main Trunk Ducts	1500 F. P. M.	300 F. P. M.
6. Branch Trunk Ducts	1200 F. P. M.	300 F. P. M.
7. Branch Ducts—Rect. sides less than 2:1—750 Rect. Sides greater than 2:1—500		
8. Side Wall Inlet (See Order 5871)		
9. Vertical Inlet Flues	500 F. P. M.	300 F. P. M.
10. Vertical Vent Flues	500 F. P. M.	300 F. P. M.
11. Return Air Flues	1,000 F. P. M.	300 F. P. M.
12. Roof Ventilators	750 F. P. M.	450 F. P. M.

2. Not Service Thoroughfares. Air supply ducts, including chambers and air-ways, shall be used for the purpose of furnishing clean air to occupied areas, and shall not be designed, considered or used for any other purpose.

Note: Steam and hot water supply and return pipes for heating systems are permitted in large chamber-like air supply ducts.



3. **Underground Air Supply Ducts.** Underground ducts shall not be considered permissible for conveying inlet air supply unless they are made and equipped as follows:

- (A) thoroughly water-proof;
- (B) provided with ample free drainage to a lower room of 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 long may be reduced to 2 feet in the clear vertically and horizontally if the top of the branch duct is flush with top of main duct, and the drainage pitch of branch duct is not less than 1 inch in 8 feet toward the main duct;

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

4. **Illumination.** Appropriate provision shall be made for illumination of interior of fresh air ducts, particularly those large enough for human access, to facilitate cleaning and inspection service.

5. **Turns.** All ducts, particularly those containing gravity currents, shall be made as direct as possible, and all turns shall be accomplished with the least practicable resistance to the contained air currents.

6. **Construction.** All ducts shall be substantially made, and all air supply ducts shall be made and maintained smooth inside so as to prevent accumulation of dust and to avoid undue resistance of air currents, and all ducts shall be tight enough to prevent undue leakage or infiltration. Ducts constructed of material otherwise presenting a rough surface to the flow of air shall be tightly lined throughout inside with sheet metal.

7. **Sheet Metal Piping.** The gauges and the construction of sheet metal ducts shall be appropriate for the size, position, location and service of the respective ducts; they shall be securely supported in place and made of such materials, or shall be protected, as to insure reasonable permanence.

**Note:** The following U. S. standard sheet metal gauges are recommended for ducts and piping.

Round Ducts Diam. Inches	Rectangular Ducts		Gauge
	Gauge	Width Inches	
1—19	26	4—18	26
20—29	24	19—30	24
30—39	22	31—60	22
40—49	20	61—118	20
50 & above	18	118 & above	18

(Plenum chamber and fan-rig housings not less than 16 gauge)

8. **Gravity Outlet Ducts.** Outlet ducts for gravity systems shall be so located, or equipped with heat service, that the required or calculated air currents will be assured.

**Note:** In steam systems it is an easy matter to install aspiration service. Often a length of properly vented 2 inch pipe extending up in the vent flue will be sufficient to assure positive air flow.

9. **Insulation of Outlet Ducts.** Where outlet ducts pass through unheated spaces, or are located in or adjacent to exposed walls, they shall be appropriately insulated against loss of heat from the contained air.

10. **Outlet Ducts Separate.** Outlet ducts shall not be combined anywhere between room outlet openings and gathering chambers or outside atmosphere unless direct-connected to exhaust fan; except that where heated, such as by stack heater, central smoke flue or aspirating coil, such outlet ducts may be combined, but not within 6 feet above or below the outlet openings; and except that gravity outlet ducts may be combined immediately below the final delivery to outside atmosphere, such as at base of roof ventilator.

11. **Termination of Outlet Ducts.** Outlet ducts used in conjunction with mechanical ventilation system inlets may terminate in incombustible gathering chambers, and may terminate in general attic space when the attic floor is fireproof; provided such ducts terminate in incombustible 90 degree elbows, or provided other adequate fire hazard precautions are used.

**Note:** Gravity ventilation system outlet ducts may never terminate in the attic space.

12. **Outlet Ducts, Horizontal Run in Gravity Systems.** Horizontal runs in outlet ducts of gravity ventilation systems shall be avoided wherever possible, and maximum practicable inclination from horizontal 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. The horizontal component or projection of any outlet circuit shall not exceed 30 per cent of the vertical component or projection of the same circuit between room outlet and the attic or gathering chamber, unless connected to exhaust fan.

