NEBRASKA

DEPT. OF ENVIRONMENT AND ENERGY

20-036 Revised December 2020

Energy Efficient Housing Application Guidelines

These guidelines list the minimum requirements for The Nebraska Energy Efficient Housing Application New Home Construction (for Pre-Sold Homes).

This is an optional, beyond code program. Homebuyers who comply with these guidelines will be eligible for low-interest construction financing and long-term financing, and may expect significant energy savings for the life of the home.

This portion of the Dollar and Energy Saving Loan Program is made available as part of an ongoing effort to conserve energy. This portion of the program promotes homes that incorporate higher efficiencies in a home's building envelope; heating, ventilating, and air conditioning (HVAC) systems; and advanced air-sealing techniques in the envelope and ductwork while using standard materials and systems already in use. Because the program requires higher efficiencies in the building products to be used, there will be an increase in the initial cost of the home. However, those additional costs will provide monthly energy savings, and the monthly mortgage and utility costs together should be less than the mortgage and utility costs of standard homes.

Remember, **to remain eligible** prior to approval of your application by the Nebraska Department of Environment and Energy (NDEE):

- *you must not file for a building permit*,
- *you must not start construction*,
- *you must not dig a hole for a basement or do other dirt work*, and
- *you must not pour any part of a foundation or foundation walls*.

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Part 1 – Initial Submittal Documents

Submitted items will not be returned. All items listed must be submitted together. Partial submittals will not be accepted or reviewed. Documents applicants must submit include:

1. Completed Form M10, Nebraska Energy Efficient Housing Application New Home Construction (for Pre-Sold Homes)—*complete all information so that it is neat and easily readable.*

2. Completed Form A, United States Citizenship Attestation Form—*complete all information.*

3. One hardcopy set of professional, computer generated house plans—*follow all of these guidelines.*

4. Air Conditioning, Heating & Refrigeration Institute (AHRI), Home Ventilating Institute (HVI), Environmental Protection Agency (EPA), ENERGY STAR®, and other equipment efficiency certificates—*provide only the pages required to show model numbers, efficiencies, and capacities and include with other submittal documents. Do not place copies of these pages on the drawings. To be eligible for this program, furnaces, boilers, heat pumps, and air conditioners must be currently listed in the AHRI online directory.*

5. Manufacturer's data sheet for ceiling drywall and attic insulation showing drywall weight limits per square foot and attic insulation weight per square foot—p*rovide only those pages that show the required data and include with other submittal documents; do not place copies of these pages on the drawings.*

6. Documentation showing that the Builder and Home Energy Rating System (HERS) rater have completed all required ENERGY STAR Version 3.1 orientation and training—*print single web page that shows certification and include with other submittal documents. Include the HVAC contractor if using ENERGY STAR Path B.*

7. Air Conditioning Contractors of America (ACCA) Manual J load calculation reports using ACCA approved software—*the reports must be a block load for the entire house to include the worksheet. All inputs must be shown. The HVAC contractor must provide a balanced duct diagram showing size and cubic feet per minute (cfm) and any zoning, and a balance point diagram when gas backup is used.*

8. ENERGY STAR efficiencies for the refrigerator (kilowatt hours per year [kWh/yr]), clothes washer (integrated modified energy factor [IMEF] and kWh/yr), dish washer (kWh/yr), ceiling fans (CFM/Watt at medium speed), range hoods (cfm and cfm/watt), and bathroom vent fans (cfm and cfm/watt)—*print single page from ENERGY STAR web site and include with other submittal documents.*

9. Hardcopy HERS rating reports: Air Leakage, Building File Summary, Equipment Sizing Summary, U.S. Department of Energy (DOE) Zero Energy Ready Home Certificate, DOE Zero Energy Ready Home Verification Summary, International Energy Conservation Code (IECC) 2018 Certificate, IECC 2018 Energy Rating Index (ERI), ENERGY STAR V3.1 Home, ENERGY STAR V3.1 Certificate, Home Energy Rating Certificate (HERC), and HERC-Home Performance.

Part 2 – Review, Approval, and Changes

Only submit an application to the Nebraska Department of Environment and Energy (NDEE) when your plans and specifications are completely finished.

When NDEE receives an application, it checks plans against the requirements listed in this document. Once the plans have been reviewed, the HERS reports and Manual J load calculations are checked to see that they represent the home shown on the plans. To ensure a speedy review and approval, each of the requirements listed in these guidelines must be reflected on the plans for the home. The HERS rater and HVAC contractor must complete their data according to those plans. The application, Form M-10, must be filled out completely and legibly. The location of the new residence must be provided. Include driving directions and a legal description if the new address is not available.

Notification of application approval will be provided by an approval letter and email. No further submittals are required until the final HERS rating. Once approved, work may commence according to the approved plans.

After the application, submitted documents, plans, HERS reports, and Manual J calculations have been reviewed and approved, no further changes may be made to the building envelope or mechanical, hot water, or lighting systems. R-values, HVAC equipment, lighting, or other items that would change the energy use of the home may not be changed without a new review and approval by NDEE.

If changes must be made to originally submitted plans, the applicant will need to update and resubmit all initial submittal documents that are affected by the change, except for Form M10 and Form A. The revised documents will be reviewed with all other submittals to NDEE, in the order in which they are received. It is likely that the HERS rater and contractors may need to increase their prices due to delays and added work caused by changes.

Submittal of the application must not occur until plans are final.

Part 3 – Final Inspection and Final Submittal Documents

(Submitted items will not be returned)

1. The HERS rater is required to contact NDEE 10 days prior to the final inspection.

2. Once the home is built, and the HERS rater has completed the final inspection, and prior to long-term financing under the loan program, the following must be submitted to NDEE:
    A. Final HERS reports in hardcopy:
        i. Air Leakage,
        ii. Building File Summary,
        iii. Equipment Sizing Summary,
        iv. Department of Energy (DOE) Zero Energy Ready Home Certificate,
        v. DOE Zero Energy Ready Home Verification Summary,
        vi. International Energy Conservation Code (IECC) 2018 Certificate,
        vii. IECC 2018 Energy Rating Index (ERI),
        viii. ENERGY STAR V3.1 Home,
        ix. ENERGY STAR V3.1 Certificate,
        x. Home Energy Rating Certificate, and
        xi. HERC – Home Performance.
    B. Completed ENERGY STAR Version 3.1 checklists with all associated Version 3 documentation attached, or DOE Zero Energy Ready Home documentation attached, hardcopy.
        i. Note: The HVAC contractor's company name must be shown. The home must meet either DOE Zero Energy Ready or ENERGY STAR Version 3.1, but not both. Regardless, submit both sets of documents.
    C. Final electronic drawings, in pdf format (emailed or on CD or memory stick).
    D. Final electronic REM/Rate file *.blg from the HERS rater (emailed or on CD).

3. When wind, solar, or fuel cells are used, the HERS reports must be submitted both with and without the wind, solar or fuel cell inputs.

Part 4 – Mandatory Minimum Design Requirements

Windows and doors

1. Windows and full glass doors must have a National Fenestrations Ratings Council (NFRC) tested U-value of 0.26 or less and a Solar Heat Gain Coefficient (SHGC) of 0.32 or less.

2. Skylights must have a U-factor of 0.50 or less and a SHGC of 0.32 or less.

3. Entry doors must have an NFRC tested U-value of 0.20 or less.

4. Window to Wall Ratio (WWR), which is total window area divided by total wall area, may not exceed 15%. Total window area includes the rough opening area of windows, glass doors, sidelites, and the glazing areas in entry doors. If an entry door is a ¼ lite, use ¼ the area of the door, and similar for ½, ¾, and full light doors. Total wall area equals the wall area including the window area in those walls.

5. The house must be sealed to a tightness, as measured by a certified HERS rater, to 400 cubic feet per minute at 50 pascals (CFM50) plus 100 CFM50 per 1000 square feet of floor area, or less.
    a. To meet this mark, and initial blower door test at rough-in is required. The HERS rater is required to contact NDEE 10 days prior to the final inspection and blower door test.

Walls

1. Sill plates must rest completely on the foundation wall below.
    a. The final approved envelope shape and design may not be changed without approval.
    b. Interior walls may be moved, provided the HVAC contractor is consultant and duct work changes are made accordingly.

2. Walls, floors and stairs between the house and garage must include blocking above the wall, floor or stair areas and an air barrier on the garage side of the wall, floor stair or blocking.
    a. This air barrier and blocking must be called out on the plans
    b. This air barrier can be a 1” or 2” layer of high density closed cell foam or minimum 6 millionths (6-mil) polyethylene sheet, provided penetrations in the polyethylene are sealed
    c. The air barrier must be applied to the walls, floor, stair and any blocking.
    d. Batt or loose fill insulation must fill the cavities between conditioned and unconditioned space, or be a minimum R-30 against any blocking.
    e. To make permanent and protect the insulation, wall and floor cavities must be covered on sides with a minimum 7/16” plywood, OSB, or drywall where drywall is required by code.

Insulation

1. Minimum ceiling insulation must be R-60.

2. Attic area must incorporate an energy heel truss. The energy heel truss must maintain a minimum 12 inches from the outside top edge of the top plate to the bottom of the roof deck above. Trusses must be designed to carry the additional weight of any future solar modules. Metal buildings and framing are not allowed.

