NEMA US 80016-2022

Meter Socket Adapters

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I. Introduction

In light of industry trends such as the integration of distributed solar photovoltaic generation and the installation of backup generators in disaster-prone areas, meter socket adapters are being more commonly used within the service entrance of residential, commercial, and industrial buildings. The purpose of this paper is to educate owners and installers of meter socket adapters on general use applications for these products, as well as design and testing requirements.

II. Definition of A Socket Adapter and Why/When Used

A meter socket adapter is an enclosed construction with blades and jaws intended for installation between a meter socket and the utility meter. While utilities have installed these devices for decades, adapter utilization has increased and grown steadily over the years. Today meter socket adapters may contain additional bus bars, protective devices, metering, communications, and other associated equipment and primarily serves as an S-base meter socket. Its physical electrical aspects are covered by ANSI/NEMA C12.7 Requirements for Watthour Meter Sockets and C12.10 Electromechanical Watthour Meters. The dimensions of the base of the adapter are provided with an appropriate envelope design, as covered in Figures 2–10 of C12.10 for the intended application. Adherence to both Standards ensures coordination between the meter, the socket, and the adapter. Additionally, performance criteria for meter socket adapters are covered by UL 414 Supplement SA.

Meter socket adapters are utilized in many different applications, such as meter conversions, transfer of meter position, distributed energy connections, surge protection, metering and communication, and other associated functions. Not all of these applications and uses are certified by third-party organizations, though some may be certified by utilities or product manufacturers. While final populated assemblies could be covered under different certification standards, such as UL 414, UL 1008M, and UL 2735, the base adapter product, consisting of enclosure, blades, and jaws, is covered by the UL 414 standard.

The typical meter socket adapter is a circular “collar” type device that is installed between the meter and the meter socket. Meter socket adapters for special applications may have larger enclosures or supplemental enclosures that are connected to the basic “collar.” Meter socket adapters may also have provisions for the use of conduit to facilitate connections to other equipment not connected to line or load terminals of the existing meter socket.

III. Overview of Different Types/Applications

Meter Conversion/ Installation Upgrades

Meter socket adapters used for meter conversions and installation upgrades allow for the conversion of legacy meter socket forms that are no longer supported by the serving utility. For example, today meter socket adapters are commonly used to convert A-base sockets to S-base sockets.

Interbase Adapters

Meter socket adapters can also be used for conversion of the meter type or orientation. For example, these meter socket adapters could be used to convert a ringless style meter socket to a ring style meter socket assembly. Meter socket adapters can also conform to varying angles to change the meter orientation, making the reading of the meter easier for the end-user.

Power Source Adapters

This type of meter socket adapter is used as a line side or load side tap to provide AC power (or DC power with a converter) in various applications such as FTTH (fiber-to-the-home).

Alternative Energy

Meter socket adapters may be provided with provisions for the interconnection of distributed energy systems, such as interactive inverters, energy storage systems, or bi-directional types of electric vehicle chargers. These provisions typically connect the distributed energy system to the load side of the meter, but, in some cases, it may be desirable for this connection to be made on the line side of the meter.

Transfer Switches

Meter-mounted transfer switches typically use an adapter for connecting the transfer switch between the meter mounting equipment and the electric utility meter, such that the transfer switch is on the line side of the service disconnect. In this case, the adapter must meet the requirements in UL 414, and the entire assembly is investigated using UL 1008M.

Surge Suppression

The 2020 edition of NFPA 70 (The National Electrical Code) requires single-point surge protection for residential service.

> **230.67 Surge Protection.**
>
> **230.67(A) Surge-Protective Device.**
> All services supplying dwelling units shall be provided with a surge-protective device (SPD).

Meter socket adapters—equipped with surge protection—may fulfill that requirement by providing whole house surge protection at the service entrance. The surge protection device(s) are investigated using UL 1449, and the adapter is investigated using UL 414.

