

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE GENERAL SPECIFICATIONS
PUMPING PLANT
SOLAR POWERED PUMP**

(No.)

CODE 533

SCOPE

These construction specifications cover the materials and installation of solar powered pumping units, including the solar panels, installed for livestock water. They **do not** include the installation of the well.

Pumps shall be installed according to manufacturer's instructions. Pump manufacturer's recommendations shall be followed in regard to interior dimensions, clearances, elbows, valves, controls, and pump head characteristics.

PUBLIC AND PRIVATE UTILITIES

Utilities are defined to be public or private, overhead and underground power or communication lines, or any pipelines. The landowner/operator/contractor shall conduct their own search and discovery for utilities in order to lessen or avoid potential damages, injuries or loss of life. Prior to construction, the owner/operator should complete an OK-ENG-45 UTILITIES INVENTORY and CONSTRUCTION RELEASE to document known utilities. Prior to any ground disturbance, the installer or their representative shall call the Oklahoma One-Call System as required by State law.

QUALITY CONTROL

Quality control of all materials and construction procedures is the responsibility of the landowner and contractor. NRCS will make periodic review(s) of the work for the benefit of the agency which will include the final construction check with the pump flowing.

EQUIPMENT

1. Photovoltaic (Solar) Powered Pump and Motor: The pump and motor shall be capable of delivering the required daily capacity at the total head shown in the construction details. The pump and motor shall have minimum 3 year warranty.
2. Solar Panels: Panels shall be tested and listed by Underwriters Laboratories (UL) to meet UL 1703; or tested and certified to withstand the impact of 25-mm (1-inch) diameter hail at a minimum velocity of 23-m/s (51-mph) without major visual defects by another nationally recognized testing lab in accordance with IEC 61215, or IEC 61646. Each Panel shall be labeled by the manufacturer with rated open-circuit voltage, operating voltage, maximum permissible system voltage, operating current, short-circuit current, and maximum power. Panels shall be assembled with seals capable of remaining watertight over a temperature range of -20°F to +120°F. The manufacturer shall warrant each Panel for a minimum period of ten (10) years against power degradation in excess of 10% of the rated power.

Panel junction boxes shall be moisture resistant and shall have sufficient space for addition of bypass diodes. Boxes that accept conduit are preferred. Panel junction boxes shall be mounted to the solar panel frame and not to the surface of the panel. During installation, the panels shall be covered until all electrical work has been completed.

3. **Mounting Structure:** The solar panel array shall be mounted on a new commercially manufactured or a professional engineer certified mounting structure, which is made of steel and has a minimum wall thickness of 1/8th inch. Approved commercially manufactured mounting structures for use in Oklahoma and can be found in the Pre-Approved Practice List; others will require a technical review. The mounting structure must be capable of supporting the solar panel array under loads caused by 130-km/h (81-mph) winds and ice loading of 25-mm (1-inch) thick minimum over all exposed surfaces. Any structure designed, certified, signed, and sealed by an engineer licensed to practice engineering in the state of Oklahoma shall be submitted to NRCS for approval prior to installation. As a minimum, the structure shall have a tilt angle from horizontal that ensures optimum utilization of the solar energy. A mounting structure that tracks the sun is recommended.

Pole mounted solar panel structures shall meet the minimum pole requirements as established in Table 1. Length in ground shall be increased 6 inches for each additional foot of height added above ground, but total height shall not be increased more than 3 additional feet above what is listed in Table 1-a. Hole will be filled with concrete which will produce a minimum strength of 3000 psi in 28 days.

Table 1

Panel Area (sq-ft)	Pole Size Sch-40 Steel (in.)	Length in Ground (in.)	Height Above Ground (in.)	Hole Dia. (in.)	Estimated Concrete (ft ³)
15	2	36	60	12	2.3
20	2.5	38	60	12	2.4
28	3	40	60	14	3.4
35	3	42	66	14	3.5
60	4	46	66	20	8.1
90	6	54	72	28	18.3
120	6	60	78	28	20.4

The solar module array mounting structure shall be installed and anchored in accordance with the manufacturer's instructions and these specifications. Concrete shall be placed at least 24-hours before the solar panel array is attached.

4. **Protective Structure:** The solar powered system shall be enclosed by durable fencing or other protective structure. The enclosure must exclude livestock and allow access to all system components for service and maintenance.
5. **Electrical Components:** All electric components including lightning arrestors and grounding shall be provided according to manufacturer's recommendations.
- a. **Controller and Electronics:** A controller, of the type recommended by the pump or solar system manufacturer, which is capable of protecting the pump from common faults, including low water (dry running), overload, and electrical short circuits, shall be provided. Electronic components shall be UL listed, (or equivalent). Solar systems shall be fused as required by the manufacturer. A controller that is capable of providing flow or level control with the addition of a remote pressure or level control switch is recommended.

The controller and other necessary electrical components shall be located in a weatherproof enclosure and mounted at a level for convenient access. A DC rated switch, circuit breaker, or other equivalent device shall be provided as a means for disconnecting the array from the system. The disconnecting device shall be located near the system controller and housed in a grounded weatherproof enclosure.

