



RCO Section 106 Commentary

Section 106 Construction documents.

The importance of this section of the OAC cannot be emphasized strongly enough. The quality of the information submitted provides the only substantive tool for clearly communicating the intent and the extent of the proposed work. Without this information, a residential department cannot fulfill its duty to assure that the built environment is safe and sanitary. The building department is not certified to provide design-consulting services to the public in lieu of the submission of adequate constructions; it is to enforce, on behalf of citizens, regulations that assure safety. This rule actually contains a minimal list of items that must be included in construction document submission to be deemed adequate.

106.1 Submittal documents. Residential construction documents and other data shall be submitted in two or more sets with each application for an approval. Before beginning the construction of any residential building for which construction documents are required under section 105, the owner or the owner's representative shall submit construction documents to the residential building official for approval. When construction documents have been found to be in compliance with the rules of the board of building standards in accordance with section 106.3 by a certified residential building department, that compliance shall be deemed sufficient to obtain approval for construction pursuant to section 105.7 and the residential building official shall issue the certificate of plan approval.

This requirement permits one copy of the approved construction documents to be held by the certified residential building department and one to be placed at the construction site. If there is a need for additional sets for wider departmental distribution or other reasons, a certified residential building department has the authority to request them under ORC 3791.04(D). Likewise, if the owner needs additional approved sets of construction documents, the building department should, when provided by the owner, endorse any additional sets in the same manner as the sets mentioned in this section.

This rule is drawn from rule section 101.2 and **prohibits** any 1-, 2-, or 3-family residential building, including a building's equipment or appurtenances, which are covered by the Residential Code of Ohio (RCO) from being completed without complying with the RCO. It is important to note that the residential building includes its equipment such as plumbing, electrical, mechanical, and other components.

This rule reflects the requirement in the Ohio Revised Code that **before** work begins, construction documents must be submitted to a building official in whose jurisdiction the work will be done. This submission must receive approval prior to beginning the proposed work. Ohio Revised Code (ORC) section 3781.12 is one of the places in law stating that codes cannot be enforced retroactively. It is this section of the law that specifies how petitions are to be submitted to change the code. Because the code can be updated or modified over time, the law controls the effect of new provisions on existing buildings by stating:

"Any such rule or regulation or amendment or annulment thereof shall not take effect until a date fixed by the board and stated therein. No such rule, regulation, amendment or annulment shall apply to any building the plans or drawings, specifications, and data of which have been approved prior to the time such rule, regulation, amendment, or annulment takes effect."

This language thereby protects building owners from having to perpetually make changes to their buildings because of code changes after their building project is completed. When an owner has, in good faith, complied with the codes in effect when work was done, the law recognizes the validity of the building approval. This protection applies as long as the building is maintained consistent with its approval and with no serious hazards present; there can be no denying the use of this tangible asset.

106.1.1 Information on residential construction documents. Residential construction documents shall be *dimensioned and* drawn upon suitable material. Electronic media documents are permitted to be submitted when approved by the residential building official. Construction documents shall be *coordinated and* of sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that it will conform to the provisions of this code. *Construction drawings, shall include information necessary to determine compliance with the building, plumbing, and fire protection codes such as:*

When the Residential Building Official receives construction documents for review, they must be:
- Clear: free from confusion or ambiguity

- Coordinated: the construction documents reflect a consistency and congruency of work product among various consultants when dealing with relevant components of a project
- Detailed: marked by careful attention to detail

The language also states that the construction documents must describe the proposed building, any additions or alterations to buildings, and all building equipment to be able to determine compliance with the RCO. These components become a part of the document review process.

1. Index. *An index of drawings located on the first sheet;*

In order for a plan examiner to be able to properly ascertain compliance with the OBC, information on the residential building must be submitted. An organized set of construction documents will speed the review and allow the plan examiner to ascertain compliance in the timeliest manner. An index is a good tool to assist in the review of the documents. This could be on the cover sheet of any large set or in a block on the first page of construction documents submitted for review. Judgment should be used when dealing with small sets of documents that can easily be identified as to whether an index is really helpful or needed.