Where a plenum system of ventilation is installed and the vent flues terminate in a common vent chamber or duct in the attic,

the final exit from the vent chamber or duct may be through one or more outlets of adequate size; provided that no flue served by such outlet shall be more than 50 feet distant from the outlet.

**Note:** A plenum system of ventilation is where a fan is used only to supply fresh air.

13. **Outlet Ducts Above Roof.** Final delivery of all outlet 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 outlet ducts shall extend to points well above high portions of roofs or parapets.

**Note:** Siphon ventilators are acceptable as gravity outlet terminals and are often advisable but their siphonic action is not generally dependable enough for consideration in calculating size or activity of outlet circuits. Restriction of the effective area of outlet and outlet ducts, due to use of siphon ventilators, is not permitted.

#### **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 meddle-proof, in an approved manner.

#### **Order 5871—Inlets and Outlets**

1. **Where Required.** Inlets and outlets shall be provided and maintained for all ventilation systems.

2. **Elevator Shafts not Ventilator Shafts.** Elevator 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 the Elevator Code issued by the Industrial Commission.

3. **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, odor, or other substances is similarly involved, the outlets therefor shall be in, at, or near the floor, wherever practicable.

4. **Number and Arrangement.** 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, and to accomplish the desired intimate contact with the body of each occupant.

5. **Inlets and Outlets for all Gravity Systems.** Gravity inlets and outlets shall be suitably arranged in room walls except as hereinafter provided, and in such manner as to use every possible natural advantage such as influence of prevailing winds and gravity distribution; and such inlets and outlets shall not be restricted in effective size.

**Note:** Foot warmers used in gravity warm air heating systems should be installed in the main heat duct walls at or near the floor-lines and be provided with suitable wing dampers hinged at inside lines of flues, so as to deflect the desired proportions of warm air through the foot warmer grilles.

6. **Inlet Grilles or Diffusers Required.** All inlets, except outdoor openings, shall be equipped with suitable grilles or devices which promote uniform distribution of air.

7. **Floor Inlets and Outlets Prohibited.** Inlets in floors shall not be considered permissible in areas classified under order 5845; nor in other areas where subject to contamination of inlet air incident to foot traffic or other floor line conditions; except in churches served by gravity furnace systems.

Outlets in floors shall not be considered permissible in areas classified under order 5845; nor in other areas where air passing there through is at any time recirculated before delivery to outside atmosphere; nor in conjunction with gravity outlet ducts unless adequately protected against contamination incident to foot traffic and other floorline conditions; except in churches served by gravity furnace systems.

#### **Order 5872—Direct Radiation**

1. **Radiators Recessed or Elevated.** Direct radiation installed in gymnasiums, playrooms, and similar occupied areas, or in passageways, or in auditoriums, shall be fully recessed or elevated not less than 7 feet above the floor; unless effectively guarded against personal contact, and arranged to prevent obstruction to traffic.

2. **Shields Required, Construction and Arrangement.** Direct radiators and similar sources of radiant heat, installed within



21½ 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; and, generally such shields shall be not less than 6 inches clear above the floor of the room served nor more than 4 inches further from the floor than the bottom of the radiator.

**Note:** While shields are required to protect adjacent persons from undue radiant heat, they also make the radiator more effective than would otherwise be experienced. It is, therefore, reasonable to expect radiators to be generally equipped with shields in sedentary occupied areas even though persons may not be habitually seated within the minimum distance specified by the code.

#### Order 5873—Indirect Radiation

1. Gravity Ventilation Systems. In every gravity indirect ventilation system a sufficient amount of indirect radiation shall be provided to suitably warm and deliver the calculated volume of fresh air in the coldest weather, and also when there is a difference of 40 degrees Fahrenheit between room temperature and outside temperature.

2. Free Air-Way Required. The net free air-way through, and about, indirect radiation surfaces shall be so arranged, and of sufficient capacity, to accommodate the calculated air volume at a reasonable velocity.

3. Arrangement. In gravity indirect ventilation systems:

(A) the indirect radiation shall be installed directly under the vertical duct served, or immediately adjacent, and with clear space equal to the depth of such flue over the top of the radiation, and below the top of the opening into the flue.

(B) the air to be heated shall be admitted below the indirect radiation and shall rise vertically there through to flues served.

(C) mixing dampers operative from the rooms served, shall be provided and maintained so that either warm air, or cool air, or both, will be admitted to such room, individually.