Load Management

Meter socket adapters may also contain monitoring devices, communication devices (including cellular communication), power quality interfaces, and recording devices for the purpose of load management and other similar functions.

IV. Scope of UL 414 / History

Main Body of Standard

The Standard for Safety UL 414, Meter Sockets (UL 414), has been utilized for certifications since the 1950s. The main body of UL 414 provides requirements for meter sockets associated with plug-in-type watthour and similar utility meters, test switches, metering transformer cabinets, and interiors. The standard limits the maximum ratings of the plug-in-type watthour and similar utility meters to 600 V AC and 400 A. The metering transformers cabinets and interiors are limited to a maximum rating of 600 V AC and 6000 A.

Supplement SA

The UL 414 Supplement SA provides additional construction, testing, and marking requirements utilized for accessories intended for use with meter sockets, such as meter socket extenders and meter socket adapters, or other similar equipment. This supplement has been updated over the past several years to accommodate requirements with assemblies containing connections for utility-interactive alternative energy sources. This supplement is used in conjunction with the main body requirements for the certification of meter socket adapters. The standard limits the maximum ratings of the meters socket extenders and adapters to 600 V AC and 400 A.

Proposed Supplement SB

A new Supplement SB has been submitted for inclusion into the UL 414 standard through the standard technical panel (STP) process. It builds upon the legacy Supplement SA requirements and provides additional guidance for construction and testing considerations for the systems and components associated with the connection of distributed generation equipment, which is currently not properly addressed in the Supplement SA. This supplement is limited in scope to meter socket extenders/adapters with connections for utility-interactive alternative energy sources, distributed generation equipment, and other similar equipment. As part of these updates, the requirements associated with distributed generation in the Supplement SA portion of the UL 414 standard will be removed once added to the Supplement SB.

VI. General Construction / Testing Requirements for Meter Socket Adapters

The performance requirements in Supplement SA generally focus on three elements of the construction: heating, the enclosure properties, and short-circuit current.

Heating Tests

The heating properties are addressed by the Heating Test in Section SA4. This heating test is conducted in either of two methods depending on the intended application. Specifically, meter socket adapters may be 1) tested for use with any manufacturer's meter socket (i.e., "any meter socket") at a specific rating; or 2) tested for use only with a specific manufacturer's meter socket (e.g., catalog number). The basic test method utilized is found in Section 14, Heating Test of the main body of UL 414. Further guidance is contained in Section SA4, which provides that both heating test methods consist of three separate devices assembled for the testing: a meter socket, the meter socket adapter, and the simulated meter.

One difference between the two test methods is that for the "any meter socket" testing method, the meter socket and simulated meter are initially calibrated to provide a baseline correction factor (Tc) to allow adjustment for the thermal differences between different meter socket constructions at the same continuous current rating. The correction factor (Tc) is used to adjust the final measured temperatures attained on the meter socket jaw used during the testing on the subsequent steps in Section 14.2 parts b) and f) such that when the adapter is installed, it will not contribute any additional heating to the end system. Products that are tested for use with any manufacturer's meter socket will have a marking that states, "Rated ____ Continuous Amps When Used in a Meter Socket Rated ____ Continuous Amps," or equivalent. The first blank specifies the test current of the meter socket adapter, and the second blank specifies the continuous current rating of the meter socket.

Meter socket adapters intended for use with a specific meter socket would be tested in a method similar to the method used when intended for use with any meter socket, except that the initial meter socket calibration step is omitted. Meter socket adapters tested for use in a specific meter socket are marked to indicate the manufacturer's name and model number of the meter socket with which they are intended to be used.

It is possible that a meter socket adapter may be tested both for use with any meter socket and also for a specific meter socket. In this case, it will contain both markings.