2. Site plan. *A site plan showing to scale the size and location of new residential construction and all existing structures on the site, including setback and sideyard dimensions, all property and interior lot lines, distances from lot lines, the locations of the nearest streets. In the case of demolition, the site plan shall show construction to be demolished and the location and size of existing structures and construction that are to remain on the site or plot. The residential building official is authorized to waive or modify the requirement for a site plan when the application for approval is for alteration or repair or when otherwise warranted.*

2.1. Residential buildings or structures located in flood hazard areas. *Construction documents submitted for residential buildings or structures located in communities with identified flood hazard areas shall include the current FEMA “Flood Hazard Boundary Map” (FHBM), “Flood Insurance Rate Map” (FIRM) or “Flood Boundary Floodway Map” (FBFM) for the project location. The required site plan shall include building elevations using the same datum as the related flood hazard map. The owner shall be responsible for the compliance with local flood damage prevention regulations for additional critical elevation information for the project site.*

3. Floor plans. *Complete floor plans, including plans of full or partial basements and full or partial attics. Floor plans must show all relevant information such as door swings, stairs and ramps, windows, shafts, all portions of the means of egress, etc., and shall be sufficiently dimensioned to describe all relevant space sizes. Wall materials shall be described by cross-hatching (with explanatory key), by notation, or by other clearly understandable method. Spaces must be identified by how each space is intended to be used;*

4. Exterior wall envelope. *The residential construction documents shall provide details of the exterior wall envelope as required, including flashing, intersections with dissimilar materials, corners, end details, control joints, intersections at roof, eaves, or parapets, means of drainage, water-resistive membrane, all elevations necessary to completely describe the exterior of the residential building including floor to floor dimensions, and details around openings.*

In order to adequately describe the project, some information needs to be provided for the details used in building a residential structure. Since this code can be used for 1-, 2-, or 3-family structures, flashings, intersections, corners, joints, membranes, rated assemblies, etc. become very important. Fire histories and research have clearly shown that an important threat to occupants is the location of the fire resistant elements in a structure. Especially important are penetrations when they are necessary and permitted. The designer of record or the owner must indicate the method in which these penetrations are to be closed and protected to maintain the integrity of the systems installed in a building to manage risks.

Again, without this information, a plan examiner cannot complete the construction document review.

5. Sections. *Cross sections, wall sections, details including typical connections as required to fully describe the residential building construction showing wall, ceiling, floor and roof materials. Residential construction documents shall describe the exterior wall envelope in sufficient detail to determine compliance with this code.*

6. **Structure.** Complete structural description of the residential building including size and location of all structural elements used in the design of the residential building and other data as required to fully describe the structural system;
7. **Ratings.** The fire-resistance ratings of all structural elements as required by this code, data substantiating all required fire-resistance ratings including details showing how penetrations will be made for electrical, mechanical, plumbing, and communication conduits, pipes, and systems, and the materials and methods for maintaining the required structural integrity, fire-resistance rating, and firestopping;
8. **System descriptions.** Description of the mechanical, plumbing and electrical systems, including: materials; location and type of fixtures and equipment; materials, and sizes of all ductwork; location and type of heating, ventilation, air conditioning and other mechanical equipment; and all lighting and power equipment;

An adequate description of electrical, plumbing, or mechanical systems are essential to assuring that the project can be built safely and will meet electrical, energy, and sanitary requirements in Ohio law. This description may take the form of a drawing, isometric, written description, table, schedule, specification, or any other form or method of adequately describing the proposed work and the systems that are a critical part of the building's service equipment that the owner chooses to submit. The system descriptions must include:

Mechanical – Equipment Type/Size, Location of Equipment, Type of Fuel, Heat Gain/Loss, Square Footage of Conditioned Space, Duct Size (Supply/Return), Equipment Efficiency Ratings

Electrical – Service Size (General Loads, HVAC Loads, Total Loads), Panel Location in Dwelling, Size of Service Entry Cable, Location of Service (Overhead, Underground)

Plumbing – Fixture Locations

and be verified by the building official. A specific plan is not required for each of these descriptions. Examples of forms that owners can use to describe and submit this system information are included below. Narrative descriptions, graphic, or other pictorial documents could also be submitted.

9. **Additional information.** Additional graphic or text information as may be reasonably required by the residential building official to allow the review of special or extraordinary construction methods or equipment.