- b. Wiring: All wire material shall be copper. Solar Panel to Panel wiring shall be in conduit or be rated sunlight and weather resistant (USE, type TC or equivalent). In-line splices are not permitted in the Panel wiring. Panel wiring connectors must be crimp ring lugs and wiring terminals or compression terminal blocks. Wire nuts shall not be used. Each wire termination shall be adequately marked to identify the circuit conductor. The marking shall be consistent with the identification included on the wiring diagram.
 - c. Grounding: Grounding conductors shall be installed per manufacture's recommendation and any safety codes.
6. Drop Pipe: All drop pipe shall meet NSF requirements. The drop pipe, not to exceed 2 inch nominal size, shall be one of the following:
- a. Galvanized steel drop pipe consisting of joints of reamed galvanized pipe, threaded and complete, with long couplings having a quality equal to the pipe. The pipe shall be Schedule 40 and meet ASTM-A-53. The total pumping head shall not exceed 72% of the pressure rating of the pipe.
 - b. Polyethylene (PE) pipe shall comply with one of the following specification: ASTM-D-2239 (SIDR-PR) or ASTM-D-3035 (SDR-PR). Polyethylene (PE) pipe fittings shall conform to manufacturer's recommendations.
- The pipe and fittings shall have a pressure rating equal to or greater than the following:
- i. For a total pumping head of 0 to 100 feet the minimum pressure rating shall be 125 psi.
 - ii. For a total pumping head greater than 100 feet the minimum pressure rating shall be 200 psi. The minimum of 3/16" diameter type 304 stainless steel cable shall be used to support the pump. Total pumping head shall not exceed 72% of the pressure rating of the pipe and shall not exceed 450'.
 - c. Polyvinyl chloride (PVC) pipe shall be PVC 1120, Schedule 80 or 120 conforming to ASTM-D-1785. Total Pumping Head shall not exceed 72% of the pressure rating of the pipe. The pipe shall have threaded couplings having a strength equal to or exceeding the pipe.
 - d. Check Valves: Check valve(s) shall be spring-loaded, stem or cage poppet-style.
 - e. Torque Arrestors: Torque arrestor(s) shall be constructed of PVC or rubber material and field adjustable to hold pump centered in well. Stainless steel clamps shall be used to securely fasten the torque arrestor to the drop pipe.

INSTALLATION

1. Pump: The installation of the pump, motor, drop pipe and other pump accessories shall conform to Oklahoma Water Resources Board Rules Title 785, Chapter 35, *Well Driller and Pump Installer Licensing*, Subchapter 9, *Minimum Standards for Pump Installation*.
2. Electrical Components: The controller, electronic components, lightning arrestors, grounding rods, and wiring shall be installed in accordance with NEC requirements and manufacturer's recommendations. Installation by a licensed electrician is highly recommended.

3. Conductors (Power Cable):

- a. *Splicing:* The power cable shall be furnished in one continuous length within the well where possible. A maximum of two water tight electrical splices within the well will be allowed. Splices may be completed using water tight wire connections or water proof taping.
 - b. *Clamps:* A stainless steel clamp may be used below each drop pipe joint to tie the power cable to the drop pipe. The installer shall protect the cable at each stainless steel clamp with a 3 inch long piece of polyethylene plastic, split on one side and placed around the drop pipe. Clamps shall be spaced a maximum of 22' apart.
 - c. *Taping:* Four turns of ¾ inch plastic tape at each joint can be substituted for the stainless steel clamps specified above in (2). However, the Installer shall also tie the power cable to the drop pipe with four turns of ¾ inch plastic tape equally spaced between joints not to exceed 10-feet. Maximum spacing between tapings shall be 10 feet.
4. Check Valves: Average spacing shall be 200 feet (not equally spaced) and a check valve shall be installed a maximum of 21' above the pump provided an internal check valve is not present in the pump. If needed for water quality protection a horizontal check valve will be installed in the discharge pipe.
 5. Centering Guides: Install centering guides at a maximum of 42' apart throughout the entire drop pipe.
 6. Torque Arrestor: If plastic drop pipe is used a minimum of three torque arrestors shall be installed. Place one immediately above the pump, one 10 feet above the pump and another 20 feet above the pump.
 7. Flow Testing: After installation is complete, the Installer shall operate the pump for a period of 1 hour. The Installer shall also provide facilities for the safe discharge of the test water.
 8. Sanitary Protection of Well: The installer shall protect the well during the construction period to prevent vandalism, tampering, or seepage of contaminated water, petroleum products or other contaminants into the well from the ground surface.

CERTIFICATION

The Installer shall certify that the pump is properly installed and operates in accordance with the design needs and with NRCS standards and specifications by signing the Certification section of the OK-ENG-54 Solar-C, Solar Pumping Plant – Vendor Certification Sheet.

GUARANTEE

The Installer shall provide the owner/operator (with a copy provided to USDA-NRCS) a guarantee that covers materials and installation against any defective or workmanship, for a period of one year from the date of completion.