2009 International Mechanical With Wisconsin Amendments

Training As Developed by

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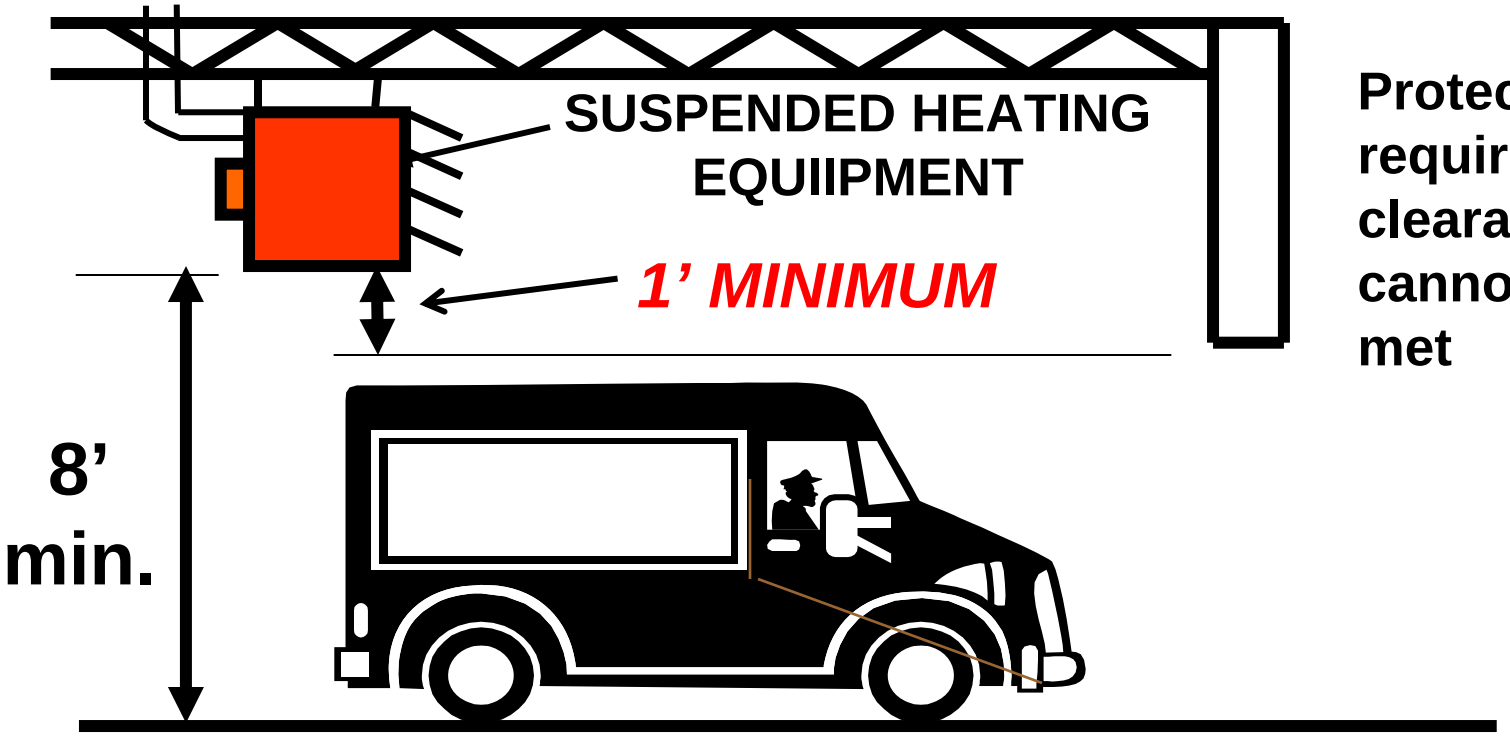
Equipment Clearances

IMC 304.6 & 7, IBC 1607.7.3

- Public motor vehicle areas-Min. 8 ft above the floor **OR** *if vehicles are capable of passing under appliance, appliance to be installed per manufacturer and not less 1 ft higher than tallest vehicle garage door opening;* **OR** guarded (See IBC for criteria)
- Private motor vehicle areas-Min. 6 ft above the floor or guarded