106.1.1.1 Fire protection system drawings. Construction documents for the fire protection system(s) shall be submitted to indicate conformance with this code and shall be approved prior to the start of system installation.

Because residential building departments could mistakenly issue full plans approval without the receipt of the completed fire protection package, if one is planned to be installed, as a part of the construction documents, it should expect to receive them at some point but issue a conditional approval to allow the project to begin. The fire protection drawings can be submitted later at which time the project can receive a full approval. Full approval of incomplete construction documents implies that nothing additional is technically required. It also implies that partial or incomplete construction documents are approved construction documents. This leaves the inspector with no approved document to inspect against for compliance in the field. Inspectors should never direct work in the field but this practice can place them in a position that can lead to arbitrary or inconsistent inspections.

106.1.2 Manufacturer's installation instructions. Manufacturer's installation instructions, as required by this code, shall be available on the job site at the time of inspection.

The residential building official must be assured that any materials, equipment, or components are used as is recommended by the manufacturer. Providing manufacturer's installation guidelines to the building official will assure that the inspections are done properly to assure that they are installed properly. Some of this information may be submitted after the project begins if that information is for part of the work has not yet been incorporated into the project. This could be accomplished using a partial or a conditional approval of the construction documents. Once all information is received and approved, a full plan approval can be issued.

106.2 Amended construction documents. *If substantive changes to the residential building are contemplated after first document submission, or during construction, those changes must be submitted to the residential building official for review and approval prior to those changes being executed. The residential building official may waive this requirement in the instance of an emergency repair, or similar instance.*

While many will claim that this requirement seems burdensome, it really is only a matter of having the residential building official included in the distribution process for proposed changes. Changes to projects are often made after initial plan approval and the changes usually involve a modification of the contract amount or contract time. When these changes are planned, change orders are commonly written and documentation is prepared to seek modification of the contract amount, the contract time, or both.

This section requires that prior to incorporating these changes into the work, the changes anticipated and described in change order documentation must be reviewed and approved by the building official. Otherwise, the residential inspector has no way of determining whether the work being done is in accordance with the RCO. The inspector is not certified to approve changes that deviate from the approved construction documents. If changes in the work are seen which do not conform to the approved construction documents, the inspector must notify the owner or owner's representative and the building official. The owner or the owner's designated representative should be informed of their responsibility to submit changes and given a reasonable time to comply. If nothing is submitted, the residential building official may need to issue an order citing this code section.

Use of good judgment is important because the language does not define "substantive changes". The word "substantive" is defined as things that are substantial, of considerable amount or quantity, actual, essential, having a direct bearing on a matter. Those changes, then, which have a direct bearing on the project and its approval that can effect the approval in a substantial way must be submitted to the residential building official. For instance, substantial changes could be seen as those that affect the contract time or contract amount and for which change orders are to be written. By including the residential building official in the distribution/approval process, the owner ensures that the right to build according to approved construction documents, including the proposed changes, is maintained.

Example 1

Ohio Residential Plan Submittal Form *Part A*

| | | | | |
|---------------------------|-----------------------------------|---------------------------------------|---|----------------------|
| Address of Project | City/Township | Project Description | | |
| | | | | |
| Contractor/DBA | Address | State License No | Phone No | Cell Phone No |
| | | | | |
| Owner | Address | Phone No | | Cell Phone No |
| | | | | |
| Electrical Design | | | | |
| Service Size | Panel Location in dwelling | Size of Service Entrance Cable | Location of Service | |
| | | | <input type="checkbox"/> Overhead <input type="checkbox"/> Underground | |

Provide additional details or drawings below

| | | | |
|-------------------------------------|----------------------------------|-------------------------------------|-----------------------|
| HVAC Design | | | |
| Equipment Type/Size | Location of Equipment | Type of Fuel | Heat Loss/Gain |
| | | | |
| Sq. Ft. of Conditioned Space | Duct Size (Supply/Return) | Equipment Efficiency Ratings | |
| | | | |

Provide additional details or drawings below

As the legal owner/agent of the property above, I am performing the electrical/HVAC work described above.

_____ Date ___/___/___

NOTE: Per section 106.1 the Residential Building Official may require additional drawings, technical data or documentation in order to verify compliance.

