

LEE HAUSER

(Accumulative) Supplement to the  
**NORTH CAROLINA STATE  
BUILDING CODE  
VOLUME III  
HEATING, AIR CONDITIONING,  
REFRIGERATION AND  
VENTILATION**

**1976 EDITION**

(All amendments noted as approved 6-8-76 become effective on September 15, 1976)

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and  
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Note: Please insert in back of 1971 Edition of the Heating Code

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The following Sections of the 1971 Edition of the N. C. State Building Code, Volume III, Heating have been amended by the Building Code Council as follows:

**Section 101.3(a) (1969 G.A.)**—Revise Section 101.3(a) to read as follows:

The code shall apply to all new buildings, structures, and additions thereto wherever they might be situated in the state of North Carolina.

This code shall not apply to farm buildings located outside the building regulation jurisdiction of any municipality. (see G.S. 143-138(b) and 160-138(c))

**Section 104.3—9-12-72—Meetings**—Amend the first sentence to read as follows:

“The Building Code Council shall meet regularly the second Tuesday in March, June, September and December.”

**Section 107—Amendments to the State Building Code**—Add the following sentence to the end of Rule #1 (a) of Section 107.1:

“In order for the filing to be placed on the agenda for the Building Code Council and to be heard at any regular or called meeting, such filing shall be complete with information required by these rules, together with all substantiating data required and must be filed in accordance with these rules at least 30 days prior to such scheduled hearings.”

**Section 108—Approved of Local Ordinances**—Change the numeral “15” to the numeral “30” in Rule #1 (c) of Section 108.2.

**Section 109—3-13-73—Alternate Materials and Methods of Construction**—Substitute the following wording for Section 109:

“Although a certain material, or a particular method of construction, is specifically prescribed by this Code, this Code is not intended to prevent the use of a material, or method of construction, different from the material, or method of construction specifically prescribed by the Code, provided any such alternate material or method of construction has been approved and its use authorized by the building official. The building official shall approve any such alternate material, or method of construction, provided the building official, in his sole discretion, finds that the proposed alternate material, or method of construction complies with the provisions of Chapter XII, and that the alternate material, or alternate method of construction is, for the purpose intended, at least the equivalent of that specifically prescribed by the Code in quality, strength, effectiveness, fire-resistance, durability and safety. The building official may require that sufficient evidence or proof be submitted to substantiate any claim that may be made regarding its use, and, in the opinion of the building official, the evidence and proof are not sufficient to justify his approval, the aggrieved party may refer the entire matter to the Building Code Council.”

**(6-11-74) Page V Foreword**—In sixth paragraph change “1970” to “1971.”

In chapter II *Definitions* make the following changes and additions:

**(6-8-76) Section 202**—At end of sentence change NFPA87M-1966 to “NFPA97M-1972”.

**(6-8-76)**—Add the following definitions:

**AIR COMBUSTION**—The air required to provide for the complete combustion of fuel and usually consisting of primary air, secondary air, and excess air.

**AIR FILTERS**—

- (a) Class 1 air filter is one which, when clean, does not contribute fuel when attacked by flame and emits only negligible amounts of smoke when tested by the Standard for Air Filter Units (UL 900-1971).
- (b) A Class 2 air filter is one which, when clean, burns moderately when attacked by flame or emits moderate amounts of smoke or both when tested by the Standard for Air Filter Units (UL 900-1971).

**AIR INLET**—An air inlet is any opening through which air is removed from a space back to a system.

**AIR OUTLET**—An air outlet is any opening through which air is delivered to a space from a system.

**AIR TERMINAL UNIT**—A device that receives air supplied through a duct system and, in turn, changes the temperature, pressure, volume, etc., of the air before delivering it to a space.

**APPLIANCE**—An appliance is utilization equipment, normally built in standardized sizes or types, which is installed or connected as a unit to perform one or more functions such as clothes washing or drying, food mixing, cooking, etc.

**BOILER ROOM**—Any room where a boiler is located. This equipment may be producing hot water or steam. For the purposes of this code, this definition shall not include rooms containing domestic type water heaters of less than one hundred-twenty (120) gallons storage capacity or rooms containing boilers in one and two-family residential occupancies (see also "Furnace room" and "Mechanical equipment room").

**CONDENSER**—A vessel or arrangement of pipe or tubing in which vapor is liquefied by the removal of heat.

**CONNECTOR, GAS APPLIANCE**—A listed product used to connect gas burning equipment to the building gas supply.

**CONFINED SPACE**—Any room or enclosed space that has a volume less than 12 times the total volume of a furnace or furnaces and 16 times the total volume of a boiler or boilers located in such room or space. If the actual ceiling height of the room or space is greater than 8 feet, the volume shall be figured on the basis of a ceiling height of 8 feet.

**COOLING UNIT—Self contained:** A self-contained refrigerating system which has been factory assembled and tested.

**COOLING UNIT—Split system equipment:** A refrigerating system the components of which are not self-contained.

**DUCT COVERING**—Duct covering includes materials such as adhesive, insulation, banding, coating(s), film and jacket used to cover the outside surface of a duct, fan casing or duct plenum.

**DUCT LINING**—Duct lining includes materials such as adhesive, insulation, coating and film used to line the inside surface of a duct, fan casing or duct plenum, exposed to air flow.

**DUCT RISER**—A duct which extends vertically one full story or more.

**DUCT SYSTEM**—A duct system is a continuous passageway for the transmission of air which, in addition to ducts, may include duct fittings, dampers, plenums, fans and accessory air handling equipment. May be part of the building construction.

**FURNACE, ATTIC**—A forced warm-air furnace designed and approved specifically for installation in an attic.

**FURNACE ROOM**—A room primarily used for the installation of fuel-fired-heating equipment other than boilers (see also "Boiler room" and "Mechanical equipment room").

**LISTED**—Equipment or materials included in a list published by a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of production of listed equipment or materials, and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner. The means for identifying listed equipment may vary for each testing laboratory, inspection agency, or other organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

**MACHINERY ROOM**—See Section 1902.42.

**MECHANICAL EQUIPMENT ROOM**—A room or space in which non-fuel-fired equipment is located (see also "Boiler room" and "Furnace room").

**PIPING, CONCEALED**—Piping, which, when in place in the finished building, would require removal of permanent construction to gain access to the piping.

