Technical Bulletin

Fan-Rated Junction Boxes

Ceiling fans exert both static and dynamic loads on electrical outlet boxes that support them. Ordinary junction boxes designed for lighting fixtures are not engineered to withstand the vibration, torque, and movement created by a rotating fan, even if a ceiling fan may be physically installed into one. To safeguard against the potential hazards associated with improper installation, specifically designed, fan-rated junction boxes must be used to ensure safe installation and long-term performance. Underwriters Laboratories (UL) establishes specific requirements for fan-rated junction boxes, and the National Electric Code (NEC) dictates where fan-rated junction boxes should be used.

With the advent of the 2020 edition of the NEC, requirements for where fan-rated boxes must be installed expanded greatly. Under this revision, any location where a ceiling fan might conceivably be installed — regardless of whether a fan is being installed during initial construction — must be equipped with an outlet box specifically listed for ceiling-suspended fan support. This mandate applies to “the ceilings of habitable rooms within dwelling occupancies”; that is, any space where individuals may reside, work, or spend time. The purpose is to preempt hazardous retrofits, such as when a light fixture is replaced with a fan without upgrading the outlet box. By requiring fan-rated junction boxes from the outset, the 2020 NEC proactively mitigates this risk.

Together with the UL 514A certification standard, these requirements ensure that every present or future ceiling fan installation is supported by a properly rated, secure, and code-compliant outlet box.

Requirements for Ceiling Outlet Boxes

Ceiling outlet boxes intended to support fixtures must undergo rigorous testing, demonstrating a safety factor of at least 4:1. In practical terms, this means that a box rated for 50 pounds must withstand a static load of 200 pounds without sustaining damage or exhibiting significant deflection. It is important to note that these standards pertain specifically to static loads, such as those imposed by conventional lighting fixtures.

When it comes to ceiling-suspended fan support, the testing protocols are even more demanding. These procedures evaluate the outlet box’s ability to endure dynamic loads — namely, the forces generated by a rotating ceiling fan — under extreme conditions, including imbalanced loads and loosened mounting hardware. Such scenarios introduce torque and movement well beyond typical ranges, subjecting the outlet box to stresses that simulate real-world challenges and ensure safe operation.

Outlet boxes rated for fan support are clearly marked and are designed to accommodate ceiling fans weighing up to 35, 50, or 70 pounds. To comply with the 2020 edition of the NEC, ceiling outlet boxes must typically be tested according to both static and dynamic methods, ensuring their suitability for a wide range of installations. The following sections provide a detailed overview of the UL 514A standard, which governs the requirements for both lighting fixture support and ceiling-suspended fan support.

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UL 514A

The UL 514A "Standard for Safety, Metallic Outlet Boxes"[1] establishes comprehensive requirements for the design and testing of metallic outlet boxes used in lighting installations. While a separate standard, UL 514C, governs non-metallic outlet boxes, the focus here remains on metallic boxes.

Key clauses within UL 514A that pertain specifically to ceiling-suspended fan support boxes include:

- 9.12 – Construction Requirements: Outlines the general construction standards for ceiling-suspended fan support, specifying the type of screws that must be provided and referencing additional sections on product marking and installation instructions.
- 12.5 – Product Testing: Details the rigorous testing protocols required for ceiling-suspended fan support boxes, ensuring their structural integrity under expected loads.
- 12.14 – Product Testing: Specifies the testing requirements for boxes intended to support fixtures, luminaires, or other products, verifying their rated support capacity.

Section 9.12 encompasses the overarching requirements, directing attention to the necessary hardware and installation guidance, while sections 12.5 and 12.14 prescribe the specific testing procedures that confirm a box's suitability for supporting ceiling fans and fixtures. Together, these clauses ensure that metallic outlet boxes meet the highest standards of safety and reliability for both lighting and fan installations.