HVAC Equipment Clearances Public Motor Vehicle Area

IMC 304.6 & 7



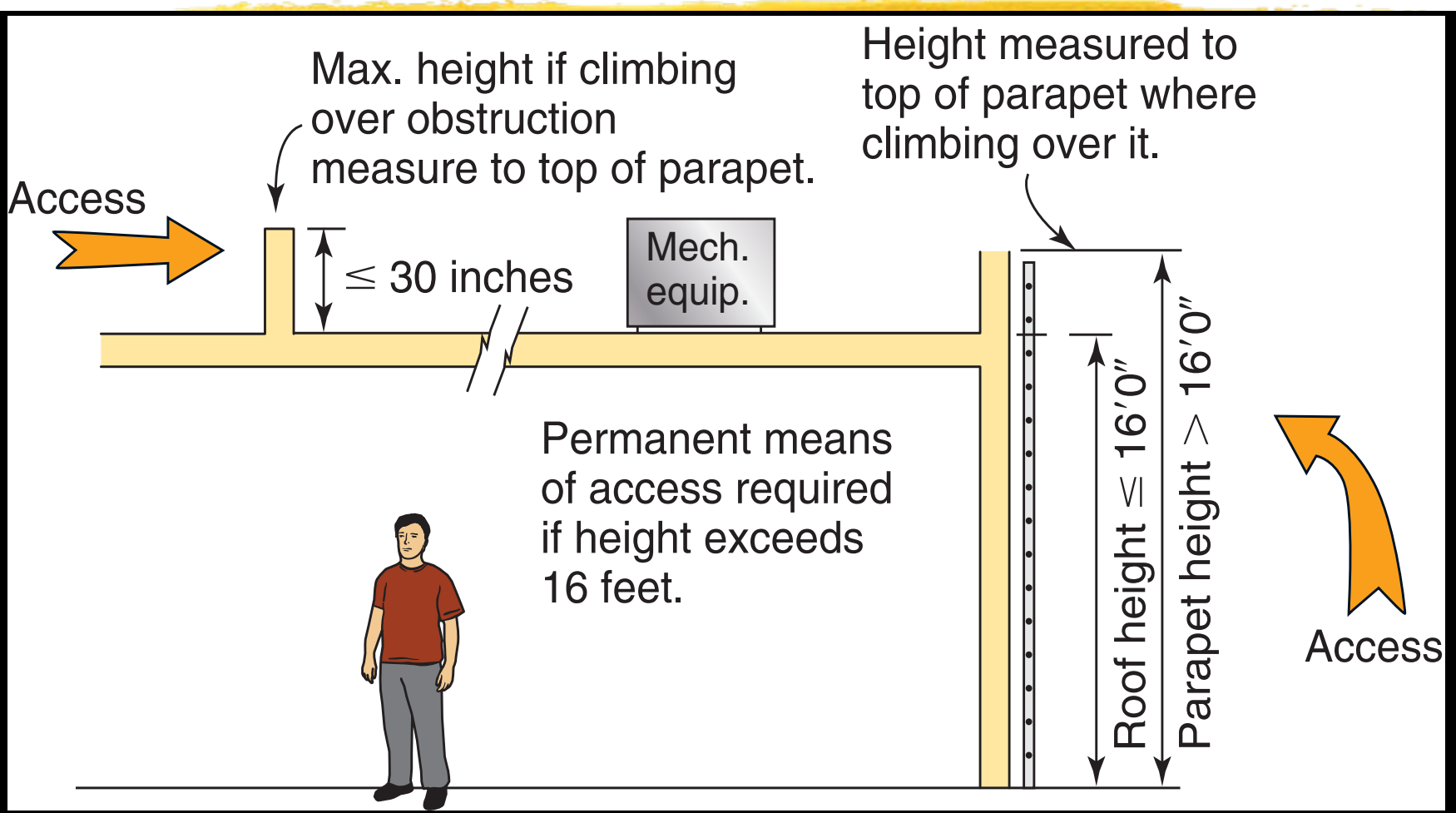
Protection required if clearances cannot be met

HVAC Equipment Clearance to Grade IMC 304.10

- *Equipment at grade level to be supported on a level concrete slab or other approved material ≥3" above grade* OR shall be suspended not less than ≥6" above adjoining grade.

NOT ACCEPTABLE

HVAC on Roofs & Elevated Structures IMC 306.5



Permanent Ladder Requirements
IMC 306.5

- *Ladders > 30 ft in height to be provided with offset sections & landings capable of withstanding 100 lbs /sf. Landing dimensions shall be not less than 18" & not less than the width of the ladder served. A guard rail shall be provided on all open sides of the landing.*

HVAC System Operations

IMC/Comm 64.0401(2)

- Except as provided by par. (b), ventilation (inclusive of exhausts) shall be provided during the periods that the room or space is occupied
  - Exception: Mechanical exhaust ventilation shall be provided for natatoriums even when the space or building is not occupied.

HVAC Calculations

- Indoor Design Temps must agree with IMC 309.1 68 degrees F at 3 ft above the floor, or
- Comm Table 64.0309

Occupancy Types	Minimum Inside Temperature (degrees F)
Dry cleaners, laundries, laundry rooms	60
Educational training shops	60
Commercial kitchens	60
Health care facilities, hospitals, nursing homes, ambulatory surgery centers	Footnote a
Factories and machine shops	60
Foundries	NMR
Sawmills	NMR

HVAC Calculations

- HVAC Calculations:
  - Outdoor Design Temps agree with Comm 63.0302?

County	Winter	Summer	
	Design Temp (°F)	Dry Bulb (°F)	Wet Bulb (°F)
Adams	–20	87	75
Ashland	–25	86	70
Barron	–25	86	75
Bayfield	–25	86	70
Brown	–15	87	75
Buffalo	–20	87	75
Burnett	–25	86	75
Calumet	–15	87	75
Chippewa	–25	86	75

HVAC Calculations

Comm Table 64.0403

Table 64.0403
Required Outdoor Ventilation Air

Occupancy Classification [i]	Ventilation Requirements - Basis of Capacity			
	Estimated Maximum Occupant Load (persons per 1,000 sq. ft.) [a]	Natural Ventilation Allowed [p]	Exhaust [e] (cfm/net sq. ft. floor area)	Air Change Rate [k] (minimum air change per hour with A/C)
Food and beverage service				
Bars and cocktail lounges	100	no	NR	2.0
Cafeterias, fast food	100	no	NR	2.0
Dining rooms	70	no	NR	2.0
Kitchens (cooking) [f, g]	20	yes	NR	1.0
Health care facilities	footnote m	no	footnote m	footnote m
Hospitals				
Nursing homes				
Ambulatory surgery centers				
Hotels, motels, resorts and dorms				
Assembly rooms	120	no	NR	2.0
Bathrooms [b, g]	NA	no	35 cfm/room	NR
Bedrooms	footnote n	yes	NR	NR

IMC – Chapter 4 Ventilation

- COMM Table 64.0403 & 64.0403(6)(a)2.b. –
  - **# of People/1,000 sf; or**
  - **Per Reasonable Justification Acceptable to the Department**
- Minimum of 7.5 CFM of Outdoor Air/person
- Continuous when people are present
- 4% Natural Ventilation permitted for certain occupancies (See IMC 402)
- Diversity Allowed

HVAC Calculations

Number of occupants match the building plans? Table 64.0403? Or an otherwise reasonable number per Comm 64.0403(6), or a listed exception?