3. Minimum above grade wall insulation must be R-27 cavity or combination cavity and continuous insulation, or R-20 continuous when using Insulated Concrete Forms (ICF), as an example:
    a. 2x6 wall cavity with 2 inches, R-6 per inch high density foam plus R-15 batt or blown,
    b. R-20 in the cavities plus an R-7 continuous insulation board outside the sheathing,
    c. R-22 in the cavities plus an R-5 continuous insulation board outside the sheathing,
    d. R-13 in the cavities plus an R-14 continuous insulation board outside the sheathing, or
    e. R-20 continuous insulation using R-20 rated ICFs.

4. All exterior wall cavities must be filled with insulation.
    a. Cavity insulation or interior board insulation must be covered on the interior side of the wall with either 7/16” plywood, oriented strand board (OSB) or drywall where drywall is required by code.
    b. Advanced framing for single top plate, two stud exterior wall corners, and partition wall connections is required.
    c. Stem, step, or full height foundation walls more than 50% above grade are considered above grade walls.
    d. R-value is for the insulation material only.
    e. Metal buildings and framing are not allowed.

5. Floor cavities between conditioned and unconditioned space must be filled with insulation and must be sufficient depth to support a minimum R-30.
    a. The floor cavity insulation must be closed on all sides using either 7/16” plywood, OSB or drywall where drywall is required by code.
    b. Metal buildings and framing are not allowed.

6. Unheated slab floors, where the top of the slab is 2 feet or less below grade, must have R-10 minimum insulation starting at the top of the slab and extending a minimum of 2 feet below, or horizontal to the bottom of the slab edge or 2 feet below grade, whichever is greater.
    a. There can be no breaks in the continuity of this insulation.
    b. Heated slabs require the same R-10 at the slab edge and 2 feet below or horizontal, plus an R-5 under the full area of the slab, regardless of depth below grade.

7. Below grade foundation walls, walls 50% or more below grade, including below grade stem or step walls, for conditioned basements or crawl spaces, must be insulated to either R-19 framed, or R-13 framed plus R-5 continuous, or R-15 continuous.
    a. When Insulation board is used, it must be sealed to the wall, all around the edge of each insulation board, to prevent humidity from condensing behind the board.
    b. Framing cavities must be filled with insulation. Wall cavities must be closed to the interior, and insulation board covered on the interior side, with either 7/16” plywood, OSB or drywall where drywall is required by code.

8. An attic access that boarders conditioned space must be provided with the same insulation R-value as the surrounding surfaces. The insulation must be a part of the insulation cover. The access cover must be weather-stripped.

Drainage

1. Backfill must be mechanically tamped to prevent settling, and a minimum 6 inch drop in grade away from the home must be achieved within a distance of 10 feet from the exterior of the home.

a. All areas exterior to the home must be provided with a natural, above grade drain path away from the home.
b. The drain path must have a minimum 5 foot width.
c. Below grade patios, or other below grade areas adjacent to the home, are not allowed.
d. Tamping of back-fill is not required if either:
    i. proper drainage can be achieved using non-settling compact soils as determined by an American Institute of Hydrology certified hydrologist, soil scientist, or engineer; or
    ii. the builder must schedule a site visit to provide in-fill and final grading 1 year after building completion.

2. Designers should check that the roof design does not channel large areas of the roof to drain to a single point.
    a. If unavoidable, ensure sufficient drainage at valley end point.
    b. The roof design must also include sufficient strength and substantial south and/or west facing areas for twelve 3'x5' solar modules.

3. Patio slabs, solid decks, porch slabs, and walks adjacent to the home, and driveways must be sloped away from the home at a grade of 1 inch, or more, every four feet.

Radon Abatement

1. A passive radon abatement system must be used that meets the requirements of the 2018 International Residential Code (IRC), Appendix F.
    a. As an example: The passive system must include a 120 volt electrical box in the attic for a future fan and a 120 volt electrical box on the lowest level for metering and control. The passive system must incorporate minimum 3-inch nominal fabric-wrapped drain tile/pipe within 3 feet of exterior walls in an under slab gas-permeable material that extends around the entire foundation, forming a loop around the entire inside of the foundation, and any central foundation supports which cause a break in the air barrier under the slab. The loop must connect, either directly or using a tee and lateral, to a minimum 3 inch PVC radon abatement riser so that the riser makes one straight run from under the slab, straight up and through the roof, with the exception that two 22-1/2 degree elbows may be used to slightly move the riser to one side or the other. The radon abatement riser must penetrate the roof, extend a minimum 1 foot above the roof, and be kept a minimum of 10 feet from any inlets, windows, or other openings to the home. A riser may be installed in interior walls or in a chase, but not in exterior walls. A 6-mil polyethylene sheeting must be installed directly under the slab, with a minimum 1 foot of overlap for any seams. Slab penetrations and joints must be sealed with a polyurethane caulk or equivalent sealant. Sufficient grade must be maintained along the length of the perforated tile/pipe to prevent water from filling low spots and hindering radon circulation through the tile/pipe. The riser must be clearly marked between each floor and in the attic as "RADON ABATEMENT SYSTEM." In the attic, the riser must have a minimum unobstructed 2 feet of length as measured from the top of ceiling joists to the bottom of the roof trusses. Radon abatement tile/pipe may be incorporated into a sump system. This system may be substituted with any system that meets the requirements of the 2018 IRC, Appendix F. Active abatement systems, while not required, are allowed, provided provisions of Nebraska statutes are complied with. When incorporating an active system, the name of the licensed radon mitigation business used for completing the post testing must be listed on the drawings. Since an active system is an added energy use, it is recommended that a passive system be installed first. To ensure the effectiveness of the passive radon system, the occupants of a new home should be

provided with written instructions to conduct a short term radon test in the lowest floor of the structure. If the results of such a test are 4.0 pCi/L or greater the passive radon system should be activated by a licensed radon mitigation business.

2. Sump systems must be fully gasketed and sealed, and may be part of the radon abatement system. See radon abatement requirements in previous item.

Appliances, electric, and plumbing

1. Refrigerators, dishwashers, clothes washers, ceiling fans, range hoods, and bathroom vent fans must be ENERGY STAR rated and listed on the ENERGY STAR web site.

2. All lighting – interior, garage, and exterior – must be light emitting diode (LED), fluorescent, metal halide, or induction lighting.

3. Hot water must be provided using either
    a. a desuperheater with minimum 0.92 energy factor (EF) on the electric backup,
    b. 2.0 EF or higher standalone heat pump water heater,
    c. 0.90 EF or higher standalone gas water heater,
    d. 95% annual fuel utilization efficiency (AFUE) or higher hot water boiler, or
    e. 0.95% EF or higher standalone electric hot water heater (not allowed in Net Zero Energy Ready).
        i. Water heaters, except for desuperheaters and solar hot water, must be currently listed in the AHRI online directory.

4. Bathtubs and showers must be located completely against interior walls.

5. While recirculating hot water systems are not allowed, nominal 3/8 inch or smaller individual distribution lines from a manifold located within 3 feet of the hot water source, per the 2018 International Plumbing Code are allowed to reduce wait time for hot water, barring any local plumbing code restrictions.

Heating, ventilation and air conditioning (HVAC)

1. Duct systems must be balanced using direct returns, transfer grills, or jump ducts.
    a. Jump ducts are not allowed in attics or in floors over unconditioned space.
    b. All ductwork must be within the conditioned space.

2. Fabric isolation connectors are required to separate the air handler, or any other source of vibration, from the duct system.

3. Ventilation must be balanced, using heat recovery ventilators (HRV) or energy recovery ventilators (ERV), having a minimum sensible recovery efficiency (SRE) of 60% and supply a minimum 1.2 cfm/watt.

4. All exhausts must be vented to outdoors.
    a. It is acceptable to run bathroom, or other exhaust through an ERV or HRV, but the final exhaust must be to the outdoors.
    b. Range hoods must be ENERGY STAR rated and use less than or equal to 75 watts at the highest volume.
    c. Bathroom vent fans must be ENERGY STAR rated and have a maximum capacity of less than 201 cfm total for all fans.

5. Duct leakage must be tested at rough-in or post construction, or both, by a certified HERS rater and must be less than 3 cubic feet per minute at 25 pascals (CFM25) per 100 square feet of floor area served.

6. Ductwork must be properly sized according to ACCA Manual D for the required air flow to include proper reductions along the trunk lines and fabric isolation joints at the HVAC equipment and any other sources of vibration. Velocity may not exceed ACCA maximums.

7. All ductwork must be located within the conditioned space.

8. Wall and floor cavities must not be used as ducts. Panning is not allowed.

9. HVAC systems must be a standard ducted system using either a geothermal heat pump, a standard air source heat pump with a furnace or electric backup, furnace and air conditioner, or hot water boiler. Radiant floor heating is allowed.