Testing Requirements & Procedures

Section 12.5, "Product Testing, Ceiling-Suspended Fan Support," delineates the rigorous protocols required for outlet boxes intended for ceiling suspended fan support. Testing must be conducted with the outlet box mounted in both horizontal ceiling joists and at a 30-degree incline from horizontal, with the fan blades remaining parallel to the floor. The tests utilize fans weighing 35, 50, or 70 pounds, corresponding to the maximum support rating of the box. For each mounting position, two 24-hour tests are performed: one with all mounting screws fully tightened, and another with a single fan mounting screw loosened by two full turns. Upon completion of these tests, the outlet box must exhibit no visible damage or stripped mounting screws and must remain securely affixed to the structure.

Clause 12.5.3 prescribes exacting parameters for fan sizing and attachment methods:

- The fan must have a diameter of 52 inches (±1 inch).
- A 40-gram imbalance is introduced, positioned 15-1/4 inches from the motor shaft on one blade.
- The fan is mounted on a rigid metal downrod, placing the blades 12 inches (±1 inch) below the ceiling.
- The downrod and mounting plate must conform to specific sizing requirements and be fastened with screws tightened to a precise torque rating; universal-type joint mounts are prohibited.
- The fan motor must be adjustable in speed and operated at a fan-tip speed of 4,000 feet per minute (294 rpm).

[1] UL 514A Standard available for purchase: https://www.shopulstandards.com/ProductDetail.aspx?UniqueKey=47429

These stringent procedures ensure that outlet boxes designed for ceiling-suspended fan support can withstand the demanding conditions encountered in real-world installations, thereby safeguarding both structural integrity and occupant safety.

Luminaire Support Testing

Testing outlet boxes for static loads, or conventional lighting fixtures, is a more straightforward process compared to the rigorous protocols required for fan-rated outlet boxes. Clause 12.14.1.1 outlines the following requirements:

- Three test samples must undergo identical testing procedures.
- A force equal to four times the rated fixture support is applied to the open face of each box for five minutes. While the box support may bend, it must not break or detach from its supporting method.
- Additionally, three new samples are tested with the rated fixture load for five minutes; during this period, the box must not deflect more than ¼ inch while the load is attached.
- Devices equipped with adjustable width hangers are tested at the maximum distance permitted by the manufacturer's specifications.

These procedures ensure that ceiling outlet boxes designed for luminaire support maintain their integrity and reliability under the demands of real-world installations.

Box Ratings & Markings

UL 514 Section 5.7 specifies appropriate product markings for ceiling-suspended fan support boxes. In the United States and Mexico, outlet boxes intended for fan support undergo rigorous testing for fans weighing 35, 50, or 70 pounds, and are marked accordingly: "Acceptable for Fan Support of ___ kg (___ lb) or less."[2] In Canada, however, any fan and its accessories with a combined weight of 16 kilograms or more must be independently supported, rather than relying solely on the outlet box. Consequently, outlet boxes in Canada may be marked to support a maximum of 16 kilograms.

It is also noteworthy that in the US and Mexico, either #8-32 or #10-32 threaded screws may be provided for fixture support. By contrast, Canadian outlet boxes are supplied exclusively with #10-32 screws, which must be accompanied by external tooth lock washers to ensure secure installation.

Where are Fan-Rated Junction Boxes Required?

The 2020 revision of the NEC broadened the mandate for fan-rated junction boxes, requiring their use in all regions of the United States unless superseded by more stringent local municipality codes. Specifically, the NEC states:

"Outlet boxes mounted in the ceilings of habitable rooms of dwelling occupancies in a location acceptable for the installation of a ceiling-suspended (paddle) fan"
as the designated locations for fan-rated junction boxes.

[2] UL 514A, Clause 5.7.1

According to the 2020 NEC, a habitable room is defined as:

"A room in a building for living, sleeping, eating, or cooking, but excluding bathrooms, toilet rooms, closets, hallways, storage or utility spaces, and similar areas."[3]

The phrase "in a location acceptable for the installation of a ceiling-suspended (paddle) fan" is open to interpretation, but most authorities agree it encompasses any area where a ceiling fan could physically be installed. Exceptions may include spaces where a fan would interfere with a standing person or where outlet boxes are positioned too close to a wall for safe fan operation.