4. Valves. In gravity ventilation systems of the steam or hot water type, there shall be no shut-off valves controlling the indirect radiation, except main line valves which also control the indirect radiation.

5. Capacity. The heating capacity of indirect radiation shall be calculated on the basis of normal working pressure of steam or vapor, or the normal working temperature of hot water, respectively, used for direct radiation of the same supply line.

#### Order 5874—Humidifiers.

1. Location. Humidifiers used in conjunction with ventilation systems shall be so located and arranged that they will effectively treat all the ventilation air handled by the ventilation system, unless otherwise permitted by the Industrial Commission.

2. Capacity. Humidifiers shall be calculated, maintained, and operated on the basis of not less than 40 per cent relative humidity, measured at 70 degrees Fahrenheit for total air supply, unless otherwise directed by the Industrial Commission.

3. Water Pans. The reservoir capacity in connection with water pan humidifiers shall be not less than enough for one normal day of operation.

The water level in water pan humidifiers having supplementary reservoirs, or supplied from pressure systems, shall be controlled and maintained by means of float valves, or similar automatic devices, in the water supply lines outside of the heat chambers.

The evaporative surface of water pan humidifiers shall be not less than the equivalent of 200 square inches of plain water pan evaporation surface per 1000 cubic feet of air supply to be treated.

Water pan humidifiers shall be located in the heated air chambers of heater unit or in similar location.

#### Order 5875—Piping

1. Pipe Sizes and Arrangement. All steam and hot water supply and return piping, and air line piping, shall be of appropriate sizes, elevations and arrangement to accomplish the calculated services in practical operation, without undue noise, stress or other detriment; and 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.

## APPENDIX

### EXTRACT FROM GENERAL ORDERS ON SANITATION

#### REQUIREMENTS APPLYING TO ALL PLACES OF EMPLOYMENT

##### Order 2000. Definitions:

###### "PURE, FRESH AND CLEAN AIR"

shall mean air that is both stimulating and refreshing to breathe. It shall not contain noxious gases, dust, fumes, vapor, or other materials in such quantities as to be injurious to the health. It does not necessarily mean outside atmosphere, but shall mean air that contains reasonable quantities of the vital constituents of the atmosphere.

###### "VENTILATING SYSTEM"

shall mean any building construction, machinery or equipment so arranged that "pure, fresh and clean air" is provided for breathing purposes.

###### "EXHAUST SYSTEM"

shall mean any building construction, machinery or equipment so arranged that noxious gases, dusts, fumes, vapor or other materials injurious to the health are removed from, or prevented from contaminating the air any employe must breathe.

**Order 2010. Purity of Air.** The air, which any employe must breathe, shall be pure, fresh and clean.

**Order 2011. Minimum Cubic Feet of Air Space.** The employer shall furnish every employe at least 400 cubic feet of air space. In computing the available cubic feet of air space the height of the room shall be taken at not to exceed 11 feet and the space occupied by equipment and material must be subtracted.

**Order 2012. Temperature and Humidity of Air.** Every employer shall furnish air temperature and humidities that do

not produce extreme or unreasonable conditions, considering the nature of the industry.

**Note:** The most desirable relative humidities and temperatures for workrooms are respectively 50 to 65 per cent, and 60 to 68 degrees Fahrenheit. The nature of the work done, the moisture and dryness of the body's surface, the kind of clothing worn, the motion of the air, its temperature and humidity, and the kind of materials used in the process are all factors which will cause a variation in temperature and humidity.

**Order 2020. Ventilating Systems.** Ventilating systems shall be provided for at all places of employment where smoke, gas, dust, fumes, vapor, foul air, vitiated air, or industrial poisons 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 health, and when there is available less than 1,000 cubic feet of air space per person. Ventilating systems must replace the air twice each hour and supply an additional amount of air to make up for losses or contamination of air or oxygen due to the nature of the work being carried on. All ventilating systems shall furnish as a minimum requirement 1,800 cubic feet of pure, fresh and clean air per person each hour.

**Note:** See Appendix I for a list of common industrial poisons, page 25 of this booklet.

**Order 2021. Exhaust Systems. When Required.** Exhaust systems shall be provided for all machines, vats, tanks, furnaces, forges, salamanders, and all equipment and processes which create and throw off dust sufficiently light to float in the air or which emit fumes, gas or smoke in such quantities as to be irritating, or injurious to the health, unless the general ventilating system keeps the air which any employe must breathe pure, fresh and clean.

