

# ICC-ES Evaluation Report

**ESR-3371**

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**DIVISION: 03 00 00—CONCRETE**  
**Section: 03 16 00—Concrete Anchors**

**REPORT HOLDER:**

NITROSET, LLC

**EVALUATION SUBJECT:**

**NITROSET SOLID PROPELLANT DRIVEN PINS AND  
CEILING CLIP ASSEMBLIES**

**1.0 EVALUATION SCOPE**

**Compliance with the following codes:**

- 2018, 2015, 2012, 2009 and 2006 *International Building Code*® (IBC)
- 2018, 2015, 2012, 2009 and 2006 *International Residential Code*® (IRC)

**Properties evaluated:**

Structural

**2.0 USES**

Nitroset Solid Propellant Driven Pins and Ceiling Clip Assemblies are used as alternatives to the cast-in-place anchors described in IBC Section 1901.3 (2012 IBC Section 1908; 2009 and 2006 IBC Section 1911) for placement in concrete. The pins are used to attach cold-formed steel and other building elements to normalweight concrete. The ceiling clip assemblies are used as supporting hardware for suspended ceiling systems and are installed in base materials of normalweight concrete and steel deck panels filled with sand-lightweight concrete. The pins and ceiling clip assemblies may be used under the IRC where an engineered design is submitted in accordance with IRC Section R301.1.3.

**3.0 DESCRIPTION**

**3.1 Pins:**

The Nitroset pins are power-actuated fasteners (PAFs) manufactured from carbon steel complying with ASTM A510 Grade 1060 or 1062. The fasteners are heat-treated after forming and have a through hardness of 50 to 54 on the Rockwell C scale. The pins are mechanically zinc-plated to a minimum thickness of 0.0003 inch (0.008 mm). The heads of the pins are encapsulated in plastic sleeves which contain a cylindrical charge of nitrocellulose (solid propellant), used in the driving mechanism. See

Table 1A for fastener descriptions, including shank type, shank diameter and head diameter.

**3.2 Ceiling Clip Assemblies:**

The Nitroset ceiling clip assemblies are comprised of a steel bracket (clip) premounted on a Nitroset pin. See Table 1B for assembly designations and associated Nitroset pins.

**3.2.1 Utility Ceiling Clip Assembly:** The Nitroset Utility Ceiling Clip Assembly is comprised of a Nitroset pin with a steel or plastic top-hat washer, and a carbon steel clip. The clip is a 111-degree angle measuring  $\frac{3}{4}$  inch (19 mm) wide. The 1-inch-long (25 mm) leg is fitted to the fastener and the  $\frac{3}{4}$ -inch-long (18.2 mm) leg has a 0.31-inch-diameter (8 mm) hole through which the ceiling wire is attached. The clip is produced from steel complying with ASTM A1008 SS Grade 30 having a base metal thickness of 0.071 inch (1.8 mm). See Figure 1 for a depiction of the assembly.

**3.2.2 Standard Ceiling Clip Assembly:** The Nitroset Standard Ceiling Clip Assembly is comprised of a Nitroset pin and a carbon steel clip. The clip is a 135-degree angle, with an offset in the fastened leg, and is  $\frac{3}{4}$  inch (19 mm) wide. The  $\frac{3}{4}$ -inch-long (19 mm) leg is fitted to the fastener and the  $\frac{7}{8}$ -inch-long (21.5 mm) leg has a 0.29-inch-diameter (7.4 mm) hole through which the ceiling wire is attached. The clip is produced from steel complying with ASTM A1008 SS Grade 30 having a base metal thickness of 0.071 inch (1.8 mm). See Figure 2 for a depiction of the assembly.

**3.3 Substrate Materials:**

**3.3.1 Concrete:** Normalweight and sand-lightweight concrete must comply with IBC Chapter 19 or IRC Section R402.2, as applicable. The minimum concrete compressive strength at the time of PAF installation must be as noted in Table 2 or 3, as applicable.

**3.3.2 Steel Deck Panels:** Steel deck panel properties and configurations must be as described in the footnotes to Table 3.

**4.0 DESIGN AND INSTALLATION**

**4.1 Design:**

**4.1.1 General:** Selection of pins must take into consideration the length of the fastener. The minimum effective shank length shown in Table 1 must equal or exceed the sum of the thickness of the attached material and the minimum embedment depth shown in the applicable table in this report.

