



## “The Path to Performance”

### Postings from a 2016 Energy Star Home Under Construction

#### ***HVAC, Electrical, and Plumbing ... Installation of Essential Infrastructure in a High-performance Home***

**(November 8 to December 10, 2016)**

With the house “dried in” so that moisture in the form of rain or snow could not penetrate the interior, subcontractors installing heating, ventilation, and air conditioning (HVAC) systems; electrical wiring, switch boxes and lighting; in-the-wall plumbing; and the septic tank/leach field were scheduled and the rapid construction pace continued.

As with the previous stage (where framing elements promoting energy efficiency were constructed), mechanical systems consistent with Energy Star® standards were installed to further promote energy efficiency. The equipment and work performed by each of the trades are described in the following sections.

#### ***HVAC ... Energy Efficiency and Indoor Air Quality***

The homeowner’s selection of an HVAC system was guided by several factors:

- The (mostly) all electric nature of the energy source for this home;
- The desire to have a high-efficiency compressor and air handler that meets Energy Star® standards; and
- The [IECC Climate Zone 4B](#) characteristic of this region of north-central Arizona and Chino Valley in particular i.e., relatively dry climate with winter temps as low as 0°F and summer temps as high as 100°F.

These criteria led to the selection of the American Standard variable speed, communicating heat pump HVAC unit which is promoted as having SEER rating up to 18.0 and HSPF up to 10.0 (meaning that this is a very energy efficient unit). This unit is designed to operate at outdoor ambient temperatures from 55° F to 120° F in cooling and from -10° F to 66° F in heating. The size of the unit (36,000 BTU or 3 ton) was guided by Manual J heat load calculations

performed by Cool Side which modeled the home requirements as being between 24,000 and 36,000 BTU. So, the bottomline is that the unit is “right-sized” based on the modeling of the heat demand.

The ductwork and air handler portion of the split system was installed into what will be an unvented, conditioned attic space by technicians from [Cool Side Inc.](#) The main trunk line of the ductwork was



sheetmetal with flex duct branching off to supply conditioned air to individual ceiling registers throughout the house. Two air return plenums (master bedroom and service hallway) were also installed. Even though the ducts are in the conditioned attic space, all seams and connections



were sealed with mastic to limit air leakage that could create air pressure imbalances.

In the building science world, there is a saying “build it tight, ventilate it right” ... and that holds true for this house as well. In a high-performance house, where air leakage in framing and around



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windows or other penetrations is minimized, indoor air quality must be maintained by other means. To accommodate this, Cool Side installed an Energy Star®-certified Venmar C12 Energy Recovery Ventilator (ERV). This unit draws in fresh air and expels stale air (from registers under the rear patio roof), while also tempering the air exchange temperature and filtering the air.



When in operation, the unit typically operates 20 minutes per hour programmed via a control unit on the wall.

Finally, ultra-quiet Panasonic bathroom and laundry room fans (also Energy Star® certified) were installed as part of the HVAC package.

Cool Side technicians will return later to install the exterior HVAC compressor and at that time pressure balance the air being supplied to the various house sectors using already-installed dampers.

#### **Electrical Wiring and LED Lighting**

Electrical subcontractor [Norseman Electric](#) roughed in the wiring for all the lighting, outlets, appliances and fixtures following the HVAC install. The setup for this home includes a ranch panel installed on the exterior garage wall (allowing flexibility to run additional circuits in outside locations) and a subpanel (with inside circuits) inside the mechanical room in the home. LED lighting is planned throughout the home, so technicians installed appropriate recessed lighting fixtures in all the rooms. (When the project nears completion, the LED lighting will be revisited in this posting.) With approvals and meter installation from Arizona Public Service in place, the power line was energized with one active outlet in garage.

#### **Rough Plumbing**

Simultaneous to the electrical rough-in, [Elsea Plumbing](#) installed copper water lines (connected to PEX in the foundation) to the bathroom, laundry room, and exterior wall hose bibs.



In addition, gas lines were run to the kitchen (gas range) and patio (gas grill). If a future owner desires gas for a dryer in the laundry room or a gas hotwater heater in the mechanical room, lines were stubbed out to these locations but will not be connected to any appliances.

#### **Septic Tank and Leach Field**

This house location is not proximal to a municipal sewer line, so a septic system was the alternative for waste water treatment/disposal. This system had been previously designed and permitted through Yavapai County Environmental Services. The soil type at the site allows for the construction of a standard septic system i.e., 1250 gallon



concrete tank and two leach trenches each 75 ft long. [Savage Development](#) was contracted to perform the excavation, set the tank, backfill with leach rock, and set the drain lines.



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#### **Loading the Tile Roof**

The roofing material scheduled for installation in this house is concrete S-tile. To allow the roof and other framing members to settle under the load of the tiles (especially important to limit cracking of with stucco cladding), workers from [Superior Roofing of Northern Arizona](#) distributed stacks of



tiles across the entire roof area.

#### **Energy Star® Inspections**

As a part of the certification process required for qualifying as an Energy Star® home, inspections must be performed at key stages. In this area, these inspections are performed by [E3 Energy](#), a certified rater in the Energy Star® program. In their most recent inspection (i.e., the “pre-insulation inspection”), a [comprehensive checklist](#) was followed to look for thermal enclosure defects and verify (for example) that air leakage in framing had been minimized prior to being covered by insulation. The inspector found no defects to correct and was suitably impressed at the level of effort in air sealing, window coefficients, and insulation design to be implemented in the upcoming construction.



These Energy Star® inspections are separate from the inspections performed by the local Town of Chino Valley jurisdiction. During November and Early December, the home passed two inspections (Exterior Building Wrap, and Rough Combination) without remediation requirements.

#### **Coming in the Next Installment**

Insulation design and installation  
Structured wiring installation