**Order 2022. Positive Inlets and Outlets.** All ventilating and exhaust systems shall be provided with positive inlets and outlets. Doors, windows, cracks, or elevator shafts are not positive inlets and will be accepted as positive outlets only when the ventilating system forces outside air into the building.

**Note:** If the building construction is such that mechanically operated sash of proper construction can be used to advantage, they will be accepted as positive inlets and outlets.

**Order 2023. Dust Collectors and Air Washers.** All exhaust systems must be provided with a dust collector, air washer

or some machine, contrivance or method which will prevent the discharge from contaminating the air in or around the place of employment.

**Order 2024. Drafts.** All ventilating or exhaust systems must be so designed, constructed and operated that there will be no drafts, changes in temperature or backdrafts, which are injurious to health. Where workmen are exposed to drafts or changes in temperature injurious to health, from the opening of doors or windows, suitable protection shall be provided.

**Order 2025. Ventilation in Drying Processes.** Conditioning drying or heating processes shall be carried on in rooms so equipped that there is sufficient motion of the air to prevent the formation and accumulation of poisonous or explosive gases, stagnant or dead air.

**Order 2207. Existing Toilet Rooms—Ventilation.** Every toilet room heretofore installed, which is not adequately ventilated by outside windows or skylight, shall be provided with a vent flue of size specified in order 5254, in which a fan shall be placed, if necessary, for proper ventilation.

Every such toilet room which cannot be kept sanitary shall be moved so as to be open to outside light and air.

**Order 2300. Laundry Requirements—Heat Deflectors.** On all roll body ironers, the hot roll must be equipped with a heat deflector which must be lined with a non-conductive material. The deflector must extend far enough down in front to deflect the heat and prevent it from being thrown out toward the operator. On all shoe body ironers, the shoe must be covered with non-conductive material.

**Note:** All machines throwing off heat should be so placed and equipped that the heat from one machine is not thrown on the operator of another machine.

**Order 2301. Rooms Provided with Exhaust Systems.** Wherever flat work ironers are operated, the room must be provided with an exhaust fan of sufficient capacity to draw out the excessive heat or steam which arises.

**Note:** Ample positive ventilation should be maintained throughout the laundry, particularly the rooms in which washing, ironing, or any other heat or humid process, is carried on.

Abundant fresh tempered air mechanically supplied at or near the floor line, and in conjunction with ample natural ceil-

ing outlets or exhaust fans, constitutes the most generally applicable and satisfactory ventilation for laundries. Outside air should be used, but it generally need not be made more than comfortably warm. Proper distribution is very important.

#### EXTRACT FROM BUILDING CODE

##### REQUIREMENTS APPLYING TO NEW INSTALLATIONS IN PUBLIC BUILDINGS AND PLACES OF EMPLOYMENT.

**Order 5203. Windows.** Every room in which one or more persons live, sleep, or are employed (except storage rooms or other rooms where the nature of the occupancy will not permit), shall be lighted by a window or windows opening directly upon street or alley or upon a court on the same lot with the building. The windows shall be so constructed and distributed as to afford proper light and ventilation. Every building more than 40 feet deep (measuring at right angles to the windows) shall have windows on at least two sides.

**Note:** For toilet room windows, see order 5253.

**Order 5206. Ventilation of Courts.** At the bottom of every shaft or inner court there shall be sufficient access to such shaft or court to enable it to be properly cleaned out. Every inner court which is required under order 5203 and which is more than one story in height shall have an intake for fresh air, leading from the street or other open space. The area of such intake in square feet shall equal at least two one thousandths of the number of cubic feet contained in said court; but such area need not be more than 50 square feet. Every intake shall be constructed of fireproof material, and unless said intake is used as a passageway for persons there shall be no openings into the same other than the inlet and outlet.

**Order 5215. Hot Air Pipes.** Every hot air pipe contained in or passing through a combustible partition or floor shall be placed inside another pipe arranged to maintain a  $\frac{1}{4}$  inch air space between the two pipes on all sides; or the pipe shall be securely covered with  $\frac{1}{4}$  inch corrugated asbestos. The bend at the bottom of the vertical pipe shall be kept at least 2 inches from any woodwork.

**Note:** Where a hot air pipe is placed in a 4 inch partition, metal lath over the pipe is recommended.

**Order 5216. Registers.** All register boxes shall be of metal, and shall either be double or be covered with asbestos not less than  $\frac{1}{8}$  inch thick.