10. Furnaces and boilers must have a minimum AFUE of 95% with combustion air ducted from outdoors.
    a. Air conditioners must have a minimum seasonal energy efficiency ratio (SEER) of 16 and minimum energy efficiency ratio (EER) of 13.
    b. Air source heat pumps must have a minimum SEER of 15, minimum EER of 12.5 and minimum heating seasonal performance factor (HSPF) of 8.5 (HSPF of 10 required for Net Zero Energy Ready).
    c. Ground water or ground coupled heat pumps must have a minimum coefficient of performance (COP) of 4.6 and minimum EER of 14.0 for water loop equipment, minimum COP of 3.6 and minimum EER of 16.2 for ground water equipment, minimum COP of 3.3 and minimum EER of 14.1 for ground loop equipment, and minimum COP of 3.5 and minimum EER of 15.0 for direct exchange equipment. Geothermal equipment must include a desuperheater.

11. Zoning is not allowed for single speed HVAC systems.
    a. Air circulation bypass is not allowed.
        i. Zoning is only allowed with fully variable speed equipment where both the low and high capacity of the equipment are rated on AHRI. The smallest AHRI rated capacity of the equipment may not exceed the smallest zone load.

12. All duct joints, including drives and cleats and adjusting seams, must be sealed with tape and/or mastic.
    a. Tape and/or mastic must be underwriters laboratory (UL)-181 A or B rated for duct sealing.
    b. UL-181 rated tape must have the ‘UL-181’ shown on the face of the tape.
    c. Blank face Foil and Duct tape are not acceptable.
    d. All ductwork must be located within the conditioned space.
    e. Duct leakage must not exceed 3 CFM25 total leakage per 100 square foot of conditioned floor space, as tested by a Certified HERS rater.

13. Heated driveways and other outdoor heating or outdoor cooling are not allowed.
    a. An enclosed heated or cooled workspace in an attached or unattached garage, up to two stalls, may be designed as a conditioned space, but the space must then be

considered in the block load calculation for heating and cooling load to determine total overall equipment capacities.

b. A heated or cooled garage or area within a garage, must meet all requirements listed in this document.
    i. The garage space must use a separate heating and cooling system keeping the garage area separated from the home.
    ii. Detached garages are recommended to promote better air quality in the home.

14. One fireplace or heating stove may be installed per home.
    a. Fireplaces, heating stoves, and other fuel fired heating units must be direct venting, taking combustion air from outdoors.
    b. Biomass fueled units must be EPA rated with a minimum EPA efficiency of 70%.
    c. Gas fireplaces must have a minimum AFUE of 70% publicly published by the manufacturer.
    d. Provide a copy of the EPA stamp for biomass fireplaces showing the efficiency.
    e. Provide a copy of the manufacturer's literature or AHRI certificate showing the AFUE for gas fireplaces.

15. For ground loop heat pumps, make certain the loop field is designed not only according to the size of the geothermal unit, but according to the soil type the loop field is going into.
    a. The HVAC contractor is responsible for obtaining a professional well driller trained in the drilling of geothermal wells and the proper design and sizing of a loop field.
    b. It is recommended that loop fields be designed by an individual certified by the International Ground Source Heat Pump Association (IGSHPA).

16. Sizing of cooling equipment must be in accordance with American National Standards Institute (ANSI)/ACCA 3 Manual S – 2014, page xi.
    a. Appendix A may not be used.
    b. Equipment sizing must use the AHRI rated full capacity.
    c. Split capacity and variable speed are reserved for humidity control only.
    d. Dehumidifiers may be used, but under no circumstances will they be considered to create a "No Latent Cooling Load" zone.

17. For homes with very small cooling loads, the sizing limit may be exceeded, but under no circumstance by more than the smallest size unit made by the manufacturer, or the smallest size from the manufacturer of its fully variable speed equipment.
    a. Variable speed equipment's low capacity must be listed in the AHRI directory, and must be smaller than the capacity of the manufacturer's smallest equipment that could be used for the home or is within ACCA sizing limits.
    b. To be eligible for this program, furnaces, boilers, heat pumps, and air conditioners must be listed in the AHRI online directory.

18. Total heating capacity of all systems must meet Manual S guidelines based on full load capacity.

19. All combustion air must be ducted from outdoors directly to the appliance.

20. Radiant hot water floor systems must use heat provided by either 95% AFUE direct vent combustion gas unit, or a geothermal hydronic/heat pump unit.

a. Solar hot water may be incorporated into the system as a secondary heating source, and the solar capacity does not need to be considered for sizing purposes.

21. Ground water heat pumps, “pump and dump,” systems must incorporate an injection well with injection piping that returns the water to a level below the wells natural water line.
    a. While it is true that water is never lost, eventually returning to the ground, it is important to return the water to the ground water system after use to maintain ground water levels as opposed to placing it in the surface water system. Piping return water to a level below the natural water line helps prevent fouling of the well.

22. Heat pumps having supplementary electric heat must have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load.
    a. Heat pumps using gas backup must submit a balance point diagram. To be eligible for this program, furnaces, heat pumps, and air conditioners must be currently listed in the AHRI online directory.

Renewable energy

1. A 1 inch nominal electrical conduit must be installed from the attic to the level of the home containing the electric panel for future rooftop solar.
    a. The conduit must extend into the attic a minimum of two feet above the top of the ceiling joists, and terminate in the level of the home within five feet of, and in the same room as, the electrical panel. Cap both ends unless used.

2. Solar, wind, or fuel cells are limited to Net-Zero, which will be equal to setting the Standard Test Conditions (STC) nameplate for solar, or kW at 28 mph rating for wind, or output rating for fuel cells to the.
    a. HERS estimated annual energy use for electricity, times six, divided by 8,760 hours, rounded up or down to the manufacturer’s next available size.

3. For solar, wind, or fuel cell energy a schedule for the equipment and ratings must be included on the drawings.
    a. The schedule must include brand, model, description, quantity, and capacity of all major components.
    b. When wind, solar or fuel cells are included in the design, the wind, solar, or fuel cell design must be firm.
    c. Components may not be subject to change at a later date.

4. Wind generators must be certified by the Small Wind Certification Council (SWCC) to American Wind Energy Association (AWEA) small wind standards.
    a. Rooftop wind is not allowed.
    b. A copy of the cutsheet showing rated output at 28 mph must be submitted.

5. Fuel cells must have a 30% efficiency and a minimum capacity of 0.5 kW.
6. Solar panels and associated electrical components must be Underwriters Laboratory (UL) listed.
    a. Solar panels must have an STC rating. A copy of the cutsheet for the solar panels which shows the STC and UL 1703 ratings must be submitted.

7. Solar hot water systems must be listed with the Solar Rating and Certification Corporation (SRCC).
    a. A copy of the SRCC OG-300 rating must be included with the submittal.
    b. The system must have a SRCC rating of SF > 0.5.
    c. Hot water systems must have a current Solar Rating and Certification Corporation (SRCC) OG-300 rating which can be viewed on the SRCC web site. SF = 1 – (EF/SEF), where EF is the energy factor of the water heater, and SEF is the rating shown on the SRCC web site.
    d. Solar storage tanks must be located inside or underground, and have a minimum R-10 insulation regardless of location.

8. Garages must include combination electrical outlets for each stall.
    a. Each outlet must including one 220 volt and one 110 volt outlet.
    b. For garages of more than one stalls, all stalls but one must include a combination outlet.

9. The finished home must meet the latest ENERGY STAR requirements or meet the latest Zero Energy Ready Home requirements. The HERS rater must complete all paperwork and register the home accordingly with either EPA's ENERGY STAR, or DOE's Zero Energy Ready Home program.

Part 5 – Drawing Format

Drawings included in the application must meet the following guidelines:

1. Submitted plans and specifications must be off a professional nature, using standard drafting practices.

2. Views, notes, and details must be specific to the home and not labeled as typical.

3. Plans must be made using computer aided drafting (CAD), with one hard copy submitted.

4. Plans must be specific to the home being funded.

5. Plans must be the final version and used for permitting after review and approval by NDEE.

6. Plans must be dated and contain revision blocks.

7. Number all plan pages, using the convention 1 of X, 2 of X, 3 of X, etc., where X is the total number of pages.

8. Minimum text size is 1/8th inch in height (9 point pica).

9. Note and dimension text must be in plain block type font, clear and easy to read.

10. All plan and elevation views, including the duct diagram, must be scaled to a sufficient size to make all text and details clearly discernable.
    a. If in doubt, increase the drawing scale or font size.
        i. Scale must be either 1/4 inch = 1 foot or 1/8 inch = 1 foot.
        ii. Clarity is a requirement, and will be determined by the reviewer.

11. Paper must be on either C size (16 or 18 inches x 24 inch) or D size (22 to 24 inches x 36 inch) drawing paper.

12. All drawing pages must be the same size.

13. Keep all views, notes, and dimensions a minimum of 1 inch from the left side of the drawing page.

14. Staple the drawing set together along the left edge, using a minimum of 3 staples, between 1/4 and 1/2 inch from the left edge.

15. All parts of the plans, the text, dimensions, views, sections, notes, etc., must be easy to read and clearly show the intended design.

16. If a separate set of specifications exist, this must be noted on the first page of the plans, and the specifications must then accompany each set of plans.