**4.1.2 Allowable Loads:** The allowable tension, shear and 45-degree-angle loads for the pins and ceiling clip assemblies installed in normalweight concrete are provided in Table 2. The allowable shear and tension loads for the pins and ceiling clip assemblies installed in concrete filled steel deck panels are provided in Table 3.

The most critical applied loads, excluding seismic load effects, resulting from the load combination in IBC Section 1605.3.1 or 1605.3.2 must not exceed these allowable loads. For pins which are subjected to seismic loads, see Section 4.1.3 for additional information. The stress increases and load reductions described in IBC Section 1605.3 are not allowed.

Allowable loads described in this report apply to the connection of the pins and ceiling clip assemblies to the base material only. Other limit states applicable to the design of a connection, such as fastener pull-through (pull-over) and lateral bearing on the attached material, which are governed by the properties of attached materials, are outside the scope of this report. Design of the connection of the attached material to the pin or clip must comply with the applicable requirements of the IBC.

**4.1.3 Combined Loading:** For pins subjected to tension and shear loads, compliance with the following interaction equation must be verified:

$$(p/P_a) + (v/V_a) \leq 1$$

where:

$p$  = Actual applied tension load on fastener, lbf (N).

$P_a$  = Allowable tension load on fastener, lbf (N).

$v$  = Actual applied shear load on fastener, lbf (N).

$V_a$  = Allowable shear load on fastener, lbf (N).

**4.1.4 Seismic Considerations:** The Nitroset pins and ceiling clip assemblies are recognized for use when subjected to seismic loads as follows:

1. The pins and assemblies may be used for attachment of nonstructural components listed in Section 13.1.4 of ASCE 7, which are exempt from the requirements of ASCE 7.
2. Concrete base materials: The pins and assemblies installed in concrete may be used to support acoustical tile or lay-in panel suspended ceiling systems, distributed systems and distribution systems where the service load on any individual pin does not exceed the lesser of 90 lbf (400 N) or the published allowable load in Tables 2 and 3, as applicable.
3. For interior, nonstructural walls that are not subject to sustained tension loads and are not a bracing application, the pins may be used to attach steel track to concrete in all Seismic Design Categories. In Seismic Design Categories D, E, and F, the allowable shear load due to transverse pressure must be no more than 90 pounds (400 N). Substantiating calculations must be submitted addressing the pin-to-base-material capacity and the pin-to-attached-material capacity. Interior nonstructural walls are limited to locations where bearing walls, shear walls or braced walls are not required by the approved plans. The design load on the fastener must not exceed the allowable loads established in this report.

#### 4.2 Installation:

Installation procedures must be in accordance with this report and the Nitroset published installation instructions. A copy of these instructions must be available on the jobsite at all times during installation.

Installation requires the use of a tool which activates the solid propellant mounted on the fastener, in accordance with the Nitroset published installation instructions.

Minimum spacing between embedded fasteners must be 4 inches (102 mm), and minimum edge distance must be 4 inches (102 mm). Concrete thickness must be a minimum of three times the embedment depth of the fastener. Fasteners must not be driven until the concrete has reached the specified concrete strength noted in Table 2 or 3, as applicable.

#### 5.0 CONDITIONS OF USE

The Nitroset pins and ceiling clip assemblies described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1 The pins and ceiling clip assemblies are manufactured and identified in accordance with this report.
- 5.2 Pin and ceiling clip assembly installation must comply with this report and the Nitroset published installation instructions. In the event of a conflict between this report and the Nitroset published installation instructions, the more restrictive requirements govern.
- 5.3 Calculations demonstrating that the actual loads are less than the allowable loads described in this report must be submitted to the code official for approval. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.
- 5.4 Refer to Section 4.1.3 for seismic considerations.
- 5.5 The use of the pins and ceiling clip assemblies is limited to dry, interior locations, which include exterior walls which are protected by an exterior wall envelope.
- 5.6 The use of pins and ceiling clip assemblies is limited to installation in uncracked concrete. Cracking occurs when  $f_t > f_r$  due to service loads or deformations.
- 5.7 The pins and ceiling clip assemblies are manufactured under a quality control program with inspections by ICC-ES.