**Order 5217. Hot Air and Ventilating Flues.** Every vertical hot air and fresh air flue or group of flues in the school, theater and hotel groups (see Order 5008) shall be enclosed with, or constructed of, incombustible material at least 2 inches thick, lined with metal or smoothly finished on the inside; except that frame buildings not more than two stories in height may have metal flues if protected as in order 5215. Horizontal ducts for hot air and fresh air, and all vent flues shall be constructed as in order 5215, or better.

REQUIREMENTS APPLYING TO NEW APARTMENT HOUSES,  
HOTELS AND PLACES OF EMPLOYMENT.

**Order 5717. Size of Rooms.** Every sleeping room shall be of sufficient size to afford at least 400 cubic feet of air space for each occupant over twelve years of age, and 200 cubic feet of air for each occupant under twelve years. No greater number of occupants than the number thus established shall be permitted in any such room.

**Order 5718. Basement Rooms.** Every basement, living or sleeping room shall be at least 8 feet high from floor to ceiling. The ceiling shall be at least 4 feet above the outside grade. The walls and floor shall be damp-proof and waterproof.

No rooms wherein persons are forcibly confined shall be located in a basement.

**Order 5719. Windows.** The outside windows in every sleeping or living room shall have a total area of at least one-tenth of the floor area of the room, but not less than 12 square feet. The top of at least one such window shall be not less than  $6\frac{1}{2}$  feet above the floor, and the upper half of it shall be made so as to open the full width.

EXTRACT FROM GENERAL ORDER ON EXISTING BUILDINGS.

REQUIREMENTS APPLYING TO ALL EXISTING PUBLIC BUILDINGS.

THEATERS AND ASSEMBLY HALLS.

**Order 6216.** Fresh air shall be supplied at the rate of not less than 1,200 cubic feet per hour per person. The fresh air shall be taken from the outside of the building and no vitiated air shall be re-heated unless it has been washed by a mechanical air washer of approved design.

MOTION PICTURE BOOTHS.

**Order 6224. Ventilation.** Each booth hereafter installed (except as provided below) shall be provided with a metal ventilating pipe not less than 12 inches in diameter, extending outside of the building. If a 12 inch outlet pipe is impracticable, a smaller pipe may (if approved by the Industrial Commission) be used if provided with an efficient rotary power fan.

If a standard fire window is provided not less than 4 square feet in area, connecting with the outside air, and opening not less than one-half, then the ventilating pipe may be omitted. In a school, church, or lodge hall where the picture machine is operated only occasionally and for short periods of time the ventilating pipe may be omitted.

APARTMENT HOUSES, HOTELS AND PLACES OF DETENTION.

**Note:** The following orders, relating to ventilation and sanitation, do not apply to those buildings which are already covered by the hotel regulations of the State Board of Health.

**Order 6409. Size of Rooms.** Every sleeping room shall be of sufficient size to afford at least 400 cubic feet of air space for each occupant over twelve years of age, and 200 cubic feet for each occupant under twelve years. No greater number of occupants than the number thus established shall be permitted in any such room.

**Order 6410. Windows.** No room shall be used as a sleeping or living room unless it has a window or windows opening upon a street, alley, or yard, or upon a court connecting therewith, or above the roof of an adjoining building, or upon an inner court not less than 25 square feet in area; or unless

it has a vertically-sliding pulley-hung sash window, not less than 15 square feet in area, opening into another room in the same apartment, which other room opens on a street, alley, or yard, either directly or through similar windows. Every such sash window shall be placed as nearly as possible in line with outside windows, and both halves shall be made to open readily; and the glass in the lower half shall be translucent.

**Order 6411. Basement Rooms.** No basement room shall be used as a sleeping or living room unless all the following conditions are complied with:

(1) The room shall be at least 8 feet high from floor to ceiling.

(2) The ceiling shall be at least 4 feet above the surface of the adjoining street or ground.

(3) The room shall have a window or windows opening upon a street, alley, or yard, or upon a court connecting therewith, or upon an inner court not less than 60 square feet in area; and the total window area shall be at least one-tenth of the floor area of the room, and the upper half of such window or windows shall be made to open the full width.

(4) The walls and floor shall be damp-proof and water-proof.

(5) The room shall have sufficient light and ventilation and shall be fit for human habitation.

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