Basic Design Heat Loss

ASHRAE/ Comm Table 64.0309, Table 64.0309

- **Building Envelope**: U x A x rT
- **Ventilation**: 1.085 x CFM x rT
  - **Where:**
  - **U = 1/R; U=U-factor; R=R-value**
  - **A = Area (sf) of Assembly;**
    rT = Temperature Difference between Indoor & Outdoor Design Temperatures;
  - **CFM = Cubic Feet per Minute of Outside Air;**

Basic Design Heat Loss

ASHRAE/ Comm Table 64.0309, Table 64.0309

- **<u>Building Envelope</u>**: U x A x rT
- Exterior wall--R19 fiberglass in <u>wood</u> framed 1,000 sf wall with interior 5/8" gypsum board, exterior vinyl siding adjacent to office occupancy in Milwaukee County
- U=1/(19 fiberglass+ 0.68 (gyp. Board) + 0.85 outside & inside air films)
- U = 1/(20.53) = 0.0487 thus
  - Heat loss for the wall assembly is:
  - 0.0487 x 1,000 sf x **[68°F- (-10°F)] = 3,799 Btu/h**

- **Would you expect the heat loss to increase or decrease with steel studs?**

Basic Design Heat Loss

ASHRAE/ Comm Table 64.0309, Table 64.0309

- **Ventilation**: 1.085 x CFM x rT
- **300 CFM of outside air in an office in Milwaukee County**
- **1.085 x 300 CFM x [68°F- (-10°F)] = 25,389 Btu/h**

HVAC Calculations

- Compare the heat loss calculations and verify that the heating equipment is > the heat loss calculated
- Compare the heat gain calculations and verify that the cooling equipment is > the heat gain ONLY IF LESS THAN 6 AIR CHANGES ARE USED
  - Remember that Air Conditioning is NOT a requirement of the WI Commercial Bldg Code

Intake Opening Locations

IMC 401.4, Comm 64.0401(4)(b)

- Intake openings shall be located not less than 10' **HORIZONTALLY** from any hazardous or noxious contaminant source

- Intake openings to be located not less ***≥ 3 ft*** below contaminant sources where such sources are located within 10 ft of the opening

Clothes Dryer Exhaust Req'ts

IMC 504.1

- Clothes dryers to be exhausted per listing.
- Dryer exhaust systems to be independent of all other systems
  - *Section 504 is not to be applied to listed and labeled condensing (ductless) clothes dryers.*

Clothes dryer exhausts & water heater vent....oh my!!!!!

Clothes Dryer Exhaust Req'ts

IMC 504.5

- **Makeup air**
  - Installations exhausting > 200 cfm to have makeup air. (one [1] residential clothes dryer)
  - *Where a closet is designed for installation of a clothes dryer, an opening having an area of ≥ 100 sq inches to be provided to the closet enclosure or make-up air shall be provided by other approved means.*

Clothes Dryer Exhaust Req'ts

IMC 504.6.2 & 504.6.3

- ***Duct Installation & Transition Ducts***
  - ***Exhaust ducts to be supported @ 4 ft intervals and secured in place.***
  - ***The insert end of the duct shall extend into the adjoining duct or fitting in the direction of airflow***
  - **Ducts shall NOT be joined w/ screws or similar fasteners that protrude into the duct**
  - **Transition ducts to be:**
    - **listed as having met UL 2158A**
    - **a maximum of 8 ft in length**
    - **shall not be concealed within construction**

Clothes Dryer Exhaust Req'ts

IMC 504.6.4

- **Exhaust Duct Limited**
- ***< 35 ft*** **unless listing allows for longer length ****
  - ***New duct length reduction table***
- **Cleanouts Req'd for each Vertical Riser**

Clothes Dryer Exhaust Req'ts

IMC Table 504.6.4.1 subtract from *35'--*

DRYER EXHAUST DUCT FITTING TYPE	***EQUIVALENT LENGTH***
4" radius mitered 45-degree elbow	***2 ft 6 in***
4" radius mitered 90-degree elbow	***5 ft***
6" radius smooth 45-degree elbow	***1 ft***
6" radius smooth 90-degree elbow	***1 ft 9 in***
8" radius smooth 45-degree elbow	***1 ft***
8" radius smooth 90-degree elbow	***1 ft 7 in***
10" radius smooth 45-degree elbow	***9 in***
10" radius smooth 90-degree elbow	***1 ft 6 in***

Clothes Dryer Exhaust Req'ts

IMC 504.6.5

- ***Length identification***
  - *Where the exhaust duct is concealed within the building construction, the equivalent length of the exhaust duct shall be identified on a permanent lab or tag.*
  - *The label or tag shall to be located ≤ 6 ft of the exhaust duct connection.*