Building Department Only

| | | |
|---|-------------------------|------------------------------|
| Residential Plans Examiner/Building Official | Date of Approval | Application/Permit No |
| | | |

Ohio Residential Plan Submittal Form *Part B*

Referenced Code Text

| ELECTRICAL | MECHANICAL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|--|--------------------------|------------------------------|--|--|--------------------------|-------|-------|----------|--------------------------|-------|---------|----------|--------------------------|---------|---------|----------|---|----------------|---------------|--------------------------|------------------------------|-----------------------------|------------------------------------|--------------------|----------------|----------|----------|---------------------------|--------------------|----------------|----------|----------|
| <p>NEC 110.3 All electrical equipment shall be installed and used in accordance with the listing requirements and manufacturer's instructions.</p> | <p>M1401.1 Heating and cooling equipment and appliances shall be installed in accordance with the manufacturer's installation instructions and the requirement's of the Residential Code.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Service | Sizing | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>Size of Service in Amperes:</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 5%;"></th> <th style="width: 15%;">Copper</th> <th style="width: 15%;">Aluminum</th> <th style="width: 15%;">Service Rating</th> <th rowspan="4" style="width: 50%; vertical-align: top;"> NEC 310-15 Conductor Sizes 120/240 VOLT 3-Wire, Single-Phase, Dwelling Services/Feeders </th> </tr> </thead> <tbody> <tr> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;">4 AWG</td> <td style="text-align: center;">2 AWG</td> <td style="text-align: center;">100 Amps</td> </tr> <tr> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;">1 AWG</td> <td style="text-align: center;">2/0 AWG</td> <td style="text-align: center;">150 Amps</td> </tr> <tr> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;">2/0 AWG</td> <td style="text-align: center;">4/0 AWG</td> <td style="text-align: center;">200 Amps</td> </tr> </tbody> </table> <p>NEC 250.50 All grounding electrodes that are present at each building or structure served shall be bonded together to form the grounding electrode system. Conductor size per NEC 250.66. NEC 250.52 Permitted Electrodes include: 1. Metal underground water pipe in direct contact with earth for 10 feet or more 2. Metal frame of the building 3. Concrete-encased electrode 4. Rod, pipe & plate electrodes</p> | | Copper | Aluminum | Service Rating | NEC 310-15 Conductor Sizes 120/240 VOLT 3-Wire, Single-Phase, Dwelling Services/Feeders | <input type="checkbox"/> | 4 AWG | 2 AWG | 100 Amps | <input type="checkbox"/> | 1 AWG | 2/0 AWG | 150 Amps | <input type="checkbox"/> | 2/0 AWG | 4/0 AWG | 200 Amps | <p>M1401.3 Heating and cooling equipment shall be sized based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies.</p> <p style="text-align: center;">Gages of Metal Ducts & Plenums Used for Htg/Cooling</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 15%;">Types of Ducts</th> <th style="width: 10%;">Size (inches)</th> <th style="width: 10%;">Minimum Thickness (inch)</th> <th style="width: 10%;">Equiv. Galvanized Sheet Gage</th> <th style="width: 10%;">Approx. Aluminum B & S Gage</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Round Ducts & Enclosed Rectangular</td> <td style="text-align: center;">14 or less over 14</td> <td style="text-align: center;">0.013 0.016</td> <td style="text-align: center;">30 28</td> <td style="text-align: center;">26 24</td> </tr> <tr> <td style="text-align: center;">Exposed Rectangular Ducts</td> <td style="text-align: center;">14 or less over 14</td> <td style="text-align: center;">0.016 0.019</td> <td style="text-align: center;">28 26</td> <td style="text-align: center;">24 22</td> </tr> </tbody> </table> | Types of Ducts | Size (inches) | Minimum Thickness (inch) | Equiv. Galvanized Sheet Gage | Approx. Aluminum B & S Gage | Round Ducts & Enclosed Rectangular | 14 or less over 14 | 0.013 0.016 | 30 28 | 26 24 | Exposed Rectangular Ducts | 14 or less over 14 | 0.016 0.019 | 28 26 | 24 22 |