17. Homes of 10,000 square feet or more must have an architect and engineer's stamp on the drawings.
    a. Garage area is included in the square footage calculation when the garage is over three stalls.
        i. The number of stalls is not limited in this program.
        ii. The following definition is only provided to determine the number of garage stalls, and whether or not the garage must be included in calculating the 10,000 square foot that requires an Architect and Engineer's stamp on the drawings:
            1. Stalls with a side on the exterior of the garage must be no wider than 13 feet including the wall thickness.
            2. Middle stalls with or without sidewalls must be no wider than 12 feet including any wall thicknesses.
            3. Stalls adjacent to the house must be no wider than 12.5 feet excluding the common wall between the house and the garage.
            4. A stall that is longer than 26 feet will be counted as two stalls.
            5. A stall that is over the maximum width will be counted as two stalls.
            6. Dimensions are measured to the outside of exterior walls and the garage interior of a wall common with the house.
            7. Handicap garages may consist of three 9 x 25 foot stalls and two 5 x 25 foot access areas, with dimensions measured from the inside of the walls.
            8. These areas include any space used for access and storage.
                a. A garage stall that is 32 feet long and 9 feet wide with 7 feet at the end of the stall for storage is still counted as two stalls because of the excess in length.
            9. Where local code jurisdictions maintain a stall definition, whether the local requirements are more or less stringent, the local definition must apply.
            10. Where local stall definitions exist, provide a copy of the definition and contact information for the person overseeing the jurisdiction.
                a. Once again, these requirements are only used for determining when the garage area must be considered in the total square footage of the building to determine if an Architect and Engineers stamp is needed. These guidelines allow as many garage stalls as are desired.

Part 6 – Drawing Requirements

Drawing requirements for the application are as follows:

1. A separate set of building specifications is not required.
    a. If a separate set of specifications exist in addition to the plans, then those specifications must be submitted for review with the drawings.
        i. There can be no differences between information in the specifications and information on the plans.
        ii. Notes in the specifications do not replace the need for plan notes.
        iii. The plans are the defining document and must contain all necessary information to build a home that meets these guidelines and to complete a HERS rating and a Manual J load calculations.

2. Plans submitted for review must be the final home design and may not be marked as "preliminary" or "not for construction."
    a. Drawings and sections views must represent how the home will be built.

3. Plans must include:
    b. Four elevation views showing each side of the home,
    c. Plan views for each floor level,
    d. A lighting diagram for each floor, including the garage and exterior lighting,
    e. A mechanical page showing the mechanical schedule and equipment used, and
    f. A roofing plan showing ridge and valley lines, direction of drain, and dimensioned soffit overhangs.

4. Break and trim lines and fill that are located around text or dimensions so that the text or dimension is shown clearly and is legible.

5. Plans must show and include grading near the home, calling out the required 6 inch drop within 10 feet of walls for grading, and 1 inch in 4 feet for solid patios.
    a. Show, label, and dimension all concrete patio's and decks on the plan views.
    b. Include the type of patio or deck in the label indicating if the floor is solid or has gaps, i.e. "Standard Gapped Deck" or "Concrete Patio" or "Solid Plastic Deck" or other appropriate label.
    c. On the plan views, from the edge of the home, show the 6 inch drop in grade on the grade line, e.g. with the grade level across the front of the home, as the grade line reaches the edge of the home, show the grade falling away at a 1/20 slope.

6. Show sump pit details. Provide a detailed cross section showing complete installation, including manufacturer's installation notes.
    a. Show piping and outlet details of a fully gasketed or sealed system.
    b. Include the manufacturer and model number.
    c. Locate the sump pit on the plan views.
    d. If no sump pit is used, include a note near the required radon note indicating that no sump system is used.

7. Show advanced framing details for single top plate, two stud exterior wall corners, and partition wall connections.
    a. Show wall thickness to scale, from inside drywall to exterior cladding.

8. Each plan view must indicate the wall R-values used.
    a. Changes in insulation R-value must be dimensioned to show where each wall, floor or ceiling with a different R-value begins and where it ends and the area it covers.

9. Show and properly label cross sections.
    a. Use standard cross section labeling with arrows on each end of the section line to show the view direction, and placing the letter label next to each arrow.
    b. Respectively label each section view accordingly, e.g. Section A-A, Section B-B, etc.

10. Provide at least one section view for each wall, floor or ceiling area that uses a different R-value and show dimensions for the area covered by that wall, floor or ceiling.
    a. Provide dimensions on wall, floor and ceiling cavities available for insulation and call out the insulation material and R-value used to fill those cavities.

11. The plans must reflect manufacturer's installation instructions and ENERGY STAR or Zero Energy Ready Home requirements.
    a. This includes minimum distances between intakes and exhausts, or required vertical and horizontal runs for fireplace chimneys, or minimum duct size for ERVs or HRVs.

12. Provide a window and door schedule which includes the window label, the quantity of each size window, the rough opening dimensions, NFRC tested U-value, NFRC tested SHGC, and the NFRC certified products directory (CPD) number.
    a. Use the same label for same size and type windows.
    b. Rough openings for doors, sidelites, and transoms must be listed separately.

13. Label windows, doors, sidelites, and skylights in the elevation views.
    a. Labels in the window/door schedule and those in the views must be consistent.

14. Show and label the door from the house to the garage using hidden lines.
    a. Show the dimension from the floor to the door opening, i.e. the distance from the garage floor to the first floor of the home.

15. Show a cross section and details of the energy truss.
    a. Provide dimensions showing the required minimum 12 inch depth from the outside edge of the top plate to the underside of the roof deck.
    b. Show the insulation blocking or sheathing, the attic insulation R-value and thickness of the attic insulation.

16. Show the location of the attic access.
    a. If the attic access is in conditioned space, provide a section view of the attic access calling out the R-value and type of insulation used to cover the access.

17. Show section views of each step, coffered or vaulted ceiling.
    a. Show and dimension the areas available for insulation.
    b. Show how insulation will be contained at a raised ceiling edge, i.e. the knee wall of the step, and how insulation requirements will be met for the knee wall.
    c. Call out the insulation material and R-value used.

18. Show details of the required passive radon abatement system.
    a. Show the electrical connections provided in the attic for the fan, and on the lowest level for metering and controls.
    b. Show the radon riser in the wall or chase used on the plan views, and label the exhaust on the elevation views.
    c. Show a dashed line on the foundation plan locating any perforated pipe that may be around the inside of the foundation.
    d. Show and dimension the 2 feet of straight pipe in the attic where a fan may be installed.
    e. Active abatement systems are allowed, but only after construction and after testing has determined that a fan is needed.
    f. Passive with accommodations to become active is required. Nebraska revised statute 76-3506 requires active systems be tested after installation by a licensed radon mitigation business.

19. Show and call out gutters and downspouts that deliver water to natural drains at a minimum of 5 feet from the foundation.
    a. These are to be shown on the elevation views.

20. Provide dimensioned details showing all knee walls.
    a. Show sufficient details for the HERS rater to calculate the area of each knee wall.

21. On the elevation views, dimension the soffit width and distance from the soffit to top of all fenestration rough openings.

22. On the elevation views, indicate the color shade of the shingles being used as light, medium, or dark.

23. A direction indicator must be shown on each drawing page that includes a plan view.
    a. The indicator must include the letters for North, South, East, and West. See example at right:
    b. On one of the plan views, provide an angle indication of the homes variation from one of the cardinal directions.
    c. A plot plan with direction indicator and angle indication of the homes deviation from one of the four cardinal directions is preferred.

24. Each elevation view of the home must indicate the direction it faces, to the nearest 45 degrees.
    a. i.e. North, South, East, West, Northeast, Northwest, Southeast, or Southwest.

25. Depth of floor joists and vaulted and other ceiling joists must be determined prior to submittal.
    a. Show those depths in the cross sections and dimensioned details on the plans showing the depth available for insulation, the type of insulation used, and the R-values of that insulation.

26. On the plan views, provide a dimension for each continuous section of uninterrupted exterior wall.
    a. Show a dimension from corner to corner for every change in wall direction.
    b. Show a dimension in between corners where moving from conditioned to unconditioned space and where moving from outside to inside of an attached garage.

27. Show and dimension all roof and patio outlines on each plan view.

28. Provide a section view of the walls, ceilings or floors, between the home and an attached garage.
    a. Show the required air barrier separating the home and the garage.

29. Clearly label unconditioned spaces.
    a. For this program an unconditioned space cannot be designed for any type of current or future heating or cooling.

30. Provide an appliance schedule near the lighting diagram.
    a. The appliance schedule must show the manufacturer, model numbers, quantity, efficiency and or energy use for the following appliances:
        i. Refrigerator – kWh/yr
        ii. Dishwasher – kWh/yr
        iii. Clothes washer – IMEF and kWh/yr
        iv. Ceiling fans – CFM/watt at medium speed
        v. Range hood – CFM settings and CFM/watt
        vi. Bathroom vent fans – CFM settings and CFM/watt
    b. When more than one of the same appliance is used, show the quantity used.
        i. If more than one of the same type of appliance is used, but of a different brand or model, list each separately.
        ii. The HERS rater must add up the total kWh/yr used by all of one type of appliance, for example the refrigerator, for input into the HERS software.