Clothes Dryer Exhaust Req'ts

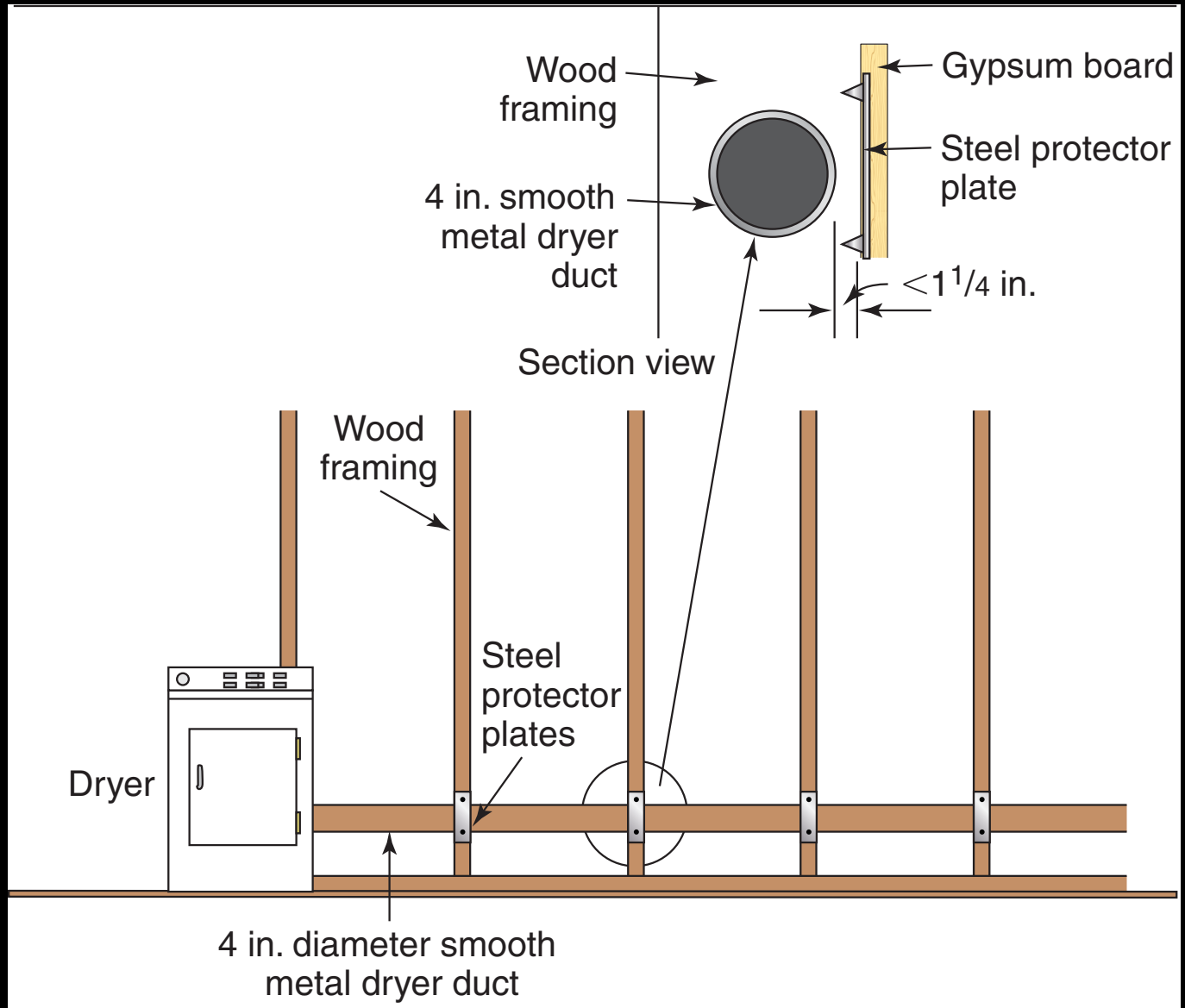
IMC 504.6.6

- *Where space for a clothes dryer is provided, an exhaust duct system shall be installed. Where the clothes dryer is not installed at the time of occupancy, the **exhaust duct shall be capped** at the location of the future dryer.*
  - *Exception: where a listed condensing clothes dryer is installed prior to occupancy of structure.*

Clothes Dryer Exhaust Req'ts

IMC 504.6.7

- *Protective shield plates shall be placed where nails or screws from finish or other work are likely to penetrate the clothes dryer exhaust duct.*
- *Shield plates to be placed on the finished face of all framing members where there is < 1-1/4" between the duct and the finished face of the framing member.*
- *Protective shield plates to be steel w/min. thickness of 0.062 " and extend a minimum of 2" above sole plates and below top plates.*



Clothes Dryer Duct Protection Against Fastener Penetration

Clothes Dryer Exhaust Req'ts
IMC 504.8

- *Where a common multistory duct system is designed and installed to convey exhaust from multiple clothes dryers, the construction of the system shall be in accordance with all of the following* ***(ALL of the following shall be met):***

Clothes Dryer Exhaust Req'ts

IMC 504.8

- *Shaft in which the duct is installed to be constructed & fire rated as required by IBC*
- *Dampers shall be prohibited in the exhaust duct. Penetrations of the shaft & ductwork shall be protected in accordance with IMC 607.5.5 exc. 2.*
- *Rigid metal sheet steel w/min. thickness of 0.0187" (No. 26 gage) installed per SMACNA Duct Construction to be used*
- *The ductwork within the shaft shall be designed and installed without offsets.*

Clothes Dryer Exhaust Req'ts

IMC 504.8

- *Exhaust fan motor design shall be in accordance with IMC 503.2*
- *The exhaust fan motor shall be located outside of the airstream.*
- *The exhaust fan shall run continuously, and shall be connected to standby power.*
- *Exhaust fan operation shall be monitored in an approved location and shall initiate an audible or visual signal when the fan is not in operation.*