| | Copper | Aluminum | Service Rating | NEC 310-15 Conductor Sizes 120/240 VOLT 3-Wire, Single-Phase, Dwelling Services/Feeders | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> | 4 AWG | 2 AWG | 100 Amps | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> | 1 AWG | 2/0 AWG | 150 Amps | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <input type="checkbox"/> | 2/0 AWG | 4/0 AWG | 200 Amps | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Types of Ducts | Size (inches) | Minimum Thickness (inch) | Equiv. Galvanized Sheet Gage | Approx. Aluminum B & S Gage | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Round Ducts & Enclosed Rectangular | 14 or less over 14 | 0.013 0.016 | 30 28 | 26 24 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Exposed Rectangular Ducts | 14 or less over 14 | 0.016 0.019 | 28 26 | 24 22 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| General Circuitry | Access & Installation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <p>NEC 210.11 and 422.12 In addition to the branch circuits installed to supply general illumination and receptacle outlets in dwelling units, the following minimum requirements apply: Two 20-amp circuits for the kitchen receptacles, One 20-amp circuit for the laundry receptacles, One 20-amp circuit for the bathroom receptacles and One separate, individual branch circuit for central heating equipment</p> <p>NEC 210.52 Receptacles installed in the kitchen to serve countertop surfaces shall be supplied by not less than two separate small appliance branch circuits.</p> <p>NEC 210.52 Generally, receptacle outlets in habitable rooms shall be installed so that no point measured horizontally along the floor line in any wall space is more than 6' from a receptacle outlet. A receptacle shall be installed in each wall space 2 feet or more in width.</p> <p>NEC 210.52 At kitchen countertops, receptacle outlets shall be installed so that no point along the wall line is more than 24 inch measured horizontally from a receptacle outlet in that space. Countertop spaces separated by range tops, sinks or refrigerators are separate spaces.</p> <p>NEC 210.52 & 406.8 At least one receptacle, accessible at grade level and no more than 6.5' above grade, shall be installed at the front and back of a dwelling</p> <p>NEC 210.12 All branch circuits supplying 125-volt, 15 and 20 ampere outlets in dwelling unit bedrooms shall be protected by a listed arc-fault circuit interrupter device.</p> <p>NEC 210.8 Ground-fault circuit-interrupter (GFCI) protection shall be provided for all 125-volt, 15 and 20 amp receptacle outlets installed outdoors, in boathouses, garages, unfinished accessory buildings, crawl spaces at or below grade level, unfinished basements, bathrooms, at kitchen countertops and within 6' of the outside edge of the sink in laundry rooms, utility rooms, and at wet-bars.</p> | <p>M1401.2 Heating and cooling equipment shall be located with respect to building construction and other equipment to permit maintenance, servicing and replacement. Clearances shall be maintained to permit cleaning of heating and cooling surfaces; replacement of filters, blowers, motors, controls and vent connections; lubrication of moving parts; and adjustments</p> <p>M1601.3.2 Metal ducts shall be supported by 0.5-inch (12.7 mm) wide 18-gage metal straps or 12-gage galvanized wire at intervals not exceeding 10 feet (3048 mm) or other approved means. Nonmetallic ducts shall be supported in accordance with manufacturer's installation instructions.</p> <p>M1401.4 Equipment installed outdoors shall be listed and labeled for outdoor installation.. Supports and foundations shall prevent excessive vibration, settlement or movement of equipment. Supports and foundations shall be level and conform to manufacturer's installation instructions.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Plumbing | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <p>Provide layout of plumbing fixtures on floor plan. Plumbing shall conform to the Residential Code.</p> | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Example 2