31. Provide a lighting schedule near the lighting diagram which includes labels that match the labels on the lighting diagram.
    a. List the name of the manufacturer, model number, type of lighting (LED, Fluorescent, Metal Halide, or Induction), fixture wattage rating, and quantity used.
        i. If using more than one of any one particular fixture, list it only once, list the quantity, and use the same label.
        ii. Show the required combination outlets, 220V/110V in the garage. Locate the 1 inch solar conduit and electrical panel on the lighting diagram.

32. Provide a Mechanical Schedule near the lighting diagram which lists the name of the manufacturers, complete model numbers, and each rated capacity and efficiency.
    a. List the HVAC equipment, ERVs or HRVs, hot water system, thermostats, backup heat, fireplace, bathroom vent fans, kitchen exhaust fan, and any other mechanical equipment.
    b. For HVAC equipment, list both the heating and cooling efficiencies and capacities as shown on the AHRI Certificate.
        i. If equipment has multiple capacities, then list each capacity and the efficiency for that capacity.
    c. Include a row at the bottom of the mechanical schedule when geothermal is used, and indicate the type of geothermal system, GLHP, WLHP, GWHP, or DX.
        i. For GLHP include the number of loops and the depth of those loops.
    d. Efficiencies for furnaces, boilers, heat pumps, and air conditioners must be as listed in the AHRI directory.
    e. To be eligible for this program, furnaces, boilers, heat pumps, and air conditioners must be currently listed in the AHRI online directory.

33. Show and label all intake and exhaust points for ventilation, exhaust fans, radon, clothes dryers, fireplaces, combustion appliances, and any other envelope penetration, on the elevation views.

34. On the plan views, show and dimension any exterior walls on floors above or below the floor being shown wherever those above or below walls do not follow the same line as the walls on the floor being shown.
    a. Show those above and below walls as dashed or hidden lines.
    b. This would be for floors that may overhang the floor shown or for floors that do not extend to the outside wall of the floor shown.

35. When the HVAC system is to be zoned, provide a duct schedule near the mechanical schedule listing and labeling each zone and showing the cooling and heating loads for each zone.
    a. List the rooms included in each zone.

36. When wind or solar are part of the design, provide an equipment schedule which lists the manufacturer, model, description, and capacity of each of the major components of the system.
    a. Show the location of the system on either a plot plan or on the roofing diagram if solar roof mount.
    b. Provide footing diagrams and location for ground mounted systems.
    c. Rooftop wind is not allowed.

37. DO NOT use cross hatching to show R-values.
    a. Label R-values directly using arrows and notes.

38. DO NOT use fill for wall sections or to show wall thickness.

39. DO NOT use notes such as “unless otherwise noted,” or other similar wording.
    a. Notes like “unless otherwise noted” send reviewers and contractors on a search for something that may or may not exist, that may or may not be “otherwise noted.” Be specific.

40. DO NOT use notes such as “per the supplier.”
    a. If certain suppliers or subcontractors are providing parts of the design, then those suppliers or contractors need to provide their information prior to submitting the application, so that it can be included in the plans.

41. DO NOT show furniture and other non-permanent objects, or any associated dimensions on the construction plans.
    a. If desired as part of the design, then these items must be shown on separate pages to avoid clutter.
    b. While a full set of drawings is required for submittal, construction drawing pages showing furniture and other moveable items will not be considered as part of the submittal being reviewed, and may not be used to show the required details.
    c. It is acceptable to show moveable items on separate drawing pages and those pages may be included in the drawing package.

Part 7 – Required Drawing Notes

Separate set of building specifications
If a separate set of building specifications exist, in addition to the plans, then the plans must contain a clearly visible note on the first drawing page indicating that those specifications exist. That note must read as follows:

"A separate set of building specifications must be provided with these plans. Do not use these plans without the accompanying specifications. If there are any differences between the plans and the specifications, follow the instructions on the drawings."

This note is not required if a separate set of specifications do not exist.

Window/door schedule
The following notes must be below each window/door schedule:

"All windows and doors must be NFRC tested. NFRC stickers are to be removed by the owner only, and only after inspection by the local Code Official and the HERS rater."

Elevation pages
The following note must be on each elevation page.

"A minimum 6 inch drop in grade away from the home must be achieved within a distance of 10 feet from the exterior of the home. All areas exterior to the home must be provided with a natural, above grade drain path away from the home, and having a minimum 5 foot width."

The note must be located at one corner of the main elevation view, with an arrow pointing to a grade line that is shown sloping away from the home. Minimum of one note per elevation page.

Concrete patios and solid decks
Include the following note for all concrete patios or solid decks:

"Maintain a minimum grade of 1 inch in 4 feet away from the home."

This note is to be located on every plan view with an arrow pointing to the patio or solid deck location. The patio or solid deck outline must also be shown and dimensioned. This note does not apply to decks with gaps between each floor board. For standard decks, with gaps between the floor boards, the requirement for grading would apply below the deck for the soil (6"/10'), or concrete (1"/4').

Floors over garages, outside air and unconditioned spaces
Include the following note for all floors over garages, outside air, and other unconditioned spaces:

"Floor insulation must be (list material) with an R-value of (list R-value). Insulation must be installed to fill the cavity and maintain contact with the floor above."

This note is to be located with the cross section for each floor over garage, outside air, or any other floor over unconditioned space. The dimension of the floor cavity must also be shown.

Wall insulation cross sections
Include the following note on pages with wall insulation cross section details:

"Exterior joints, seams or penetrations in the building envelope, that are sources of air leakage, must be sealed with durable caulking materials, sealed with gasketing systems, taped or covered with moisture vapor-permeable housewrap."

Envelope construction details
Include the following note on pages with plan views and section views showing envelope construction details:

*"The house must be sealed to a tightness, as measured by a certified HERS rater, to __** CFM50, or less."*

**The calculated CFM50 is 400 plus 100 for every 1,000 square feet of floor area. The floor area is measured to the outside of the walls, not including areas open to the floor below. Stairwells are not areas open to the floor below. Mezzanines adjacent to stairwells, open areas adjacent to balconies, or open areas adjacent to lofts are examples of areas open to the floor below. Double check computer calculations of this area by hand to avoid resubmittal delays.

Mechanical schedule
Include the following notes near the mechanical schedule:

- *"To minimize the wait for hot water at the tap, except for flushing rim sinks, you may use maximum 3/8" nominal diameter hot water piping and individual distribution lines from the hot water heater as outlined in the 2018 International Plumbing Code. All hot water piping must be insulated to R-3. Locate hot water manifolds within 3 feet of the hot water supply. Recirculating hot water systems are not allowed."*

- *"At least one return air opening is required for every floor level, and one return air opening, jump duct, or transfer grille is required for every room that can be isolated by a door, except bathrooms."*

- *"Duct leakage must be tested by a certified HERS rater, and must be less than __** CFM-25."*
    - **The calculated CFM 25 is 3 times the floor area divided by 100.

- *"All ductwork must be located within the conditioned space. Ducts are not allowed in floors over garages, floors over unconditioned spaces, or floors over outside air."*

- *"Ductwork must be properly sized according to ACCA Manual D for the required air flow, to include proper reductions along the trunk lines, and must include fabric isolation joints at the HVAC equipment and any other source of vibration."*

- "*Recommended duct velocities are as follows:*
    - *Supply Trunk Lines: 700 fpm rigid duct, or 600 fpm flex duct.*
    - *Supply Branch Lines: 600 fpm rigid or flex duct.*
    - *Return Trunk Lines: 600 fpm rigid or flex duct.*
    - *Return Branch Lines: 400 fpm rigid or flex duct.*

  Ductwork must not exceed the following maximum velocities:
    - *Supply Trunk Lines and Branches: 900 fpm rigid duct, or 700 fpm flex duct.*
    - *Return Trunk Lines and Branches: 700 fpm rigid duct, or 700 fpm flex duct.*

  (Check also that these values do not exceed manufacturer's maximums)."

- *"Wall and floor cavities must not be used as ducts for either supply or return. Panning is not allowed. Ducts are not allowed in attics or floor or wall cavities that boarder unconditioned space."*

- *"Heat pumps having supplementary electric heat must have controls that, except during defrost, prevent supplemental heat operation when the heat pump can meet the heating load."*

- *"All duct joints, including drives and cleats and adjusting seams, must be sealed with tape and/or mastic. Tape and/or mastic must be UL-181 A or B rated for duct sealing. UL-181 rated tape must have the 'UL-181' shown on the face of the tape. Mastic must be used when connecting metal to metal. Tape may only be used when connecting metal to flex duct. Blank face foil and Duct Tape are not allowed."*

- *"Locate primary thermostat away from fireplaces, or other sources of heating or cooling. The thermostat must be located in rooms without fireplaces, and away from supply registers, direct sunlight, or drafts from open doors."*

- Include one of the following notes/information near the mechanical schedule:
    1. *"The HVAC system is not zoned."*
    2. Or, if the HVAC system is zoned, provide a schedule indicating the number of zones, and indicating which rooms are served by each zone, and the total load for each zone. HVAC bypass is not allowed.

- When a geothermal loop field is used, use the following note:
    "Properly size the loop field according to local soil conditions."

- When a fireplace is used, include the following note near the mechanical schedule:
    "Fireplace installation must meet International Residential Code requirements and all other state/local codes and/or regulations. Fireplace must be direct venting taking all combustion air from outdoors."