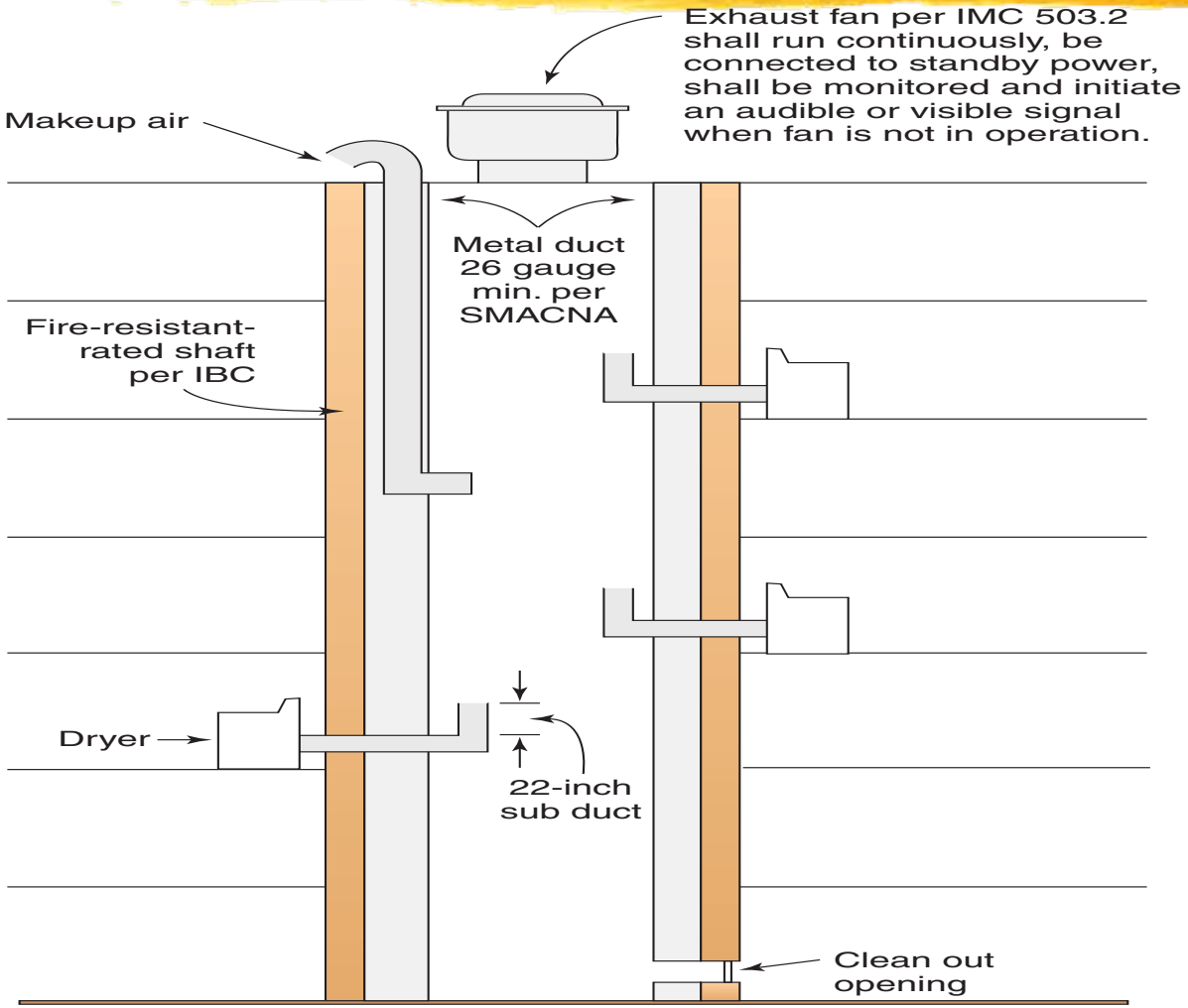
Clothes Dryer Exhaust Req'ts

IMC 504.8

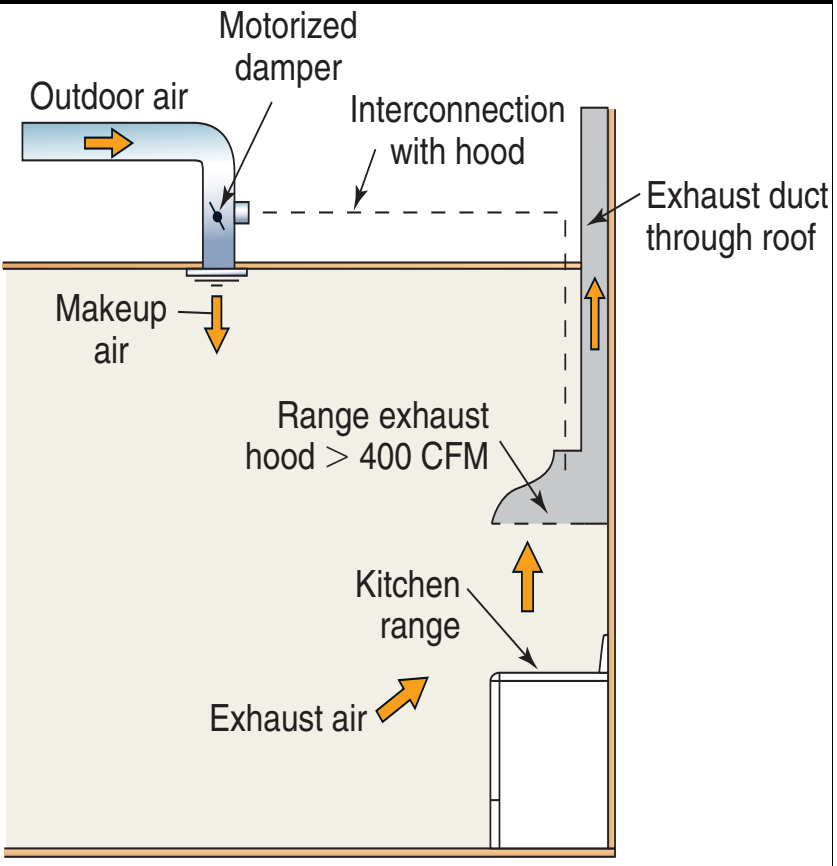
- *Make air shall be provided for the exhaust system*
- *Provide cleanout openings at base of shaft with min. 12" by 12" dimensions.*
- *Screen shall not be installed at the termination.*