In addition to the above, meter socket adapters with provisions for connection of an alternative energy source will be tested per paragraph 14.2(f) twice: first with the alternative energy source terminals carrying 100 percent of the continuous ampere rating of the alternative energy circuit and balance of the current through the utility source terminals; and the second test conducted with a total load of 100 percent of the continuous current rating of the meter socket adapter, supplied through the utility source terminals. Products will have a marking that states, "Rated ___ Continuous Amps for Combined Utility and Distributed Generation When Used in a Meter Socket Rated ___ Continuous Amps" and "Rated ___ Vac,

____ Amps Maximum, ____ A Continuous Amps for Distributed Generation Input," or equivalent. The blanks are filled with the appropriate ratings based on the testing conducted.

Enclosure Tests

UL 414 Paragraph 4.1 requires compliance with the requirements of the Standard for Enclosures for Electrical Equipment, Non-Environmental Considerations, UL 50, and the Standard for Enclosures for Electrical Equipment, Environmental Considerations, UL 50E. In the case of non-metallic meter socket adapters, the testing would generally consist of flammability – 5-inch (127 mm) flame tests, resistance to impact (both normal and cold) tests, crushing resistance tests, mold stress relief distortion tests, and ultraviolet light exposure testing. Some of these tests may be omitted based on the polymeric material's small-scale property ratings if a recognized component plastic is used.

Short Circuit Tests

Meter socket adapters with a short-circuit current rating greater than 10,000 amperes are subjected to the Short Circuit Current Test, Section 15, or the Short-Circuit Current Test with Specific Circuit Breaker, Section 16, as appropriate. All meter socket adapters with provisions for connection of an alternative energy source having overcurrent protection integral to the adapter are subjected to a short circuit withstand test in accordance with SA5.2.2 – SA5.2.12 regardless of the short circuit rating. In all cases, the testing setup and methods as described in Section SA5 are utilized.

A proposed Supplement SB uses the same basic construction and performance testing criteria as the Supplement SA for meter socket adapters with provisions for the connection of an alternative energy source. It also includes requirements associated with the following:

a. ventilation,
b. overtemperature detection and protection,
c. overcurrent protection and disconnection means,
d. printed circuit board electrical spacings,
e. external connections to power circuits,
f. external connections for low energy communication and control circuits,
g. switching components installed in meter socket adapters,
h. metering circuits in meter socket adapters, and
i. communication circuits in meter socket adapters.

VII. Special considerations

Security concerns/access by unauthorized persons

Meter socket adapters are required to have provisions for locking and sealing by the utility. Additionally, covers for access to distributed energy connections are required in the Supplement SB to have provisions for the application of a seal or lock by the serving utility to prevent unauthorized access.

Weight/moment arm

Supplement SA and the proposed supplement SB in UL 414 do not currently address the weight and moment arm concerns related to adapter size or configuration. Those requirements are found in ANSI/NEMA C12.7 Requirements for Watthour Meter Sockets.

Connections ahead of service disconnect

The disconnection means overcurrent protective devices, and surge protective devices installed in meter socket adapters are required to be of a type suitable for use on the line side of the service. When external circuits are intended to be connected directly to a meter socket adapter, the meter socket adapter shall be provided with certified fittings for connection of a flexible liquid-tight conduit system. Terminations are required to be located in an area that can be sealed or locked by the serving utility.

Connections ahead of utility meter

Meter socket adapters may have provisions for connection of external circuits to the line side of the meter socket adapter when the adapter is provided with instructions and marked “This meter socket adapter has provisions for connecting external circuits to the line side of the meter. Approval from the serving utility is required before connection of these circuits.” Terminations are required to be located in an area that can be sealed or locked by the serving utility.

VIII. Conclusion and Summary

When installed properly, meter socket adapters can be an important tool in measuring electric loads. We encourage electric utility engineers to familiarize themselves with the various products and models for different applications. For further information on meter socket adapters, please contact Jonathan Stewart (jonathan.stewart@nema.org) or visit UL.com to purchase the UL 414 Standard for Meter Sockets.

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