**PIPING, HOUSE GAS**—House gas piping means the system of piping within a structure or a building, either exposed or concealed, which conveys gas from the outlet of the service meter or line to appliances at various places throughout the building.

**QUICK-DISCONNECT DEVICE**—A listed hand-operated device which provides a means for connecting and disconnecting an appliance or an appliance connector to a fuel supply and which is equipped with an automatic means to shut off the fuel supply when the device is disconnected.

**REFRIGERATING SYSTEM**—See Section 1902.56.

**SMOKE DAMPER**—A damper arranged to seal off airflow automatically through a part of an air duct system, so as to restrict passage of smoke. A smoke damper may be a standard louvered damper serving other control functions, if location lends itself to the dual purpose. A smoke damper does not need to meet all the requirements of a fire damper.

**SMOKE DETECTOR**—A smoke detector is a listed device which senses visible and invisible particles of combustion.

**SMOKE DEVELOPED RATING**—The smoke developed rating of a material is determined by the *Method of Test of Surface Burning Characteristics of Building Materials* (NFPA 255-1972).

**SMOKE PARTITION**—The smoke partition is an effective membrane, continuous from outside wall to outside wall and from floor slab to floor slab, thereby providing continuity through all concealed spaces, such as those found above a suspended ceiling and including interstitial spaces.

(6-8-76) Page 2-2—Masonry chimney—Add to end of definition: "(see Chapter 2700 of North Carolina Building Code Volume I)"

(6-8-76) Page 2-8—Change definition of "ROOMS LARGE IN COMPARISON WITH THE SIZE OF THE APPLIANCE" to the following: "See CONFINED SPACE"

(6-8-76) Page 3-1—Principle 3, paragraph a—Delete the words "home or."

\* (6-8-76) Page 3-2—Delete Principle No. 6. — *Foundations move to 521*

\* (6-8-76) Page 3-3—Delete Principle No. 9. — *Return Air to chpt 6*

(6-11-74) Page 3-3—Principal #11—Revise last sentence to read as follows: "Once a warm air heating system has been installed there shall be no further welding done on the heat exchanger or the warm air system, unless approved by the authority having jurisdiction."

(6-8-76) Page 3-3—Principle 12(a)—Delete: "See appendix for excerpt."

\* (6-8-76) Page 3-4—Delete: "Principle No. 16." — *Ductwork to chpt 6*

(6-8-76) Page 3-6—Delete: "Principle No. 19." — *Condensate to chpt 17*

(6-11-74) Page 3-7—Section 303.0—In heading change (General) to "(Residential)". In Section 303(a) change the word should in lines 1 and 2 to "shall."

In Section 303(b) change the word should in lines 2, 6, 7 and 10 to "shall."

(6-11-74) Page 3-8—In Section 303(c) change the word should in lines 3, 4, 6 and 8 to "shall."

(3-13-73) Page 3-10—Section 304.2—Delete item "304.2(b)(6)."

(6-11-74) Page 3-13—Table 2—Change the word "not" to "no."

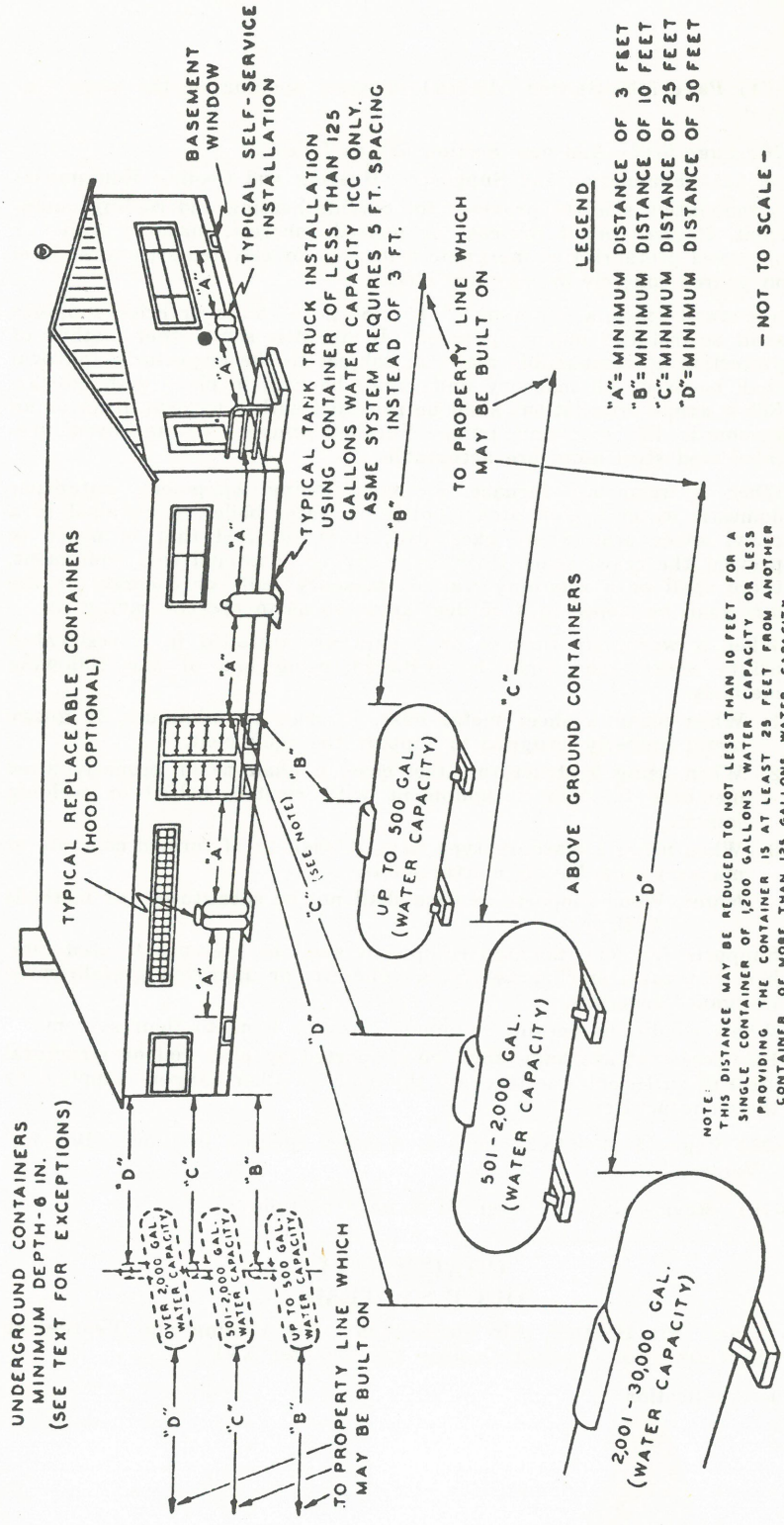
(6-8-76) Page 3-14—Section 305.2—Add (Residential and Non-commercial) to heading.