Clothes Dryer Exhaust Req'ts

IMC 504.8



Domestic Kitchen Exhaust Equipment IMC 505.2



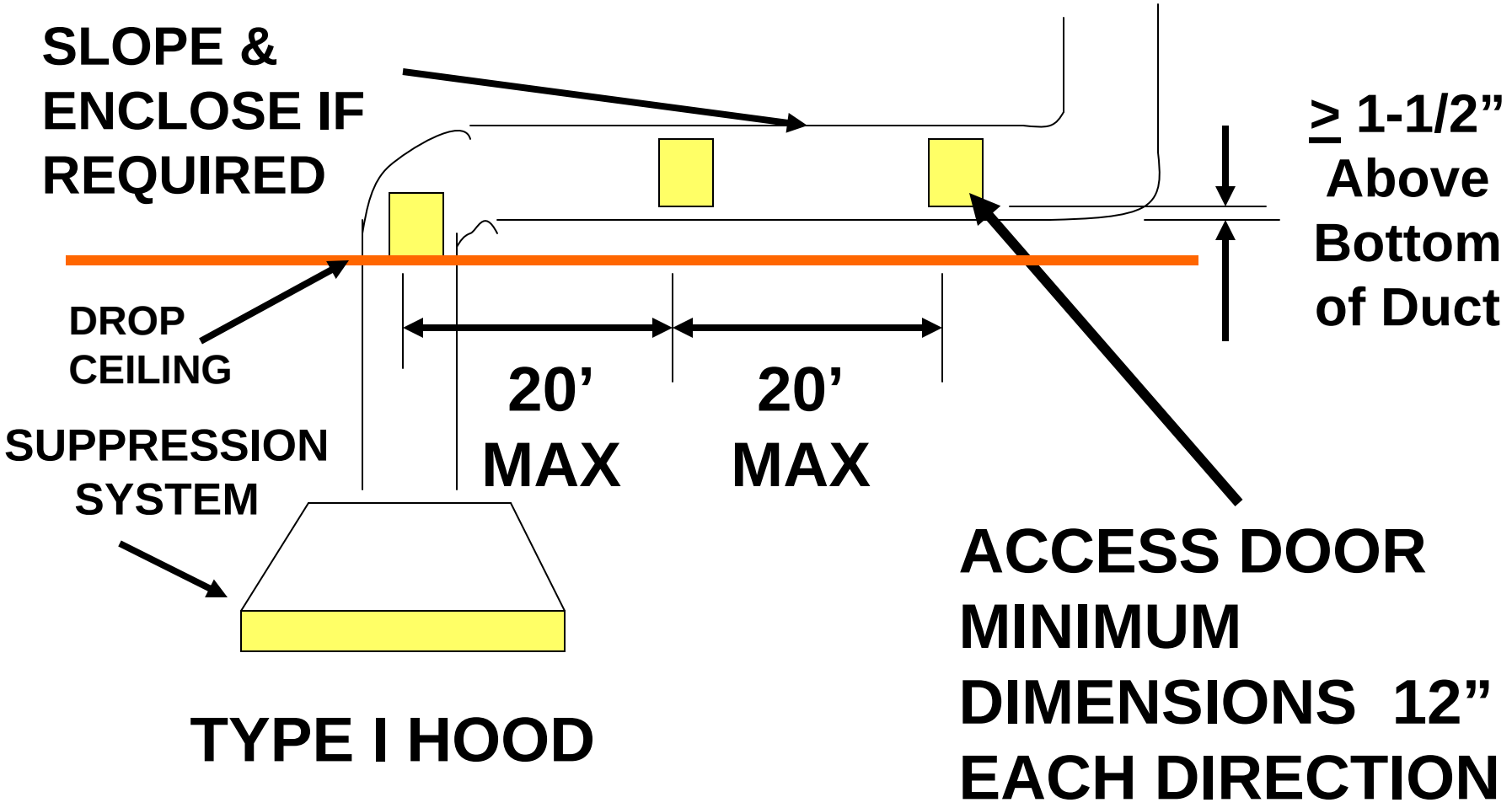
Required Makeup Air for Kitchen Exhaust Hoods Exceeding 400 CFM

- *Makeup air required if capable of exhausting > 400 cfm*
- *Shall be equipped with a means of closure*
- *Makeup air to be automatically controlled to start & operate simultaneously with the exhaust system*

Type I Kitchen Hood/ Exhaust Duct Reqr's IMC 506.3.8, 506.3.9

- Horizontal cleanouts must be < 20 Ft apart
- Access opening to be ≥ 1.5" above the bottom of the duct, other options listed
- Access door dimensions must be a minimum of 12"/side, --Exception
- *Access door to open without need for tools*
- Personnel entry required if duct dimensions allows entry of personnel (min. access *22"* x 20" with properly sized supports)

Type I Kitchen Hood/ Exhaust Duct Reqr'ts IMC 506.3.7, 8 & 9



Type I Kitchen Hood/ Exhaust Duct Requirements IMC 506.3.8

- *A cleanout to be provided on inlet & outlet side of inline fan used with any commercial kitchen hood.*
- *Cleanouts to be located within 3 ft of the fan duct connections.*