Example 3

INSPECTION BUREAU, INC.
250 WEST COURT STREET, SUITE 125 W
CINCINNATI, OHIO 45202
(513) 381-6080
FAX: (513) 381-6123
www.inspectionbureau.com

“Electrical Safety Since 1888”

RESIDENTIAL LOAD CALCULATIONS

(Load Calculations based on applicable sections of NEC 220)

Dear Installer,

As you know, the NEC provides many methods of providing load calculations for residential occupancies. In addition to the sections found in NEC Art. 220, there is a lot of information about this in NEC “Annex D Examples”. This document is provided to help you comply with the requirements of the Residential Code of Ohio when preparing your load calculations for submittal.

The examples in this document are based on *only three* of the permitted methods of calculation found in NEC 220.

Examples 1 and 2 show how to use NEC 220.82 as an option to the sometimes lengthy processes described in NEC 220 Part III. Example 3 shows a method of how to compute the adequacy of an existing service when a room addition is built.

You’ll notice in the examples the loads that **shall** be computed for every dwelling are **separated** from the loads that only some dwellings have. For example, not every dwelling has a dishwasher, disposal, sump pump, sewage pump, garage door opener, etc.

You can use the format of these examples with *your* square footage measurements, *your* additional loads, and *your* HVAC loads to quickly and accurately determine *your* service requirements.

Feel free to contact us with questions about residential load calculations. We will be happy to assist you.

Thank you,

Gaylord Poe
Chief Electrical Inspector, President

**NOTE: FOR UPDATED AUTOMATED LOAD CALCULATION WORKSHEETS GOT TO
THE IBI WEBSITE AT: <http://www.inspectionbureau.com>
NEXT, CLICK ON: Residential Code of Ohio and scroll to the bottom of the page to:
IBI Residential Load Calculation Worksheets**

EXAMPLE # 1 (OPTIONAL CALCULATION)

Conditions: New single family dwelling, 1800 sq. ft.,
heating load is larger than air-conditioning load.
(Heat Pump, 20KW Furnace)

Required Loads (less HVAC)

| | |
|---|------------|
| 1800 sq. ft. @ 3 watts sq. ft | 5400 watts |
| 2 Small Appliance Circuits @ 1500 watts ea. | 3000 watts |
| 1 Laundry Circuit | 1500 watts |

Additional Loads (less HVAC)

| | |
|--------------------------|-------------------|
| Range (Nameplate Rating) | 12,000 watts |
| Water Heater | 4500 watts |
| Clothes Dryer | 5000 watts |
| <u>Dishwasher</u> | <u>1200 watts</u> |

Total Calculated Load (less HVAC) 32,600 watts

Service Demand

General Load:

| | |
|------------------------------|--------------|
| First 10kw @ 100% | 10,000 watts |
| (First 10kw of 32,600 watts) | |
| Remainder @ 40% | 9040 watts |
| (22,600 X 40%) | |

Heating and Air Conditioning Load:

| | |
|----------------------------------|--------------------|
| 30 amp compressor load @ 100% | 7200 watts |
| (30A X 240V = 7200 watts) | |
| 20kw electric furnace load @ 65% | <u>13000 watts</u> |
| (NEC 220.82 (C)(4)) | |

Calculated Service Load 39,240 watts

Minimum Service Ampacity 163.5 amps

(39,240 watts ÷ 240V)

**WORKSHEET BASED ON IBI'S
EXAMPLE # 1 (OPTIONAL CALCULATION)**

Conditions: New single family dwelling, heating load is larger than air-conditioning load.
(Heat Pump, Electric Furnace)

Required Loads (less HVAC)

| | | | |
|--|---|--|-------|
| | sq. ft. @ 3 watts sq. ft | | watts |
| | Small Appliance Circuits @ 1500 watts ea. (Minimum is 2) | | watts |
| | Laundry Circuit(s) @ 1500 watts ea. (Minimum is 1) | | watts |
| | | | watts |

Additional Loads (less HVAC)

| | | | |
|--|--|--------------------|-------|
| | Range, Cooktop, Oven (Total Nameplate Ratings) | | watts |
| | Electric Water Heater (Nameplate Rating) | | watts |
| | Electric Clothes Dryer* | | watts |
| | Gas Clothes Dryer Motor (Nameplate Rating) | | watts |
| | Dishwasher (Nameplate Rating) | | watts |
| | Disposal (Nameplate Rating) | | watts |
| | Sump Pump (Nameplate Rating) | | watts |
| | Sewage Pump (Nameplate Rating) | | watts |
| | Water Pump (Nameplate Rating) | | watts |
| | | (Nameplate Rating) | watts |
| | Total Calculated Load (less HVAC) | | watts |

(* Electric dryers use 5000 watts each or nameplate, whichever is larger, up to 4 dryers)

Service Demand

General Load:

| | | |
|--|--------|--------------|
| First 10kw of Total Calculated Load (less HVAC) @ 100% | 10,000 | watts |
| Remainder of Total Calculated Load (less HVAC) @ 40% | | watts |
| Total General Load | | watts |