(6-11-74) Page 3-19—Section 305.10 I (f)—Delete this paragraph in its entirety.

(6-8-76) Page 3-26—Delete Sections "305.22, 305.23 and 305.24."

(6-8-76) Page 3-28—Section 305.25—Add to heading (Blower and Exhaust systems.)

(6-8-76) Page 4-3—Add new paragraph 404.0 as follows: 404.0 CONTAINER SPACING: Storage containers shall be located in accordance with Figure 404.0.



UNDERGROUND CONTAINERS  
MINIMUM DEPTH-6 IN.  
(SEE TEXT FOR EXCEPTIONS)

TYPICAL REPLACEABLE CONTAINERS  
(HOOD OPTIONAL)

BASEMENT WINDOW

TYPICAL SELF-SERVICE  
INSTALLATION

TYPICAL TANK TRUCK INSTALLATION  
USING CONTAINER OF LESS THAN 125  
GALLONS WATER CAPACITY ICC ONLY.  
ASME SYSTEM REQUIRES 5 FT. SPACING  
INSTEAD OF 3 FT.

TO PROPERTY LINE WHICH  
MAY BE BUILT ON

UP TO 500 GAL.  
(WATER CAPACITY)

ABOVE GROUND CONTAINERS

501-2,000 GAL.  
(WATER CAPACITY)

2001-30,000 GAL.  
(WATER CAPACITY)

LEGEND

- "A"= MINIMUM DISTANCE OF 3 FEET
- "B"= MINIMUM DISTANCE OF 10 FEET
- "C"= MINIMUM DISTANCE OF 25 FEET
- "D"= MINIMUM DISTANCE OF 50 FEET

NOTE:  
THIS DISTANCE MAY BE REDUCED TO NOT LESS THAN 10 FEET FOR A  
SINGLE CONTAINER OF 1200 GALLONS WATER CAPACITY OR LESS  
PROVIDING THE CONTAINER IS AT LEAST 25 FEET FROM ANOTHER  
CONTAINER OF MORE THAN 125 GALLONS WATER CAPACITY.

-- NOT TO SCALE --

FIGURE 404—CONTAINER SPACING

(6-11-74) Page 5-8—Section 512.2(a)—Correct spelling of the word “installed.”

(6-8-76) Page 5-17—Add new Section 521 as follows:

**Section 521—Foundation and Supports. (Heating and Cooling Equipment)**

- A. A foundation shall be provided for outside heating and cooling equipment. It shall be of pre-cast or poured concrete, masonry units or approved prefabricated inorganic materials, or elevated structural steel on poured concrete or masonry blocks.
- B. In a crawl space, a minimum of 4" x 8" x 16" block or brick supports shall be installed under equipment. In an attic some other method of protection of combustible material subject to the inspector's approval shall be used. All masonry units shall be held in place with mortar. Below grade installations shall be provided with a natural drain or an automatic lift or sump pump. Formed concrete or approved prefabricated steel units are acceptable.
- C. When a warm air furnace, air conditioning equipment, automatic domestic water heater, steam boiler or water boiler is installed in a crawl space area where excavated, it is required that in order to prevent the crawl space floor from caving in around said equipment, there shall be a retaining wall of masonry units or concrete or the dirt shall be sloped to a 45 deg. angle so as to prevent caving in.
- D. When a warm air furnace or boilers are installed in a residential utility room, they shall be installed using one of the following methods:
1. When using a sheet metal base, it shall be minimum 24 guage metal properly designed to support the equipment.
  2. When using a structural steel base, it shall be of properly sized members to support equipment with riveted, bolted or welding joints.
  3. When using a masonry type base, it shall be of formed concrete or masonry units having mortar joints.
- Note: Wood supports or base shall not be substituted for methods A, B, or C.
- E. Supports for roof mounted equipment shall be pressure treated lumber, structural steel, masonry or concrete, or approved prefabricated inorganic materials.
- F. Where conditions permit, equipment may be hung to floor system.
- G. Furnaces that are hung shall be supported by pipe, rod or structural steel of sufficient size to carry the load, or other hangers supplied by the manufacturer.

(6-8-76) Pages 5-10—513.2—Line 4: Correct spelling of word “Bolume” to “Volume.”

(6-8-76)—Revise all of Chapter VI to read as follows:

**CHAPTER VI  
DUCT SYSTEMS**

600—Warm Air Heating, Air Conditioning, Air Cooling and Ventilating Systems (For Comfort Cooling See Chapter XVII)

601.0—Application.



- A. This chapter applies to air duct systems employing mechanical means for the movement of air and used for heating and ventilating including warm air heating systems, plain ventilating systems, combination heating and ventilating systems, air cooling systems, air conditioning systems, and exhaust systems except that it does not apply to systems for removal of flammable vapors and residues nor to systems for conveying dust, stock or refuse by means of air currents.

**602.0—Construction of Ducts. —**

(Sections 602, 603, and 604 do not apply to systems serving one or two family dwellings or serving spaces having a volume of 25,000 cubic feet and less.)