Foundation plan view
Include the following note below on the foundation plan view. Also provide an arrow pointing to the perforated tile/pipe of the radon abatement system, and another arrow pointing to the riser location, calling out radon abatement tile and radon abatement riser. The notes on those arrows must also direct the contractor to the following note, e.g. if this were note 3 on your drawing, then the arrow would tell the contractor to "See Note 3."

"Install a passive radon abatement system which meets the requirements of the International Residential Code (IRC), Appendix F. As an example: Locate minimum 3" nominal fabric wrapped perforated radon abatement tile/pipe within an under slab gas permeable material all along the entire length, and within 3 feet of the inside edge, of all foundation walls, and along any central foundation supports which cause a break in the air barrier under the slab. Install a 6-mil, or 3-mil cross laminated polyethylene air barrier type sheeting directly under the slab, with minimum 1 foot of overlap for any seams. Slab penetrations and joints must be sealed with a polyurethane caulk or equivalent sealant. The perforated tile/pipe must create a loop around the entire inside edge of the home and be connected to a minimum 3" PVC radon abatement riser. Use a tee and lateral to locate the riser so that it makes one straight run from under the slab, straight up and through the roof, with the exception that two 22-1/2 degree elbows may be used to slightly move the riser to one side or the other. The radon abatement riser must penetrate the roof, extend a minimum 1 foot above the roof, and be kept a minimum of 10 feet from any inlets, windows, or other openings to the home. A riser may be installed in interior walls or

in a chase, but not in exterior walls. A 6-mil polyethylene sheeting must be installed directly under the slab, with a minimum 1 foot of overlap for any seams. Slab penetrations and joints must be sealed with a polyurethane caulk or equivalent sealant. Sufficient grade must be maintained along the length of the perforated tile/pipe to prevent water from filling low spots and hindering radon circulation through the tile/pipe. The riser must be clearly marked between each floor and in the attic as "RADON ABATEMENT SYSTEM." In the attic, the riser must have a minimum unobstructed 2 feet of length as measured from the top of ceiling joists to the bottom of the roof trusses. Radon abatement tile/pipe may be incorporated into a sump system. This system may be substituted with any system which meets the requirements of the 2018 IRC, Appendix F. Active abatement systems, while not required, are allowed, provided provisions of Nebraska statutes are complied with. When incorporating an active system, the name of the licensed radon mitigation business used for completing the post testing must be listed on the drawings. Since an active system is an added energy use, it is recommended that a passive system be installed first. To ensure the effectiveness of the passive radon system, the occupants of a new home should be provided with written instructions to conduct a short term radon test in the lowest floor of the structure. If the results of such a test are 4.0 pCi/L or greater the passive radon system should be activated by a licensed radon mitigation business."

Elevation views
Include one of the following notes near the edge of each elevation view.

1. *"Backfill will be tamped."*
2. Or *"Builder will return after one full year to backfill any settled areas and repair or replace any associated landscaping."*
3. Or provide a note that lists the name of the certified hydrologist or soil scientist used and listed the type of soil that will be required as backfill, i.e. *"Per [expert's name], all backfill must be [product name] [product brand]."*

Part 8 – Home Energy Rating System (HERS) Rater Requirements

1**.** The HERS rater must advise the draftsperson to add any information to the plans that are needed to perform a complete rating. To be eligible, a home must achieve a rating of either ENERGY STAR or Net Zero Energy Ready. The plans are the defining document and must contain all necessary notes and dimensions to complete the HERS rating regardless of whether or not a separate set of specifications exist.

2. The HERS rater must use exact plan dimensions. HERS requires that dimensions used be within 1 inch or 1/10th of a foot, but that is for measurements on an existing home. Use exact plan dimensions. Be precise and detailed. Do not take shortcuts. The latest version of REM/Rate must be used.

3. The HERS rater, except for the direction of the home, must model the home as it is laid out on the plans using worst case scenario. Notes on the plans may use terms like “not to exceed” or “minimum” or “less than.” Those phrases are only used as an aid to the builder, giving them a range of products or materials. If the plans call out an R-value rating of “not less than 60,” then R-60 must be used.

4. The HERS rater must input the lighting and appliances. This accounts for about 5 points of the HERS rating. If more than one appliance is used, for example two refrigerators, be sure to add the combined kWh/yr.

5. Check the HVAC contractor’s ENERGY STAR checklist for equipment sizing requirements. If the HVAC contractor’s checklist does not agree with the HERS Equipment Sizing summary, work with the HVAC contractor to determine what is causing the difference. Sizing will not match exactly, but should be within a half ton.

6. No credit may be given for waste water heat exchangers or reflective coatings.

7. FINAL SUBMITTAL: See page 6, and provide NDEE with 10 days prior notice before the final blower door. NDEE may attend the final blower door test.

Part 9 – Manual J, S, and D Requirements

1. The HVAC contractor must submit Manual J, Version 8 load calculation reports using Air Conditioning Contractors of America (ACCA) approved software. Calculations must comply with all of the “Dos and Don’ts” outlined in the text version of Manual J8, and must use accurate dimensioning. The reports must be a block load for the entire house to include the worksheet. The reports must show all inputs. The HVAC contractor must provide a balanced duct diagram showing size and cubic feet per minute (cfm) and any zoning. A balance point diagram must be provided when gas backup is used.

2. The Manual J reports must not only show the calculated peak cooling and heating load, but also show the contractor’s inputs. “Short Forms” by themselves are not sufficient. The calculations must be accurate. If errors are found in the Manual J Calculation, the calculation will need to be revised and resubmitted, and this will not only cost the HVAC contractor time and money, but will also delay approval and start of construction for the home owner.

3. To be eligible for this program, furnaces, heat pumps (air source and geothermal), air conditioners, boilers, and water heating equipment, except for desuperheaters and solar hot water, must be currently listed in the Air-Conditioning, Heating and Refrigeration Institute (AHRI) online directory.

6. To ensure a quick and speedy review for the customer, be precise, detailed, and take no shortcuts. Size according to what’s on the plans, as opposed to calculating according to a desired size. The latter is tell-tale and will result in the submitted Manual J requiring revisions.

7. Make certain windows and doors are input as the National Fenestration Rating Council (NFRC) rated, using ratings shown on the plans. The Manual J calculation must consider overhangs, adjacent shading, U-values, SHGCs, and internal shades.

8. The equipment Sensible Heat Ratio (SHR) used in a Manual J calculation must be set to match the calculated load SHR. In Nebraska, which is relatively dry when compared to a costal climate, SHR should not be used to size equipment, and is not an excuse to oversize equipment. The SHR is an adjustable feature of all cooling equipment and is adjusted by varying the air flow across the coil (see ACCA Manual S and the manufacturer’s expanded performance data). Size the equipment according to the total load calculated in Manual J, and then adjust the air over the coil so that the equipment SHR matches the load SHR.

9. The contractor is responsible for entering data into the load sizing program which matches the equipment, materials, dimensions, etc. called out on the plans. Load calculations with data that does not match the building plans, or those that do not use Manual J default values for design parameters such as indoor and outdoor temps, number of people, miscellaneous loads, etc., will only result in delaying the approval of the customers application until the errors are corrected.

11. The HVAC contractor may only use 2,400 btuh as internal gains, unless a calculated custom internal load estimate is submitted. When a custom internal load estimate is submitted, each appliance or item listed on the calculation must also be shown in a schedule on the plans that includes the manufacturer, model number, and rated output. A catalog cut sheet for each item, showing rated output, must be submitted for each listed appliance. The calculation must include the use of the diversity factors shown in Manual J, e.g. an electric range with a total output of 10,000 btuh (3,000 watts or 3 kW), will have an average in use output of 0.25, and a percent used per hour of 0.25, for a total internal gain of, 10,000 btuh x 0.25 x 0.25 = 625 btuh.

12. For geothermal heat pumps, you must size the loop fields according to the soil type. Equipment size has very little to do with the number of, or depth of, the loops in a geothermal loop field.

13. If the HVAC contractor needs to contact the building contractor or design professional for information not available on the plans, the HVAC contractor must advise the draftsperson of that lack of information, and inform the draftsperson that the plans will need to be revised to include the information. If the plans do not include this information at review, the review process will be delayed by plan revision.

14. The plans are the defining document and must contain all necessary notes and dimensions to complete a Manual J load calculation, regardless of whether or not a separate set of specifications exist. If you cannot find an input on the plans, once you have found that input, advise the drafter to change the plans to include it.

Part 10 – Acronyms

ACCA

Air Conditioning Contractors of America, website www.acca.org.

AFUE

Annual Fuel Utilization Efficiency, an efficiency measure that tells what percentage of the potential energy in the fuel makes it into the heating distribution ducts or pipes on a seasonal basis.

AHRI

Air-Conditioning, Heating, and Refrigeration Institute, website www.ahridirectory.org.

ANSI

American National Standards Institute, website www.ansi.org.

AWEA

American Wind Energy Association, website www.awea.org.

CAD

Computer Aided Drafting, a term used to describe software used to make drawings.

CFM

Cubic Feet per Minute.

COP

Coefficient of Performance, a dimensionless measure of efficiency, defined by output divided by input.