#### 6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Power-actuated Fasteners Driven into Concrete, Steel and Masonry Elements (AC70) dated February 2016 (editorially revised November 2017).

#### 7.0 IDENTIFICATION

- 7.1 Pins are imprinted with an 'N' on the head as shown in Figure 3. Packages of pins and ceiling clip assembly packaging are labeled with the product designation, pin description, report holder's name (Nitroset, LLC) and address, and the evaluation report number (ESR-3371).
- 7.2 The report holder's contact information is the following:

**NITROSET, LLC**  
**5600 BONHOMME ROAD, SUITE D**  
**HOUSTON, TEXAS 77036**  
**(800) 524-4649**  
[www.nitroset.com](http://www.nitroset.com)

TABLE 1A—NITROSET POWER-ACTUATED FASTENERS

PIN DESIGNATION	SHANK STYLE	SHANK DIAMETER (in.)	HEAD DIAMETER (in.)	MAXIMUM POINT LENGTH <sup>1</sup> (inch)	SHANK LENGTH (in.)	MIN. EFFECTIVE SHANK LENGTH <sup>2</sup> (inch)
PIN 219	Smooth	0.125	0.289	0.26	3/4	0.728
PIN 222					7/8	0.846
PIN 525	Step	0.145 / 0.130	0.289	0.28	1	0.945
PIN 532					1 1/4	1.181

TABLE 1B—NITROSET CEILING CLIP ASSEMBLIES

CEILING CLIP DESIGNATION	CLIP TYPE	PIN DESIGNATION
CLU222	Utility	PIN 222
CLAS525	Standard	PIN 525
CLAS532		PIN 532

For SI: 1 inch = 25.4 mm.

<sup>1</sup>Maximum point length is the maximum specified length from the tip of the fastener to the location where the diameter of the shank becomes constant.

<sup>2</sup>Minimum effective shank length is the minimum specified length from the underside of the fastener head to the tip of the fastener. The minimum effective shank length must equal or exceed the sum of the thickness of the attached material and the minimum embedment depth shown in Table 2 or Table 3, as applicable.



FIGURE 1—UTILITY CEILING CLIP ASSEMBLY



FIGURE 2—STANDARD CEILING CLIP ASSEMBLY



FIGURE 3—FASTENER HEAD MARKING

TABLE 2—ALLOWABLE LOADS FOR NITROSET PINS AND ASSEMBLIES INSTALLED IN NORMAL-WEIGHT CONCRETE <sup>1,2,3</sup>

PRODUCT DESIGNATION	EMBEDMENT DEPTH (inches)	ALLOWABLE LOADS (lbf)					
		4,000 psi			6,000 psi		
Concrete Compressive Strength:		Tension	Shear	45-Degree	Tension	Shear	45-Degree
Load Direction:							
CLU222	Controlled by clip thickness	120	165	120	115	276	209
CLAS525		158	242	151	163	184	168
CLAS532		150	147	213	171	146	152
PIN 219	5/8	85	70	—	175	65	—
PIN 222	3/4	100	200	—	205	100	—
PIN 525	13/16	180	195	—	205	185	—
PIN 532	1 1/16	250	355	—	200	215	—

For SI: 1 inch = 25.4 mm; 1 lbf = 4.4 N; 1 psi = 6895 Pa.

<sup>1</sup>Fasteners must not be driven until the concrete has reached the specified compressive strength.

<sup>2</sup>Concrete thickness at the point of penetration must be a minimum of three times the embedment depth.

<sup>3</sup>The fasteners listed in the table above may be used for static load conditions and for the seismic load conditions described in Section 4.1.3, as applicable. The tabulated allowable loads apply to static load conditions. For seismic load conditions, the allowable loads must be limited in accordance with Section 4.1.3, Items 2 and 3 of this report, as applicable.