- A. Ducts shall be constructed of iron, steel, aluminum, or other approved metal or non-combustible materials such as clay or asbestos cement. [For ducts used in a rated assembly see section 604(M)].  
Exception: Ducts constructed of Class 1 materials tested in accordance with Standards for Air Ducts UL-181 may be used for air duct systems when they comply with the following:
1. They are not used for vertical risers serving more than two stories.
  2. They are not used in systems which operate with a normal air temperature higher than 250°F.
  3. They are installed in accordance with the manufacturer's installation instructions.
- B. The materials, thickness and construction and installation of all ducts shall provide structural strength and durability so as to be safe to persons or property. Ducts shall be deemed as meeting these requirements if constructed, braced and reinforced in accordance with the requirements of the Sheet Metal and Air Conditioning Contractors National Association's Fibrous Glass Construction Duct Manual, Low Velocity Duct Construction Standard or High Velocity Duct Construction Standard or ASHRAE Guide and Data Book, whichever is applicable.
- C. Ducts may be of independent construction or a part of the building construction provided they are in accordance with the requirements of this code.
- D. Flexible connectors and ducts for use between ducts and air outlets, air inlets or air terminal units and which do not pass through floors of buildings, need not conform to the requirements for ducts, Section 602(a), if they conform to the following provisions and are approved for this use:
1. Connectors and ducts shall conform to the requirements for Class 1 materials when tested in accordance with Standard for Ducts UL-181.
  2. They shall not exceed 14 feet in length.
  3. They shall not pass through any fire wall or partition required to have a fire resistant rating of two hours or more.
  4. They shall not be used in concealed spaces of a rated assembly unless they have been tested for this service. (This does not prohibit the use of these connectors and ducts above lay-in type ceilings.)

- E. Flexible connectors and ducts which are for use between ducts and air terminal units may pass through one floor only provided they conform for their full length to the following provisions:
1. They shall be of material having a melting point of not less than 1700°F, classed as non-combustible as defined in Test for Noncombustibility of Elementary Materials (ASTM E-136) and conforms with the requirements for Class 1 air duct materials of Standard for Air Ducts UL-181.
  2. They shall not exceed 20 square inches in cross-sectional area.
  3. They shall not exceed 14 feet in length.
  4. They shall not pass through a wall or partition required to have a fire resistance rating of two hours or more. [See Section 1107 (e)]
  5. The penetration shall be firestopped in accordance with Section 604(c) of this code.
- F. Vibration isolation connectors in duct systems shall be made of woven asbestos or of an approved flame retarded fabric or shall consist of sleeve joints with packing of approved material having a flame spread rating of not over 25 and a smoke development rating of not over 50. Vibration isolation connectors of fabric shall not exceed 10 inches in length.
- G. A vibration isolation connector at the joint between duct and fan where the inlets to the fan, if of exhaust type, or the outlets from the fan are in the same room or enclosure as the joint shall be exempt from Section 602.0(f) if not over 10 inches in length.
- H. Duct coverings, linings, insulations including vapor barriers and core materials in panels used in duct systems shall have a flame-spread rating not over 25 without evidence of continued progressive combustion and with a smoke developed rating not higher than 50. If the coverings and linings are to be applied with adhesives, they shall be tested as applied with such adhesives, or the adhesives used shall have a flame-spread rating not over 25 and a smoke developed rating not higher than 50.  
Exception: Coverings need not meet these requirements where they are entirely located outside of a building and do not penetrate a wall or roof, and do not create an exposure hazard.  
Evidence shall also be offered that the duct coverings and linings will not flame, glow, smolder, or smoke when tested in accordance with *Test for Hot-Surface Performance of High-Temperature Thermal Insulation* (ASTM C411—1961) at a temperature to which it is exposed in service. In no case shall the test temperature be below 250°F.
- I. Equipment, such as fan coil units, self-contained air conditioning units, furnaces, etc., shall be considered to meet the requirements of 602(h) if they are listed.
- J. Work involving the use of torches shall not be undertaken on ducts until the system has been shut down, the duct cleaned and all combustible lining and covering material has been removed from the portion of the duct being repaired.
- K. Ducts shall be made reasonably tight throughout and shall have no openings other than those required for proper operation and maintenance of the system. Approved wire glass may be used for inspection

windows in ducts. Tape may be used for sealing joints but where exposed to the air in the duct, it shall be not more combustible than approved flameproof fabric.

*horizontal return  
air ducts,*

**603.0—Clean-out openings in ducts.**

- A. Return ducts, other than vertical, shall be so constructed that the interior is accessible for cleaning, except that accessibility is not required when the occupancy is not productive of combustible material, such as lint, dust or greasy vapors. Such occupancies include banks, offices, churches, hotels and institutions, but not kitchens, service rooms and manufacturing portions.
- B. Clean-out openings at approximately 20-foot intervals shall be provided where accessibility to facilitate cleaning is required and where the ducts are smaller than 18 x 24-inch. Removable grilles of adequate size and accessibility may be accepted as cleanout openings. Inspection windows if required shall be of approved wired glass.
- C. Supply ducts, other than vertical, shall conform to section 603(a) and 603(b) unless all of the supply air passes through either water spray or filters.

**604.0—Installation of ducts.**

- A. Ducts shall not be built into a building in such a way as to impair the effectiveness of the fireproofing around steel or iron structural members such as placing ducts between the fireproofing and the members protected, except in the case of structural members protected by a fire-resisting ceiling.
- B. The clearance from metal ducts to combustible construction including plaster on wood lath shall be not less than ½ inch. These clearances apply only to heating systems of the fuel burning type and those using electric resistance heaters.
- C. Where ducts pass through walls, floors or partitions the opening in the construction around the duct shall not exceed ½-inch average clearance on all sides and shall be firestopped by packing with mineral fiber or other approved material to prevent the passage of flame and smoke.  
Exception No. 1: This requirement may be disregarded where ducts are installed and enclosed as required under 604(e).  
Exception No. 2: Where fire dampers are installed their proper clearance to building construction shall be maintained.
- D. Where ducts pass through concealed spaces within a floor/ceiling assembly or a roof/ceiling assembly constructed of combustible materials or through partitions or walls constructed of combustible materials, either the ducts or the interior surfaces of such concealed ceiling space, partition, or walls shall be protected with ¼-inch asbestos or other approved insulating material, or a clearance of ½-inch (as specified in 604(b)) shall be maintained between ducts and all combustible materials. The integrity of fire-stopping shall be maintained. The spaces between the ducts and the fire-stopping shall be maintained. The spaces between the ducts and the fire-stopping shall be filled solidly with brick, mineral fiber, or other approved noncombustible material.