CPD

Certified Products Directory, a directory listing of windows and their efficiencies on the National Fenestration Ratings Council website, www.nfrc.org.

CRI

Color Rendering Index, the ability of a light source to reveal the colors of various objects faithfully in comparison to daylight.

DOE

The U.S. Department of Energy, website www.energy.gov.

EER

Energy Efficiency Ratio, a measure of efficiency, defined by output btu/hr divided by input in watts.

EF

Energy Factor, an efficiency measure that tells what percentage of the potential energy in the fuel makes it into usable heat, typically used to rate water heating appliances.

EPA

Environmental Protection Agency, website www.epa.gov.

ERI

Energy Rating Index, an efficiency measure used to determine compliance with the 2018 International Energy Conservation Code.

ERV

Energy Recovery Ventilator, a device used to provide balanced mechanical ventilation while also working as an air to air heat and humidity exchanger.

HERC

Home Energy Rating Certificate, one of many reports that can be generated by the Home Energy Rating System software REM/Rate.

HERS

Home Energy Rating System, a standardized method of rating housing efficiency.

HRV

Heat Recovery Ventilator, a device used to provide balanced mechanical ventilation while also working as an air to air heat exchanger.

HVAC

Heating Ventilation and Air Conditioning.

HVI

Home Ventilating Institute, website www.hvi.org.

ICF

Insulated Concrete Form, plastic forms made of board insulation used to build concrete walls.

IECC

International Energy Conservation Code, website www.iccsafe.org.

IGSHPA

International Ground Source Heat Pump Association, website www.igshpa.org.

IMEF

Integrated Modified Energy Factor, a performance metric for ENERGY STAR certified clothes washers, having units of ft^3/kWh/cycle.

IRC

International Residential Code, website www.iccsafe.org.

kWh

Kilowatt-hour, a measure of the amount of energy you are using, number of watts in an hour divided by 1,000.

LED

Light Emitting Diode, a semiconductor light source.

NDEE

Nebraska Department of Environment and Energy, website (Energy and Assistance Division) www.neo.ne.gov.

NFRC

National Fenestration Ratings Council, website, www.nfrc.org.

OSB

Oriented Strand Board, a type of engineered wood.

R-value

A measure of a products heat resistance, ft^2 x °F x hr / btu, the inverse of U-value R=1/U.

SEER

Seasonal Energy Efficiency Ratio, a measure of efficiency, defined by output btu/hr divided by input in watts.

SHGC

Solar Heat Gain Coefficient, a percentage measure of the amount of solar heat that will pass through a window.

SRCC

Solar Rating and Certification Corporation, website www.solar-rating.org.

SRE

Sensible Recovery Efficiency, a percentage measure of efficiency for the amount of sensible heat transferred by an air to air heat exchanger.

STC

Standard Test Conditions, the standard under which solar panels are tested, a cell temperature of 25°C and an irradiance of 1000 W/m² with an air mass 1.5 (AM1.5) spectrum.

SWCC

Small Wind Certification Council, website www.smallwindcertification.org.

U-value

A measure of a products heat conductance, btu / ft^2 x °F x hr, the inverse of R-value U=1/R.

WWR

Window to Wall Ratio, a percentage measure of the amount of windows in a wall, the quotient of the area of windows divided by the total area of a wall including the windows.

Part 11 – Examples and Building Design Information

Ceiling Drywall Example:
If the drywall used has insulation load limits of 1.3 pounds per square foot (psf) for ceilings on 24 inch centers and 2.2 psf for ceilings on 16 inch centers, and if the weight of R-60 cellulose at 17.5 inches thickness is 2.1 psf, and the weight of R-60 fiberglass at 22 inches is 1.0 psf, then for R-60 you either use 16 inch centers and cellulose, or 24 inch centers and fiberglass. While this may look like an advantage with fiberglass, the ceiling trusses must also be considered, and using 16 inch centers may allow the use of 2x4s vs 2x6s. Another example might be to use a combination of some level of high density spray foam for sealing, and then topped with either fiberglass or cellulose insulation. Note that this is shown as an example only, and the designer must check the manufacturer's specifications for actual load limits.

Double Floor Joists:
For areas of your floor under a fireplace, or perhaps a kitchen island, have your designer check the load limits for the floor joists you're using. Do you need to double the joists in certain areas? Fireplaces themselves can weigh anywhere from 200 to 700 pounds. And if you would like a nice stone or brick ledge in front of the fireplace, and stone or brick facing around the fireplace, suddenly you can have a 500 to 1000 pound load on your floor that has not been accounted for. Or maybe you want a nice 1-inch-thick granite counter top on your kitchen island, and a sink and garbage disposal, and considering all the piping and electrical also needing support, you may need more than just the minimum floor joists that have been designed only to support a person or light furniture. A 6-inch-deep, king size water bed mattress would weigh 1,300 pounds. By comparison, the waterbed weight would probably be spread out more, less weight per joist, than a 1,000 pound fireplace. Look for things on your plans that are heavy, and ask your designer if they have accounted for the weight.

Foundations and Band Joists Insulation:
When the foundation wall or band joist is insulated on the interior, the freeze point, 32 degrees, will move inside the wall to a point somewhere between the outside surface and inside surface of the insulation. When this happens, moisture vapor in the air will start to condense and accumulate on the inside surface of the rim joist or the foundation wall, just like the frost that can accumulate on a single pane window. Closed cell spray foam in these areas is considered a best practice. Another good practice is to glue foam board on these surfaces, but you must take care to glue all around the outside edge of the foam board to prevent moisture from getting behind the foam board. Both of these practices put the freeze point inside the foam, and stops the moisture vapor in the air from condensing, accumulating, and possibly causing rot or mold. Recent recommendations, or best practices, now recommend a small amount, 1 or 2 inches, of foam on the inside of wall cavities as well, for this same reason.

Mass Walls:
Brick and concrete are not insulators. The R-value of an 8 inch concrete wall will range between R-0.5 to R-1.5. This is very similar to an old single pane windows, which has an R-value of 1. However, brick and concrete have great heat capacities, or thermal mass. They can store lots of heat. The inside wall temperature on a typical wood frame home tends to want to swing with the outdoor temperatures. Brick or concrete walls, or insulated concrete form walls, on the other hand, will actually delay the outdoor temperature from reaching the inside surface of the wall because it has a capacity to absorb the heat. While a similar amount of heat, or cold, is seen by each home, brick or concrete will tend to temper that heat, and lower the maximum and minimum temperatures seen by the home. Thermal mass will

smooth out the temperature curve your home sees. This tends to even out the load on the heating and cooling system, and lower the maximum load. Thermal mass can also reduce energy use, and can shift energy use away from peak demand times.

HVAC Sizing:
The Energy Code limits the size of heating and cooling equipment (HVAC) to prevent short cycling. Oversized HVAC uses more energy, has less capacity to remove humidity, and fails prematurely because of short cycling. Oversizing adds up to reduced comfort and increased costs the homeowner.

In just the last few years, we are seeing fully variable speed and multi-speed equipment, which allows us to slightly oversize while still maintaining efficiency and comfort. While it is an option to use dual units inside the home, in parallel, connected to one duct system, and with one only running when oversize is desired, it is not preferred in this program. In all situations, proper sizing and proper design of ductwork is critical.

ERVs and HRVs:
Build it tight and ventilate right. This is considered a best practice. Ventilation can be done using exhaust-only, with bathroom or other exhaust fans; supply-only, drawing in fresh air using the furnace fan; or with balanced ventilation from an Energy Recovery Ventilator (ERV) or Heat Recovery Ventilator (HRV). HRVs and ERVs bring in new air and exchange and conserve both heat and moisture (ERV) or just heat (HRV) from exhausted indoor air.

The problem with the exhaust-only approach is that that the air you exhaust must be replaced somehow, and you really don't know where that replacement air is coming into the house. The air coming into the house might not be that good.

Supply-only systems are better because you at least know where the air is coming from. However, both of these systems cause you to expel air that you usually have paid to condition, and replacing that air with air you will need to condition again. The HRVs and ERVs give you fresh air from a location you know, and save you some of the cost you paid to condition the air you are exhausting.

What about clothes dryer exhaust at 250 cfm? Where does the air come from that replaces that? How about kitchen exhaust at 100 cfm or more? Bathroom exhaust at 30 cfm or more?

Ideally, we would have all our exhaust connected to HRVs or ERVs. Contractors are already starting to tie bathroom exhausts into the ERVs and HRVs. Are clothes dryers and kitchen exhaust next? With clothes dryers and ERV or HRV could save some of the dryer heat in the winter, but would require a bypass so that the dryer heat would still be exhausted in the summer. We would certainly need to filter air coming from a dryer that we send to an ERV or HRV, and maybe from a kitchen exhaust, as well, but a typical furnace filter might accomplish this. Perhaps the next step is to have HRVs or ERVs that conserve and control the conditioning in all our exhaust air.

All Spray Foam Is Not Alike:
Spray foam insulation is expensive, and all foams are not alike. High density spray foam costs are nearly the same as low density spray foams. High density spray foams will have R-values near 7 per inch. Low density foams will have R-values near 3.5 per inch. Know what you're getting.