Type I Kitchen Hood / Exhaust Duct Req'ts IMC 506.3.10 Exception #1

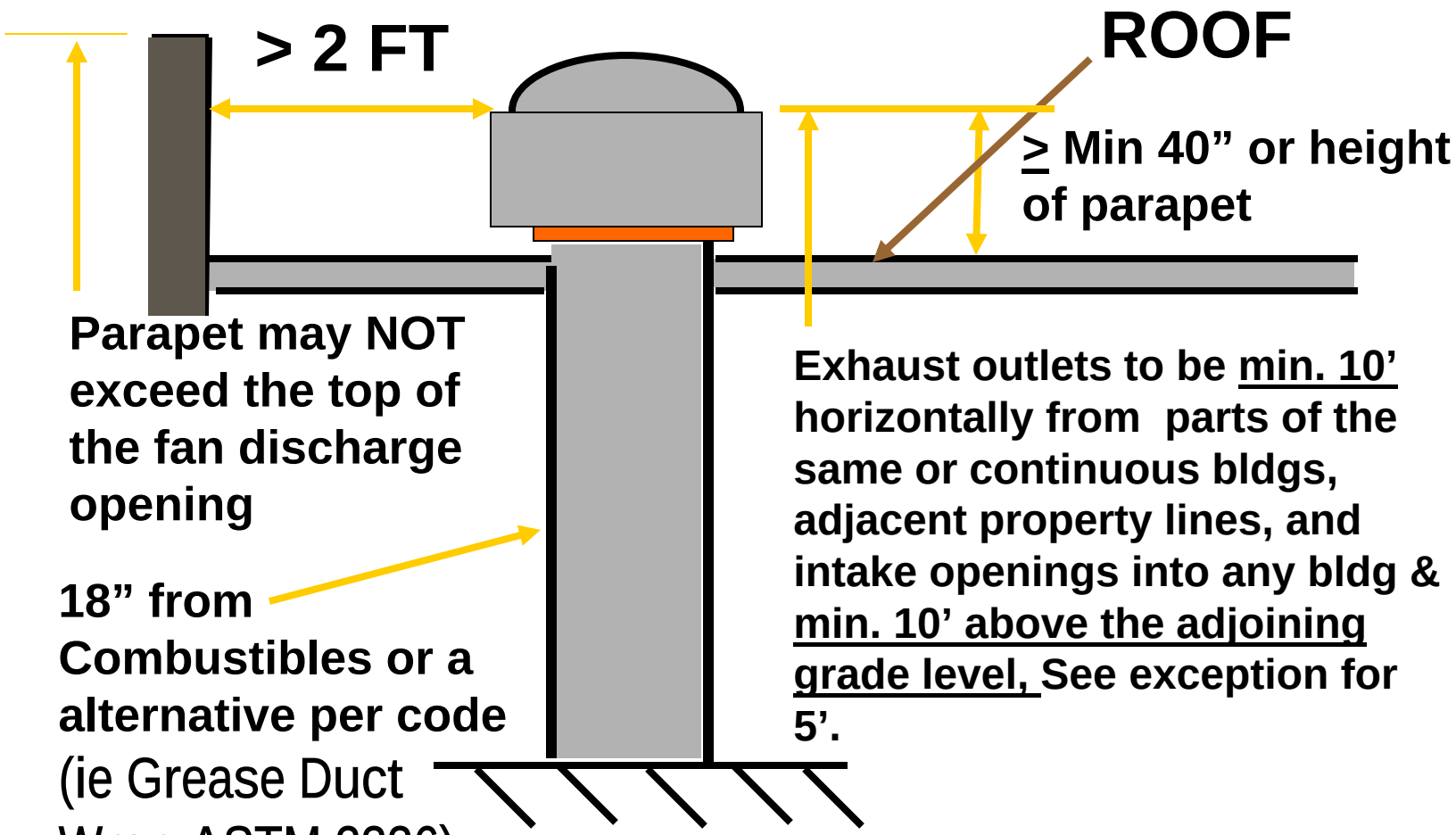
- 2 layers of wrap material required to attain a listing criteria -- Refer to Material Listing
- **Wraps MUST meet ASTM E 2336—Major Issue**
- Many wraps are listed as allowing "'zero' clearance to combustibles". The listing MUST be followed before this clearance reduction is recognized as acceptable.
  - Example: Some wraps can only be used with welded or brazed seams – not seams with sealants

Type I Kitchen Exhaust Duct Req'ts IMC 506.3.10.4

- *A duct enclosure shall be not be required for a grease duct that penetrates **ONLY** a non-fire-resistance rated roof/ceiling assembly*

  - **** Remember: IMC 507.9 requires a minimum clearance of 18" from combustibles.*

Type I Kitchen Hood/ Exhaust Duct Req'ts IMC 506.3.10 506.3.12



Type II Kitchen Exhaust Terminations IMC 506.4.2

- *Exhaust outlets to terminate ≥ 3 ft in any direction from openings into the bldg*
- *Outlets to terminate ≥ 10 ft from property lines or bldgs on same lot*
- *Outlets to terminate ≥ 10 ft above grade*
- *Outlets to terminate ≥ 30 inches above the roof surface*
- *Outlets to be protected against weather conditions*
- *Outlets shall not be directed onto walkways*
- *Outlets to meet the provisions for exterior wall opening protectives in accordance with the IBC*

This is a new idea in building make-up air. The white framework is the base to a pedestal floor fan.