**TABLE 3—ALLOWABLE LOADS FOR NITROSET ASSEMBLIES INSTALLED INTO STEEL DECK FILLED WITH SAND-LIGHTWEIGHT CONCRETE THAT HAS A MINIMUM COMPRESSIVE STRENGTH OF 3000 PSI<sup>1,4</sup>**

PRODUCT DESIGNATION	MINIMUM EMBEDMENT DEPTH (inch)	ALLOWABLE LOADS (lbf)					
		Installed through Lower Flute of 3-inch Deep Steel Deck Panel (W-deck) into Concrete <sup>2</sup>		Minimum Required Concrete Topping Thickness Above Deck Panel (inches)	Installed through Lower Flute of 1½-inch Deep Steel Deck Panel (B-deck) into Concrete <sup>3</sup>		Minimum Required Concrete Topping Thickness Above Deck Panel (inches)
Fastener Location:		Tension	Shear		Tension	Shear	
Load Direction:							
CLU222	Controlled by clip thickness	45	180	3½	100	230	5
CLA525		90	280		110	330	
CLA532		140	315		170	355	
PIN 219	5/8	20	290		45	240	
PIN 222	3/4	80	280		95	325	
PIN 525	13/16	55	275		125	340	
PIN 532	1 1/16	110	385		175	430	

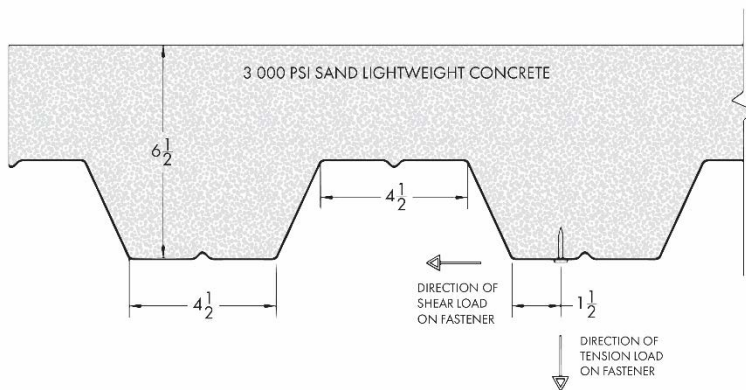
For SI: 1 lbf = 4.4 N, 1 inch = 25.4 mm, 1 psi = 6.895 kPa.

<sup>1</sup>Fasteners must not be driven until the concrete has reached the specified compressive strength.

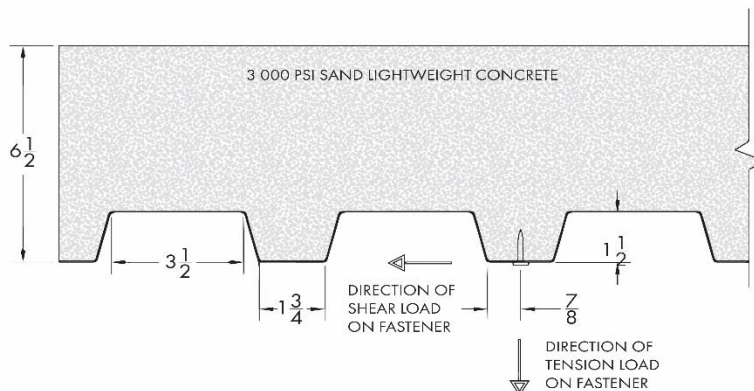
<sup>2</sup>The steel deck must have a minimum base material thickness of 0.035 inch and conform to the profile requirements as shown in Figure 4A. The steel deck must have a minimum yield strength,  $F_y$ , of 40 ksi and a minimum tensile strength of 55 ksi. Fastener edge distance must be a minimum of 1½ inches. Fastener spacing along the length of the steel deck panel must be a minimum of 4 inches.

<sup>3</sup>The steel deck must have a minimum base material thickness of 0.035 inch and must conform to the profile requirements as shown in Figure 4B. The steel deck must have a minimum yield strength,  $F_y$ , of 50 ksi and a minimum tensile strength of 65 ksi. Fastener edge distance must be a minimum of 7/8 inch. Fastener spacing along the length of the steel deck panel must be a minimum of 4 inches.

<sup>4</sup>The fasteners listed in the table above may be used for static load conditions and for the seismic load conditions described in Section 4.1.4, as applicable. The tabulated allowable loads apply to static load conditions. For seismic load conditions, the allowable loads must be limited in accordance with Section 4.1.3, Items 2 and 3 of this report, as applicable.



**FIGURE 4A—FASTENER INSTALLATION IN 3-INCH-DEEP STEEL DECK**



**FIGURE 4B—FASTENER INSTALLATION IN 1½-INCH-DEEP STEEL DECK**