Don't Trust Claims of Equivalent R-values and Radiant Barriers:
Some manufacturers will tout "equivalent R-values." Do not be fooled by these ads. Some claim that reduced infiltration is equivalent to R-value. It is not. It is equivalent to reduced infiltration, which, when

there is no wind, is zero. A good contractor with a few tubes of caulk can make infiltration near zero, even when there is a wind.

Some radiant barriers claim to stop up to 99% of radiant heat loss, which is great if you live in outer space. Here on earth, conduction and convection are our major heat loss/gain components. Stopping 99% of 1% is only 0.99%. Look for ASTM tested R-values. For R-value information consult the Federal Trade Commission's (FTC) R-Value Rule. The maximum thermal resistance you can expect from radiant barriers has been tested and is listed in the ASHRAE Handbook of Fundamentals. Note the footnotes in the ASHRAE Handbook state that the values listed are for laboratory conditions, sealed air spaces, and flat and clean surfaces. Even a small amount of dust or moisture on a radiant surface greatly reduces its effectiveness. Imagine dressing in nothing but foil, C insulated clothes, and walking a few miles to work on a subzero day.

Occupancy Sensors:
As a minimum, these should be installed in your bathrooms to turn on lights and fans and turn them off at a set time after you leave. The first rule of saving energy is to turn lights and fans off, and that's what occupancy sensors do.

Net Zero Energy Example:
In the article "Insight Zeroing In, Net Zero Houses," by Joseph W. Lstiburek, Ph.D., P.Eng., Fellow ASHRAE, consulting firm Building Science recommends the following building practices for Net Zero Homes:

- R-5 windows
- R-10 slab insulation
- R-20 basement insulation
- R-40 walls
- R-60 roof insulation
- Airtightness of 1.5 ach@50 Pa or less
- Heat recovery on ventilation
- LED lighting everywhere
- SEER 18 or more for A/C
- HSPF 10 or more for heating
- Appliances from the top 10% of ENERGY STAR (most efficient)
- AFUE 95% sealed combustion condensing for furnaces, water heaters and boilers

Building Science estimates that a 2,800 square foot home built to the specifications above would require a 7.5 kW solar system to reach net zero energy use with a "conserving lifestyle."

Lighting:
Compact Fluorescent Lights, CFLs, come in all sorts of colors, and so do LEDs, but this isn't necessarily a good thing.

When we go to the store looking for a light bulb, a good recommendation might be to look for bulbs that list the Color Rendering Index (CRI). The CRI is a comparison of the bulbs light to natural sun light. You should also look for the bulbs color temperature, which is an indication of the color of the light. A good neutral color bulb would have a CRI of 84 or higher, and a temperature of around 4,000 Kelvin. Higher Kelvin temperatures will give a more blue light, and cooler temperatures tend toward yellow and then red. Direct sunlight is at 4,800 Kelvin, a little blue, but this may be a little too blue for your liking. Instant Start, or short start times, are also often desirable.

For tube type fluorescent lighting, you can use the same CRI and color temperature recommendations. Tube type fluorescents can have CRIs in the 90's. It is also recommended to use "low harmonic" and "instant start" electronic ballasts when using tube type fluorescent fixtures.

LED efficiency is very similar to fluorescent efficiency. The big advantage of LEDs is the life of the bulbs. Changing bulbs may become a once in a lifetime event with LEDs. CRIs and color temperature still apply.

Induction lighting is a type of fluorescent lighting that does not require a spark to start the light. This greatly increases the life of the bulbs. Induction lighting is another big energy saver.

3/8 Inch Hot Water Piping:
Shower heads and faucets have been limited to 2.5 gpm and 2.2 gpm, respectively. When this was done, maximum pipe size was not limited, and has stayed the same. Recommended maximum pipe velocities are between 5 and 8 fps. Full 2.5 gpm in 3/8 xps copper (smallest I.D. for copper) results in a velocity of 5.8 fps, and in SPS results in a velocity of 4.2 fps. Note that this is considering running nothing but hot water through the shower head. Typically we run our facets mixing some fraction of hot water with some cold water, so the water running in the hot water pipes is some fraction of the 2.5 gpm, or 2.2 gpm limits. The velocity will be the same fraction, and less than max recommended.

Advantage of smaller pipe size is that less water is required to fill 3/8 vs 1/2 inch nominal pipe, meaning less time to hot water in the shower, and less energy loss from storing hot water in the pipes. In the case of xps, 19% less time to shower, and 19% less hot water in the pipes.

Websites:
Manufacturers' web sites can be good sources of technical information for your design. Here are a few:

www.buildingscience.com – for best practice information on the building envelope, framing, insulation, roofing, window and door installation, and everything else. The information section has free best practice articles that deal with all aspects of residential building.

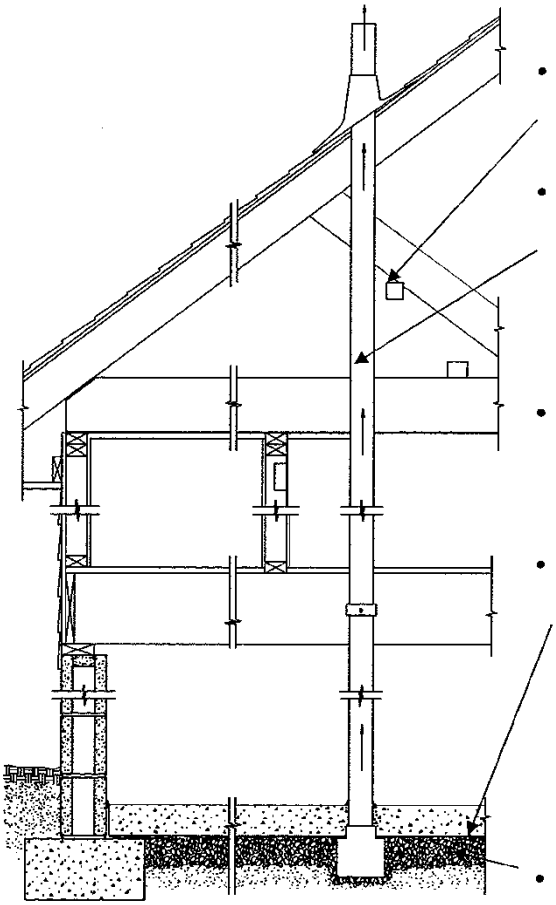
www.energystar.gov – in recent years, ENERGY STAR has developed a new level of efficiency they call "Most Efficient." This rating is similar to the top 10% of products with regard to efficiency. You may need to actually search the ENERGY STAR website for "Most Efficient" but they do have product lists, and they are the best with regard to efficiency. Note that for the Nebraska Energy Efficient Housing Loan Program, furnaces, air conditioners, and heat pumps must be currently listed in the AHRI online directory, regardless of listings on the ENERGY STAR website.

http://dhhs.ne.gov/Pages/Radon.aspx - for more information on radon in the State of Nebraska. Also see the radon example on the following page.

www.bulbs.com, www.lighting.phillips.com, www.sylvania.com, and other manufacturer and sales web sites can provide you with additional information on lighting and lighting fixtures. You can use these sites to find information on lighting CRI's and color temperature for bulbs (see "Lighting" above). Note that manufacturer information is provided as an example, and for information only, and is not a recommendation of any kind.

MINIMIZE RADON AND SOIL GAS ENTRY INTO HOMES

INSTALL A PASSIVE, SUB-SLAB, SOIL GAS VENTILATION SYSTEM



- **Install an electrical junction box in the attic** to permit the installation of a fan to activate the system, if needed.
- **A 3- or 4-inch diameter PVC ventilation pipe vertically through the building floors.** The ventilation pipe should have a "T" fitting bedded in the aggregate below the plastic sheeting and should terminate at least 12 inches above the surface of the roof.
- **Seal all joints, cracks, or other openings** around all penetrations of both exterior and interior surfaces, **below grade,** with an elastomeric sealant to provide an air-tight seal.
- **Install 6-mil (or 3-mil cross laminated) polyethylene sheeting material on top of the aggregate material.** The sheeting should cover the entire floor area and separate pieces of sheeting should be overlapped at least 12 inches. The sheeting should fit closely around any pipe or other penetrations of the material. Where practical, punctures or tears in the material should be sealed or covered with additional sheeting.
- **Install a 4" thick layer of clean, 1/4 to 2-inch size aggregate** to create a permeable layer (for soil gas collection below the basement slab) and provide a ***"capillary break"*** from the soil.

Notes:

1. Label all interior radon vent pipes as a "Radon Reduction System."
2. If the structure will have an interior sump to serve as the outlet point for an interior or exterior drain tile loop, then it should be covered with a gasketed or otherwise sealed lid to retard soil gas entry.

Additional information on building design, construction techniques and good building practices that should be considered as part of a general radon reduction strategy are available from ***the Nebraska Radon Program Office*** (1-800-334-9491) upon request.

Prepared By Mark Versch,
Environmental Health Analyst

Department of Health & Human Services
DHHS
NEBRASKA

Produced by: Nebraska Department of Environmental Quality, P.O. Box 98922, Lincoln, NE 68509-8922; phone (402) 471-2186. To view this, and other information related to our agency, visit our web site at http://deq.ne.gov.