Type I Kitchen Hood Operating Requirements

IMC 507.2.1.1

- Type I hoods to be installed to **AUTOMATICALLY** activate the exhaust fan whenever cooking operations occur
  - Activation may occur through:
    - interlock with the cooking appliance,
    - by means of heat sensors, or
    - by other approved methods

Heat Sensors Installed Inside Type I Commercial Kitchen Hood

Type I Kitchen Hood-- Fire Suppression Required

IMC 509/IBC 904.11 & 906, IFC 904.11.5

Follow IBC for location of Fire Suppression Activation system

Additionally, cooking equipment involving vegetable or animal oils & fats to Class K rated portable extinguisher located within 30 ft

Commercial Cooking Systems

Reference IBC 904.11

- Fire-extinguishing system to be tested in accordance with UL 300
- Manual System Operation defined
  - Location to be a min. of 10 ft, max. of 20 ft from kitchen exhaust system.
  - Activation device @ height ≥ 42” and ≤ 48”
  - To require a max. force of 40 lbs & max. movement of 14 inches to actuate
- Special provisions for automatic sprinkler systems defined

Combustion Air

IMC 701.1

- ***Solid fuel-burning appliances*** *shall be provided with combustion air in accordance with the appliance manufacturer's installation instructions.*
- ***Oil fired appliances*** *shall be provided w/combustion air per NFPA 31*

Hydronic Piping Testing

IMC 1208

- **Hydronic Piping Systems** (except for ground source heat pump loop systems) to be tested hydrostatically at 1-1/2 times the maximum system design pressure, but not less than 100 psi. Min. duration 15 min.
- **Ground Source Systems** to be pressure tested w/water @ 100 psi for 30 min w/ no pressure loss or leaks. If Design vs Actual flow pressure differs by > 10%, the problem shall be identified & corrected.

Pressurizing During Installation

IMC 1209.2

- Piping to be embedded in concrete shall be pressure tested prior to pouring concrete. **During pouring, the pipe shall be maintained at the proposed operating pressure.**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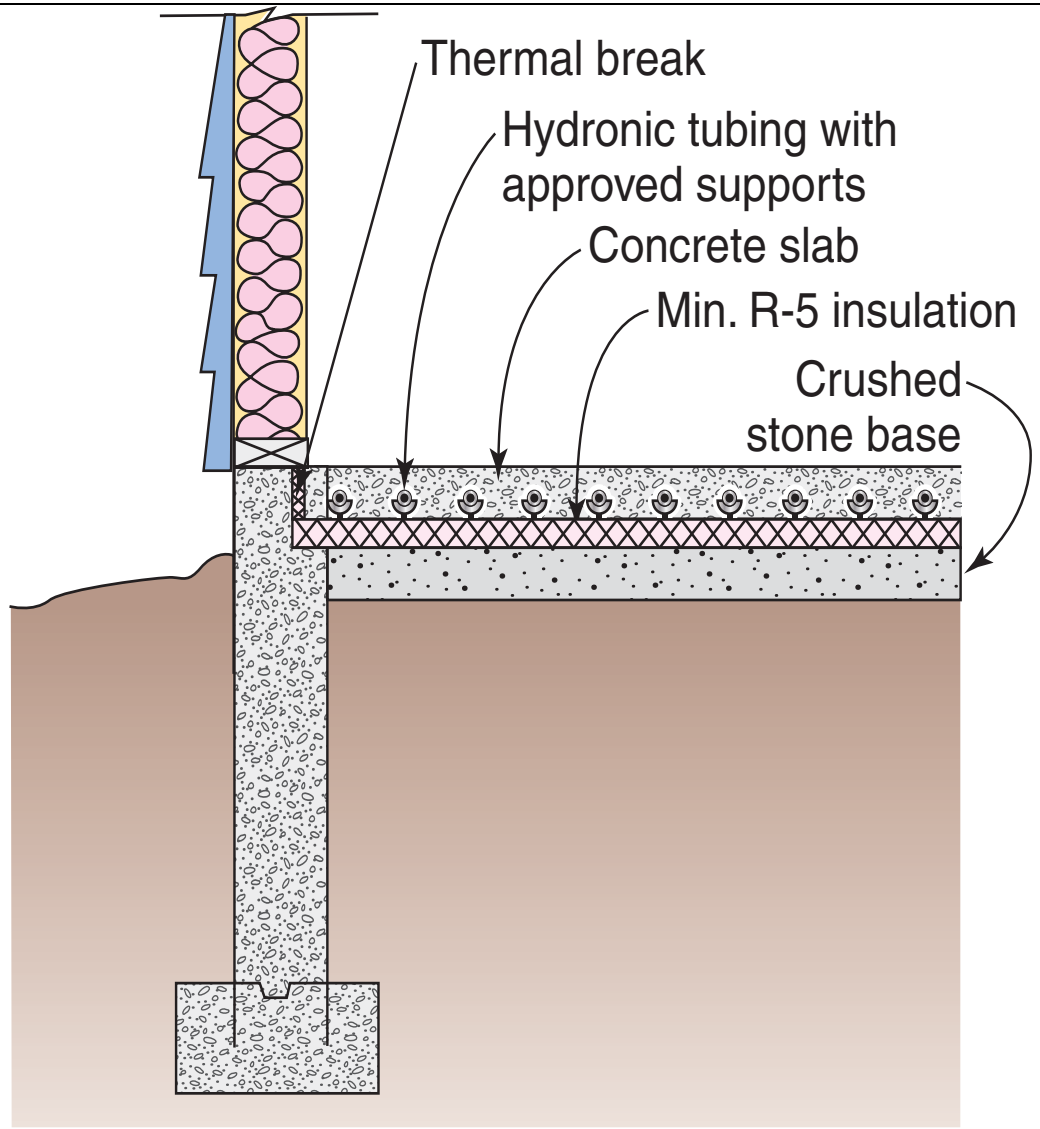
Hydronic Piping Slab/Floor Insulation Installation

IMC 1209.5

- *Radiant piping for:*
  - ***Slab-On-Grade Applications*** *(**NOT** inclusive of basement floors) to be provided min. R-5 insulation installed beneath the piping.*
  - ***Suspended Floor Applications*** *requires joist bay cavities serving the heating space above to have a min. R-11 insulation installed.*
- *Thermal break to be provided of asphalt expansion joint mat'ls or similar at point where a heated slab meets a foundation wall or conductive slab*



Hydronic Floor Heating System