6. Electric heating equipment installed in drop ceiling area used as supply or return plenums shall be in accordance with the following:
  - (a) No electric resistance heating equipment not utilizing positive forced air movement across the heating element shall be installed.
  - (b) A minimum of three feet of duct shall be installed on the discharge end of any electric furnace or heater with the ductwork terminated in a bullhead tee.
  - (c) The heating unit must be provided with necessary controls to prevent operation of the heating element without air flow through the unit.
  - (d) A filter must be provided on the inlet side of the unit and the unit must be provided with a high limit control.
  - (e) Equipment shall be accessible for inspection, service and maintenance.

7. Fuel fired equipment shall not be installed.

Exception No. 2: The space between the ceiling and floor (or roof) of non-rated assemblies may be used as part of the duct system in all occupancies except assembly and institutional provided the space complies with the following:

- (1) No combustible materials shall be incorporated in the floor/ceiling or roof/ceiling assembly construction. No combustibles shall be installed in the plenum unless it is properly protected or has been tested and obtained a flame spread rating of 25 or less and a smoke developed rating of 50 or less. Electrical wiring including control and communication wiring is considered properly protected when installed in accordance with Section 300-21 and 300-22 of the National Electrical Code.
- (2) The ceiling is constructed to resist deformation or collapse during installation and use.
- (3) The ceiling material shall be made from a base material of metal or mineral and shall not be subject to deterioration or deformation on long exposure to temperatures of 250°F or conditions of high humidity, excessive moisture or mildew.
- (4) The ceiling material shall be supported by non-combustible material having a melting point above 1400°F.
- (5) The concealed space shall not be used on systems which operate with an air temperature higher than 250°F.
- (6) Electric heating equipment installed in drop ceiling area used as supply or return plenums shall be in accordance with the following:
  - (a) No electric resistance heating equipment not utilizing positive forced air movement across the heating element shall be installed.
  - (b) A minimum of three feet of duct shall be installed on the discharge end of any electric furnace or heater with the ductwork terminated in a bullhead tee.
  - (c) The heating unit must be provided with necessary controls to prevent operation of the heating element without air flow through the unit.
  - (d) A filter must be provided on the inlet side of the unit and the unit must be provided with a high limit control.
  - (e) Equipment shall be accessible for inspection, service and maintenance.

(7) Fuel fire equipment shall not be installed.

- I. Where access doors or panels are necessary in the ceiling of a floor and ceiling assembly or roof and ceiling assembly, which has been tested in accordance with the *Standard Methods of Fire Tests of Building Construction and Materials* (NFPA—1972), the door or panel shall be designed and installed to not reduce the fire resistance rating of the assembly.
- J. Where the installation of the hangers for the components of an air duct system penetrates an existing ceiling of a fire resistive floor and ceiling assembly or roof and ceiling assembly and requires removal of a portion of that ceiling, materials used to repair the ceiling shall provide a construction equivalent of the existing ceiling.  
Exception: In lieu of repair of the existing ceiling, another ceiling of the same construction may be installed below the duct system.
- K. Ducts shall not be located where they will be subject to damage or rupture. Where so located they shall be suitably protected.
- L. Ducts shall be substantially supported. Hangers and brackets for supporting ducts shall be of metal.
- M. Where ducts and openings are employed in a fire resistive floor and ceiling assembly or roof and ceiling assembly, the duct materials tested shall be used and such openings shall be limited in size and adequately protected to preserve the required fire resistance.

**605—Residential and Small Commercial Systems**

Section 606 through 609 apply only to central warm air heating and cooling systems including separate air cooling systems, combination heating and air conditioning systems, and to heat pump systems:

- A. Serving one or two family dwellings; or
- B. Serving spaces not exceeding 25,000 cu. ft. in volume in any occupancy.  
Exception: For buildings of combustible construction exceeding three stories in height. Sections 602, 603 and 604 shall apply.

**606—Duct Materials**

- A. Except as permitted in paragraphs 606 <sup>b</sup>, <sup>c</sup> and <sup>d</sup> supply and return ducts shall be constructed of sheet metal having a nominal thickness as shown in the following table, Class 0, Class I or other non-combustible materials.

**Round Ducts and enclosed rectangular ducts**

Diameter or Width (in.)	Nominal Thickness (inches)	Equiv. Galvanized Sheet Gage Number	Approximate Aluminum B & S Gage
14 or less	0.016	30	26
over 14	0.019	28	24
<b>Exposed Rectangular</b>			
14 or less	0.019	28	24
over 14	0.022	26	23

- B. Class 2 duct materials may be used for supply and return ducts in single family dwelling only, except for ducts located within three feet of the bonnet or plenum and ducts located directly above the heating surface of the unit.
- C. Return ducts except those directly above the heating surface or within two feet of the outer jacket may be one inch nominal wood boards

(Flame spread classification of 200) or other suitable material which is not flammable than one inch boards.

- \* D. Ducts installed in or below concrete floors or slabs shall be of metal completely enclosed in two inches of concrete or other materials specifically designed for this purpose and installed in accordance with the manufacturer's installation instructions. Materials other than metal shall not be installed within two feet of a furnace plenum or within two feet of a vertical connection to a riser or register.
- E. Vibration isolation connectors in duct systems shall be made of approved flame retarded fabric or shall consist of sleeve joints with packing of approved noncombustible material. Vibration isolation connectors of fabric shall not exceed 10 inches in length.

607—Construction and Installation of Ducts—Duct systems shall be constructed and installed in accordance with Section 602(b) and the following:

- A. Radius elbows or turning vanes shall be required in supply duct and shall not diminish the cross sectional area or throat.
- B. Balancing dampers shall be installed in each branch supply duct. A register or diffuser damper shall not be used as a balancing damper.
- \* C. All metal ductwork for heating and cooling installed in an attic shall be insulated. All metal supply ductwork installed in a ventilated crawl space or other non-conditioned area shall be insulated. Metal heating ductwork installed in a basement, cellar or unventilated crawl-space with properly insulated walls need not be insulated. Insulation shall be a minimum of 2" thick  $\frac{3}{4}$  pounds density flexible blanket or 1" thick  $1\frac{1}{2}$  pounds density, rigid. Other equivalent insulation, lining or duct materials having a minimum thermal conductance value of 0.23 at 75°F may be used. External insulation shall have a vapor barrier having a permeance of 0.05 perms or less, or aluminum foil having a minimum thickness of 2 mils. Insulating materials including adhesives shall have a flame spread rating of not more than 25 and a smoke developed rating of not more than 50.
- D. All ductwork shall be sized in accordance with the ASHRAE Guide, SMACNA Standards and/or other acceptable warm air and air conditioning manuals. Joints and seams shall be securely fastened and made substantially air tight. Slip joints shall have a lap of at least one inch and shall be individually fastened.
- E. When installing round pipe for air distribution systems and/or for furnace venting systems and/or for exhaust systems, any change of direction from a straight line run shall be made with a factory-made fitting or equal approved by the inspector.
- \* F. Ducts and plenums shall not be installed within four inches of the ground. Ducts installed in and/or under slab floors shall be waterproofed and/or have an acceptable method of drainage.
- G. Cutting a hole in a plenum or duct system and inserting the pipe in the opening or field dovetailing is prohibited. Take off fittings shall be used. All plenums shall be constructed of approved materials.
- H. Joints in all round pipe shall be secured with three or more sheet metal screws.
- I. Tape shall be used for sealing joints but where exposed to the air in the system, it shall not be more combustible than flameproofed fabric complying with STANDARD METHODS OF FIRE TESTS FOR FLAME-RESISTANT TEXTILES AND FILMS, NFPA 701 (1969).

maximum

- J. Ducts shall be securely supported by minimum 1" wide metal hangers, straps, lugs or brackets. No nails shall be driven through the ducts walls and no unnecessary holes shall be cut therein. Galvanized wire may be used for hangers when approved by the inspection official having jurisdiction.
- K. Where the installation of supply ducts in walls, floors, or partitions requires the removal of any firestopping, the spaces around the duct at such points where firestoppings was removed shall be sealed with noncombustible insulating material.
- L. Covering of exposed vertical supply ducts. Where vertical heating supply ducts are exposed in closets or rooms, they shall be covered or lined at least ¼-inch approved fire resistant insulation or other approved methods.
- M. Except where listed for specific clearances, ductwork shall have the following minimum clearances from construction of combustible materials:
  - 1. Horizontal supply ducts within three feet of the furnace plenum shall have a minimum clearance of two inches.
  - 2. A vertical duct, riser, boot or box connecting to a supply duct within three feet of the furnace plenum shall have a minimum clearance of two inches or the duct shall change directions equivalent to two 90 degree turns before entering the combustible construction.
  - 3. No clearance is required for ducts beyond the distances noted in 1 and 2 above.
  - 4. No clearance is required for ducts used solely for air conditioning, environmental exhaust and ventilating systems.
- N. Where a main supply duct enters the floor of the first story above that in which the furnace is located, the space around the duct at such points shall be sealed with asbestos cement or other noncombustible material.

#### 608—Use of Concealed Ceiling Spaces as Supply or Return Plenums

When concealed ceiling spaces are to be used for air chambers or plenums, the following shall apply:

- A. No concealed ceiling space plenum shall serve more than one story of such building. This shall not preclude separate installations on each floor.
- B. The concealed space plenum shall be separated from any other concealed spaces and shall be completely enclosed with construction not more flammable than one inch (nominal) wood boards. (Flamespread classification not exceeding 200).
- C. Such spaces shall not be used for storage.
- D. No exhaust systems shall discharge into such spaces.
- E. Units supplying such spaces shall be designed to limit the temperature of the air discharged into the supply plenum or chamber to 165 degrees F.
- F. Where units incorporate heating elements, heated surfaces, or combustion chambers, developing temperatures higher than 165 degrees F., such components shall be shielded so as to prevent direct radiation onto combustible material when the unit is installed.

- G. Any duct used to convey heated air to or from the air changer or plenum to distant rooms shall conform to Sections 606 and 607.
- H. The installation of the unit supplying such spaces shall not produce negative pressure in the attic when the attic is the source of air for combustion for fuel fired equipment.

**609—Use of Under Floor Space as Supply Plenum**—When heated air is discharged downward into an air chamber which forms a plenum of an under floor space, the following shall apply:

- A. Use of such spaces shall be restricted to one story portions of single family dwellings.
- B. Such spaces shall be not more than 24 inches in height to the bottom of floor joists, shall be cleaned of all combustible material and shall be tightly and substantially enclosed.
- C. The enclosing material of the under floor space including the side wall insulation shall be not more flammable than one-inch (nominal) wood boards (Flame spread classification of 200). Combustible ground cover shall be covered over with at least two inches of sand or other noncombustible material.
- D. Access, if provided to such spaces, shall be through an opening in the floor and shall not be less than 24 by 24 inches.
- E. The furnace supplying warm air to such space shall be equipped with an automatic control that will start the air circulating fan when the air in the furnace bonnet reaches a temperature not higher than 150°F. Such control shall be one that cannot be set higher than 150°F.
- F. The furnace supplying warm air to such space shall be equipped with an approved temperature limit control that will limit outlet air temperature to 200°F.
- G. Floor registers shall be designed for easy removal.
- H. Exterior walls and interior stud partitions shall be firestopped at the floor.
- I. Each wall register shall be connected to the air chamber with a duct or boot complying with Sections 606 and 607.
- J. Supply ducts to the air chamber shall comply with the provisions of Sections 606 and 607 and shall terminate approximately under the center of a room above, at a distance of not less than six feet from the plenum chamber.
- K. Furnaces, boiler's or other heat-producing appliances shall not be installed in such a supply plenum.
- L. The "U" value of the insulated foundation walls shall not exceed 0.17. A vapor barrier shall be provided within the foundation perimeter with joints lapped two inches. The vapor barrier shall be equal to or greater than polyethylene film of 4 mil thickness.

**610—Return-Air Intakes for Residences**

- A. If only one central return air grille is installed, it shall be of proper size. The size shall be sufficient to return a volume of air compatible with the CFM requirements and temperature rise limitations specified by the equipment manufacturer. The face velocity of return air grilles shall not exceed 450 feet per minute. At least one separate return shall be installed on each level of a multilevel structure. For split-



level and split-foyer structures one return may serve more than one level if located near the levels served and the total area of the levels does not exceed 1600 square feet. Return air grilles shall not be located in bathrooms or kitchens. This does not prohibit the installation of a return grille in a combination kitchen-dining room or kitchen-living room if the grille is not located within 10 feet of the cooking appliance.