HVAC Load:

| | | |
|---|--|--------------|
| Nameplate Heat Pump Compressor load @ 100% (Volts X Amps = Watts) | | watts |
| Nameplate Electric Furnace Load @ 65% (Nameplate Rating X .65) (NEC 220.82 (C)(4)) | | watts |
| Total HVAC Load | | watts |

| | | | | |
|---------------------------|-------|------------------------|-------|--------------------------------|
| Total General Load | + | Total HVAC Load | = | Calculated Service Load |
| | watts | | watts | watts |

| | | | | |
|--------------------------------|-------|------------------------|-------|---------------------------------|
| Calculated Service Load | ÷ | Service Voltage | = | Minimum Service Ampacity |
| | watts | | volts | amps |

Example # 2 (Optional Calculation)

Conditions: New single family dwelling, 1800 sq. ft.,
air-conditioning load is larger than heating load.
(Gas Furnace, 20A A/C Compressor)

Required Loads (less HVAC)

| | |
|---|------------|
| 1800 sq. ft. @ 3 watts sq. ft | 5400 watts |
| 2 Small Appliance Circuits @ 1500 watts ea. | 3000 watts |
| 1 Laundry Circuit | 1500 watts |

Additional Loads (less HVAC)

| | |
|--------------------------|--------------|
| Range (Nameplate Rating) | 12,000 watts |
| Water Heater | 4500 watts |
| Clothes Dryer | 5000 watts |
| Dishwasher | 1200 watts |

Total Calculated Load (less HVAC) 32,600 watts

Service Demand

General Load:

| | |
|------------------------------|--------------|
| First 10kw @ 100% | 10,000 watts |
| (First 10kw of 32,600 watts) | |
| Remainder @ 40% | 9040 watts |
| (22,600 X 40%) | |

Heating and Air Conditioning Load:

(Outdoor unit plus central unit blower motor)

| | |
|--|------------|
| Air-conditioning load @ 100% | 5640 watts |
| (Compressor = 20A X 240V = 4800 watts) | |
| Plus | |
| (Blower motor = 7A X 120V = 840 watts) | |
| (NEC 220.82 (C)(1)) | |

Calculated Service Load 24,680 watts

Minimum Service Ampacity 102.8 amps
(24,680 watts ÷ 240V)

WORKSHEET BASED ON IBI'S
EXAMPLE # 2 (OPTIONAL CALCULATION)

Conditions: New single family dwelling,
 air-conditioning load is larger than heating load.
 (Gas Furnace)

Required Loads (less HVAC)

| | | | |
|--|---|--|-------|
| | sq. ft. @ 3 watts sq. ft | | watts |
| | Small Appliance Circuits @ 1500 watts ea. (Minimum is 2) | | watts |
| | Laundry Circuit(s) @ 1500 watts ea. (Minimum is 1) | | watts |
| | | | watts |

Additional Loads (less HVAC)

| | | | |
|--|--|--------------------|-------|
| | Range, Cooktop, Oven (Total Nameplate Ratings) | | watts |
| | Electric Water Heater (Nameplate Rating) | | watts |
| | Electric Clothes Dryer* | | watts |
| | Gas Clothes Dryer Motor (Nameplate Rating) | | watts |
| | Dishwasher (Nameplate Rating) | | watts |
| | Disposal (Nameplate Rating) | | watts |
| | Sump Pump (Nameplate Rating) | | watts |
| | Sewage Pump (Nameplate Rating) | | watts |
| | Water Pump (Nameplate Rating) | | watts |
| | | (Nameplate Rating) | watts |
| | Total Calculated Load (less HVAC) | | watts |

(* Electric dryers use 5000 watts each or nameplate, whichever is larger, up to 4 dryers)

Service Demand

General Load:

| | | |
|--|--------|--------------|
| First 10kw of Total Calculated Load (less HVAC) @ 100% | 10,000 | watts |
| Remainder of Total Calculated Load (less HVAC) @ 40% | | watts |
| Total General Load | | watts |

HVAC Load:

(Outdoor unit plus central unit blower motor)

| | | |
|-------------------------------|--|--------------|
| Air Conditioning load @ 100%* | | watts |
| Total HVAC Load | | watts |

*Air Conditioning load is the sum of:

(Compressor = Volts X Amps = Watts) **Plus** (Blower motor = Volts X Amps = Watts)

(NEC 220.82 (C)(1))

| | | | | |
|---------------------------|---|------------------------|---|--------------------------------|
| Total General Load | + | Total HVAC Load | = | Calculated Service Load |
| watts | + | watts | = | watts |

| | | | | |
|--------------------------------|---|------------------------|---|---------------------------------|
| Calculated Service Load | ÷ | Service Voltage | = | Minimum Service Ampacity |
| watts | ÷ | volts | = | amps |

Example # 3

Conditions: 20 X 24 bedroom room addition to an existing 1800 sq. ft. single family dwelling with 200A Service, existing gas furnace, existing central air-conditioning system, no increase in HVAC load.

| | |
|---|---------------------|
| 2280 sq. ft. @ 3 watts sq. ft. (1800 sq. ft. + 480 sq. ft. addition) | 6840 watts |
| 2 Small Appliance Circuits @ 1500 watts ea. | 3000 watts |
| 1 Laundry Circuit | 1500 watts |
| Range (Nameplate Rating) | 12,000 watts |
| Water Heater | 4500 watts |
| Dishwasher | 1200 watts |
| Clothes Dryer | <u>5000 watts</u> |
| Total Calculated Load | 34,040 watts |

Service Demand

Total Computed Load (NEC 220.83):

| | |
|--|---------------------|
| First 8kw @ 100% (First 8kw of 34,040 watts) | 8,000 watts |
| Remainder @ 40% (26,040 X 40%) | 10,416 watts |
| Existing air-conditioning load @ 100% (Outdoor unit plus central unit blower motor) | <u>5640 watts</u> |
| (Compressor = 20A X 240V = 4800 watts) Plus (Blower motor = 7A X 120V = 840 watts) | |
| Calculated Service Load | 24,056 watts |
| Minimum Service Ampacity (24,056 watts ÷ 240V) | 100.2 amps |

Existing 200A Service is OK

**WORKSHEET BASED ON IBI'S
EXAMPLE # 3 (OPTIONAL CALCULATION)**

Conditions: Room addition for an
existing single family dwelling, existing gas furnace,
existing central air-conditioning system,
no increase in HVAC load.

Existing plus Added Loads (less HVAC)

| | | | |
|--|---|--------------------|-------|
| | sq. ft. @ 3 watts sq. ft (Existing sq. ft. + additional sq. ft.) | | watts |
| | Small Appliance Circuits @ 1500 watts ea. | | watts |
| | Laundry Circuit(s) @ 1500 watts ea. | | watts |
| | Range, Cooktop, Oven (Total Nameplate Ratings) | | watts |
| | Electric Water Heater (Nameplate Rating) | | watts |
| | Electric Clothes Dryer* | | watts |
| | Gas Clothes Dryer Motor (Nameplate Rating) | | watts |
| | Dishwasher (Nameplate Rating) | | watts |
| | Disposal (Nameplate Rating) | | watts |
| | Sump Pump (Nameplate Rating) | | watts |
| | Sewage Pump (Nameplate Rating) | | watts |
| | Water Pump (Nameplate Rating) | | watts |
| | | (Nameplate Rating) | watts |
| | Total Calculated Load (less HVAC) | | watts |

(* Electric dryers use 5000 watts each or nameplate, whichever is larger, up to 4 dryers)

Service Demand

Total Computed Load (NEC 220.83):

| | | |
|---|-------|--------------|
| First 8kw of Total Calculated Load (less HVAC) @ 100% | 8,000 | watts |
| Remainder of Total Calculated Load (less HVAC) @ 40% | | watts |
| Existing Air-Conditioning load* @ 100% | | |
| Calculated Service Load | | watts |

*Existing Air Conditioning load is the sum of:
(Compressor = Volts X Amps = Watts) **Plus** (Blower motor = Volts X Amps = Watts)
(NEC 220.82 (C)(1))

| | | | | |
|--------------------------------|---|------------------------|---|---------------------------------|
| Calculated Service Load | ÷ | Service Voltage | = | Minimum Service Ampacity |
| watts | ÷ | volts | = | amps |

| | | |
|--|---|-------------|
| New Minimum Service Ampacity Requirements | = | amps |
|--|---|-------------|