Further clarification from the Office of the Chief Electrical Inspector for the State of Washington[4] identifies two possible exceptions:

1. Areas within four feet of walls or soffits
2. Areas directly above permanently installed island or peninsular countertop surfaces

In summary, exceptions to this code are rare (aside from those explicitly listed in the previously mentioned NEC Article 100). To maximize the likelihood of passing inspections, it is strongly recommended to use ceiling-fan rated junction boxes throughout all habitable spaces.

[3] 2020 NEC, Article 100
[4] Washington State Department of Labor & Industries Newsletter, April 2021 - https://lni.wa.gov/licensing-permits/_docs/Elc2104.pdf

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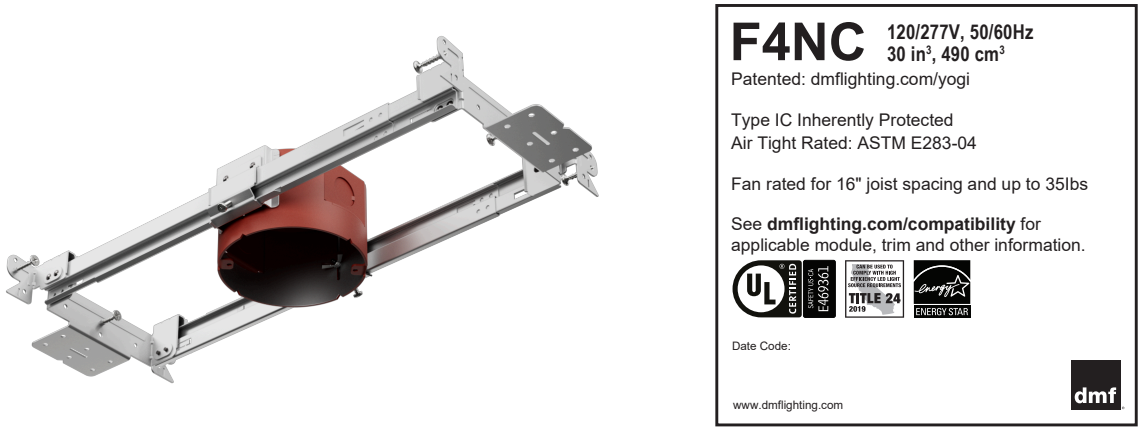
DMF's Fan-Rated F4NC Housing

DMF's F4NC housing is an IC (insulation-contact) rated, fire-rated 4-inch junction box designed for new construction applications. It is compatible with DMF's S Series surface mount fixtures, DRD2 and H Series modules with surface mount trims, as well as DMF's entire line of cylinder luminaires. It may also be mounted in vertical (wall) applications for fixtures weighing less than 7 lbs, including DMF's A Series and Wall Mount Cylinders. The F4NC features a highly durable, universal bar hanger design, accommodating joist spacing from 14 to 24 inches[5] — or even down to 8 inches with simple field modification. For secure installation, the F4NC is supplied with two #8-32 screws for fixture support and six pre-installed screws to fasten the bar hangers to joists. Note that for ceiling suspended fan support, the F4NC may be installed into wood joist or studs only and all 6 joist screws must be fastened.



DMF's F4NC Housing and label, denoting maximum fan support rating.

This junction box meets UL 514A requirements and is rated for fixture support up to 50 lbs in the US, Canada, and Mexico, and for ceiling-suspended fan support up to 35 pounds and up to 16" joist spacing in the US and Mexico.

Additionally, the F4NC boasts STC/IIC Sound Rating, ASTM E283 Air Tight rating, and is code compliant for use in appropriate fire-rated assemblies for up to two hours.

[5] Up to 16" maximum joist spacing for fan-rated applications