- B. In buildings with 1600 square feet or less of conditioned area, a central return is permitted. When the building contains more than 1600 square feet of conditioned area, additional returns shall be provided. Each return shall not serve more than 1600 square feet of area and shall be located in the area it serves. Return air may travel through the living space to the return air intake if there are no restrictions, such as solid doors, to the air movement. When panned joists are used for return air, the structural integrity shall be maintained. Air capacity for joists 16" on center shall be a maximum of 375 CFM for 8" joists and 525 CFM for 10" joists. Wiring shall not be located in joist spaces used for return air ducts.

#### 611—Air Filters

- A. Air filters are required and shall be of an approved type that will not burn freely or emit large volumes of smoke or other objectionable products of combustion when exposed to flames. Filters qualifying as Class I and Class II shall be accepted as meeting these requirements. An evaporative cooler containing a combustible filter or water evaporation medium such as excelsior shall not be used.
- B. Liquid adhesive coatings used on filters shall have a flash point of 325°F, Cleveland Open Cup test or higher.

#### 612—Registers

- A. Floor registers shall be of metal or other approved material designed to resist without structural failure a 200 pound concentrated load on a two-inch diameter disc applied at the most critical area of the exposed face of the register when the temperature of the register is a minimum of 165°F. The material for non-metallic registers shall meet equivalent requirements of Class 2 duct materials.
- B. Wall and ceiling registers shall meet the requirements of above except the structural failure test is not required.
- C. Registers of combustible material shall not be used in buildings of residential, institutional, schools and assembly occupancies and shall be approved in other occupancies by the authority having jurisdiction.

(6-11-74) Page 8-2—In Section 803.3(a)(1) change Section 2708.3(a) to "803.3(a)."

(3-13-73) Page 9-1—Section 901—In Sixth line of paragraph add "schools" between "institutional" and "and."

(3-13-73) Page 9-2—Section 903.4(b)(1)—Delete the "Exception" in this section.

(6-11-74) Page 9-2—Section 903.4(b)(2)—Add new paragraph "(ee)" under sub-paragraph III to read as follows: "The shaft or enclosure shall be used exclusively to enclose a single grease exhaust system."

(6-11-74) Page 9-2—Section 903.4(f)—At the end of the sentence delete “unless fire dampers are used.”

(6-11-74) Page 9-3—Section 903.4(h)(3)—In first and second sentence delete “Aluminum or fiber glass.”

(6-11-74) Page 9-3—Section 903.4(i)(1)—Revise to read as follows: “With at least forty (40) inches clearance from the outlet to the nearest roof surface.”

(6-11-74) Page 9-4—Section 905(b)(1)—Revise to read as follows: “(1) Materials. Grease filters, including frames or other grease removal devices shall be UL listed.”

Page 9-5—Change the paragraph designation “I” to “909.”

Page 9-8—Section 918.0—In paragraph (g) change “908.0” to “918.0.”

(6-11-74) Page 11-2—Section 1107(c)—Delete first paragraph beginning with “Fire dampers shall be—” and ending with “—Building Official is granted.”

(6-11-74) Page 11-3—Section 1107(e)—Revise paragraphs 1107(e)(1) through (3) to read as follows:

(e) **INSTALLATION OF APPROVED FIRE DAMPERS**

Approved fire dampers shall be installed in the following locations:

(1) **OCCUPANCY SEPARATIONS**—In ducts or openings piercing occupancy separations of 2 hours or more as required by Vol. I, N. C. State Building Code, Sec. 412.

(2) **CEILING PROTECTION**—When dampers are selected as the means of protecting the opening. (See specific designs in U.L. Fire Resistance Index, and alternate methods approved for use.)

(3) **WALLS AND PARTITIONS, INCLUDING SHAFT WALLS**—Penetrations of enclosures required by this Code or Volume I of N. C. State Building Code to have fire resistance ratings as follows:

A. 2-hours or more (not fire walls). All such penetrations.

B. 1-hour. As follows:

(1) Air transfer openings not protected by proper ducts, as defined in (3) below.

(2) Air transfer openings, with or without proper ducts, in enclosures for exits and for boilers and furnaces where the enclosures are required by this Code or by Volume I, N. C. State Building Code.

(3) Proper ducts, as used above, shall mean:

(a) Sheet steel ducts meeting the requirements of Chapter VI.

(b) Protection of the opening by having not less than ½” clearance of the duct from combustible material, sealing the clearance space with non-combustible material retained, and the duct secured in the opening, by steel collars of a gage equivalent to that of the duct and fastened to both the duct and the enclosure, or other approved method affording equivalent protection.”

(6-11-74) Page 11-4—Section 1108—Add note under this section to read as follows: "Note: Refer to Section 1127, Volume I of the North Carolina Building Code for requirements as to where smoke detectors shall be provided."

(6-11-74) Page 12-5—Section 1205—Add the following sub-paragraphs, c, d, e, f, and g as follows:

- (c) In systems between 2000 cfm and 15,000 cfm capacity, fans shall be arranged to shut down automatically when the temperature of the air in the system becomes excessive, as from a fire. For this purpose, approved fixed temperature thermostatic devices shall be provided as follows: —with a setting not in excess of 136 degrees F., at a suitable location in the return air stream prior to exhausting the building or being diluted by outside air, or with a setting not in excess of 50 degrees F, above the maximum operating temperature, at a suitable location in the main supply duct on the downstream side of the filters. Either of the thermostatic device shall be of the type that is manually reset or the control system shall be so arranged that some manual operation is required to restart the fan after the thermostatic device has operated. Smoke detectors approved for duct installation may be used in lieu of the thermostatic devices.
- (d) Except as required in 1205(b), in systems of over 15,000 cfm capacity, smoke detectors approved for duct installation shall be installed and arranged to automatically shut down fans. For this purpose, smoke detectors approved for duct installation shall be provided as follows: At a suitable location in the return air stream prior to exhausting from the building or being diluted by outside air, or at a suitable location of the main supply duct on the downstream side of the filters. Smoke dampers shall be installed in such a manner as to restrict circulation of smoke, and arranged to close automatically when the system is not in operation, and also by operation by the smoke detecting apparatus and by the manual emergency fan stop.
- (e) Systems incorporating automatic exhaust rather than automatic fan shut down may be used in lieu of the requirements in (c) and (d), subject to the authority having jurisdiction. Automatic smoke detection shall be provided for such systems.
- (f) In systems of 15,000 cfm capacity, and under, effective means of detecting and controlling the spread of smoke in air conditioning systems is recommended in premises where the panic hazard is pronounced or where there are valuable contents particularly subject to smoke damage. [See also (b)].
- (g) Fire and smoke detectors covered by this standard are not to be construed as a substitute for complete area protection afforded by an approved fire detection system as covered by NFPA No. 71, 72A, 72B, 72C, 1972 Editions, and 72D, 1973 Edition. When such an approved fire detection system is installed in the building, the fire and smoke detectors in (b), (c) and (d) shall be connected thereto in accordance with approved practice so that actuation of any fire or smoke detector will sound the alarm as well as provide the function of controlling the ventilation system.

(6-11-74) Page 14-6—Section 1406(b)—Correct spelling of "pipe" in first sentence.

(6-8-76) Page 14-11—Section 1411.0—Add new paragraph "c" as follows:  
(c) Appliance Shutoff Valves—Any appliance connected to a piping system

shall have a manual shutoff valve or cock of an approved type located within 2'-0" of the appliance it serves except when connectors are permitted the manual shutoff device may be located a maximum of 6'-0" from the appliance casing. In either case, the shutoff device shall be accessible from the appliance and located in the same room as the appliance but shall not be located within the appliance casing.

(6-11-74) Page 14-14—Section 3.2.1(d)—Delete the last paragraph beginning with "aluminum alloy tubing—", and ending with "with exterior locations."

(6-11-74) Page 15-1—Section 1500—Delete "local ventilation ordinances may require greater quantities of outdoor air" from last sentence of first paragraph.

(6-11-74) Page 15-2—Section 1502—Change reference in third sentence from 906(b) to "903.4(b)."

(6-11-74) Page 15-2—Section 1502(b)—Change reference to G-16 to "Figure 4, Page A-138 of Appendix G."

(6-11-74) Page 15-6—Section 1507—Delete paragraphs "n" and "o."

(6-11-74) Page 16-1 and 16-2—Section 1601—Change the dates on the NFPA references in accordance with the following: Change NFPA 31-68 to "NFPA 31-72", Change NFPA 33-69 to "NFPA 33-73", Change NFPA 90A-69 to "NFPA 90A-73", Change NFPA 90B-68 to "NFPA 90B-73", Change NFPA 91-61 to "NFPA 91-73", and Change NFPA 96-69 to "NFPA 96-73."

(6-8-76)—Section 1602—Page 16-3—Revise second sentence to read as follows: "There shall be no direct opening between a room containing equipment using Group 2 or Group 3 refrigerants and a boiler room."

(6-8-76)—Section 1604—Page 16-3—Revise to read as follows: "Refer to Chapter 19 of this code for requirements governing equipment located in refrigeration machinery rooms."

(6-11-74)—Page 16-4—Add new Section 1605 to read as follows: 1605—*Rooftop Mounted Equipment*—Fire dampers are required only in ductwork which penetrates a fire rated roof assembly and is attached to a roof mounted unit, containing gas or oil fired equipment, having a clearance of less than 18" from the bottom of the unit and the roof surface. Fire dampers shall be located at the roof line.

(6-8-76) Page 17-2—Add the following new sections:

#### 1704.0—Refrigerant Piping

Refrigerant piping, valves, fittings and related parts shall be in accordance with paragraph 1908.4 of this code.

All suction lines of systems shall be insulated to prevent sweating and heat gain. Liquid lines shall be insulated only when they are located in areas of very high temperatures to minimize heat gain. Hot gas lines shall be insulated where there is a possibility of people being burned by the pipe.

#### 1705.0—Condensate Drains

(a) Condensate drains from air conditioning units shall be sized and in-

stalled in accordance with the unit manufacturer's recommendations. Condensate drains shall be piped to the outside of a building, natural drain, dry well, lavatory, service sink, roof drain or storm sewer, connected directly to the drainage piping between a lavatory, service sink or lab sink and its trap, or connected indirectly (air gap) to a properly trapped and vented connection to the sanitary drainage or vent systems. Dry wells shall be installed outside the building and condensate shall drain into the well by means of an air gap. If none of these solutions are possible, an automatic sump pump shall be used.

- (b) In attics, above ceilings or other areas where condensate damage may occur, an auxiliary drain pan shall be installed under the cooling and or heating equipment, with the equipment having a separate drain. In lieu of an auxiliary drain pan, a float switch may be added to the condensate pan and wired into the control or electrical circuit of the equipment in such a way that the equipment may be cut off when excessive condensate accumulates in the pan.
- (c) Condensate drainage may be connected directly into a storm sewer, or roof leader.
- (d) Condensate shall not be piped to ground under a building or crawl space or allowed to flow across a sidewalk or concrete floor to a floor drain.

(6-8-76)—Delete Appendix "A", Appendix "B", Appendix "C" and Appendix "E".

Add Appendix K Recommended Construction for Ductwork.

*Note:* These tables are not included with these amendments but may be found in Chapter 1, Pages 3 through 5 of the 1972 ASHRAE Guide.

JAN 77 RATES

Crawl SPACE

HEAT Loss only - 2 1/2 Ton Heat Pump, 1125 CFM  
 Supply - 100ft - 100° Supply - 35° Amb  
 Return - 20ft - 70° Ret. - 35° Amb

Supply -

Insulation In.	Heat Loss	COST OF ENERGY
0	22,040	129.75
1	5,220	30.73
1 1/2	4,060	23.90
2	2,900	17.07
Return		
0	2508	14.77
1	594	3.50
1 1/2	462	2.72
2	330	1.94

No Ins vs. 2" =  $1.13/\text{ft supply} + .64/\text{ft ret} = 1.77/\text{ft}$

1 1/2 vs 2" =  $.54/\text{ft sup} + .44/\text{ft ret} = .98/\text{ft}$

ATTIC

Supply	Loss	GAIN	TOTL LOSS	TOTAL COST
1 1/2	6020	2940	7960	49.42
2	4300	2100	6400	35.33
			1560 <sup>80/142</sup>	14.58

Return:

1 1/2	686	392	1078	5.91
2"	490	280	770	4.22
			308	1.69

1 1/2 vs 2" =  $1.44/\text{ft. supply} + .854/\text{ft ret} = 2.294/\text{ft}$