

GENERAL INFORMATION

DDI™ + (DECK INSERT)

Threaded Insert for Metal Deck

PRODUCT DESCRIPTION

The DDI+ (Deck Insert) is a concrete insert designed for installation in concrete-filled metal deck assemblies (i.e. “pan-deck”, “Q-deck”) applications. After installation, the threaded male hanger of the insert protrudes below the surface of the deck. The DDI+ comes in sizes ranging from 3/8" to 7/8" in diameter. The threaded bolt offers adjustability for precise height requirements and guarantees the minimum embedment depth. The longer "T" brace enables a variety of installation locations in across the deck.

GENERAL APPLICATIONS AND USES

- Seismic Loading and Cracked Concrete
- Hanging Pipe and Sprinkler Systems
- HVAC Ductwork and Strut Channels
- Suspending Trapeze and Cable Trays
- Mechanical Unit Overhead Utilities
- Conduit and Lighting System

FEATURE AND BENEFITS

- + Fast and simple to install, low installed cost
- + Pre-mounted self drilling screws for convenient installation
- + Fine-tuned thread length for guaranteed minimum embedment
- + Lengthened "T" brace for more flexible installation positions

APPROVALS AND LISTINGS

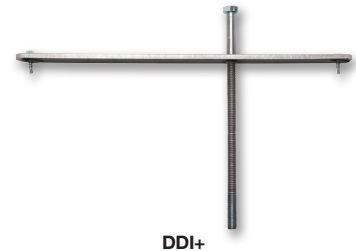
- International Code Council, Evaluation Service (ICC-ES), ESR-3958 for concrete. Approved for seismic and wind loading
- Code compliant with the 2015 IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, and 2009 IRC
- Underwriters Laboratories (UL Listed) - File No. EX1289, see listing for sizes.
- FM Approvals (Factory Mutual) – File No. J.I. 3059197

GUIDE SPECIFICATIONS

CSI Divisions: 03 15 19 - Cast-In Concrete Anchors and 03 16 00 - Concrete Anchors. Concrete inserts shall be DDI+ as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

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DDI+

THREAD VERSION

- UNC Thread

ANCHOR MATERIALS

Plain and zinc plated carbon steel

ANCHOR SIZE RANGE

- 3/8" diameter through 7/8" diameter

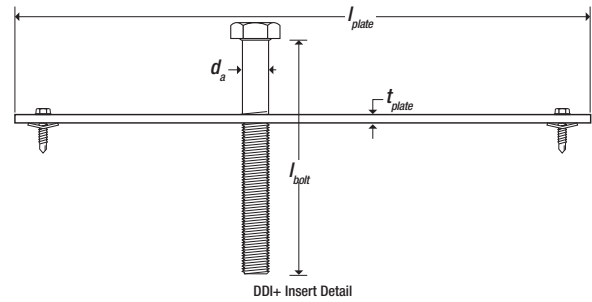
SUITABLE BASE MATERIALS

- Concrete or lightweight concrete over metal deck



MATERIAL SPECIFICATIONS

Anchor Component	Component Material
Metal Plate	ASTM A1011 Carbon Steel or equivalent (plain)
Hex Head Bolt	ASTM A307 Grade A (zinc plated)



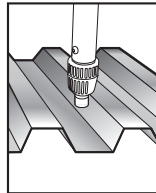
INSTALLATION SPECIFICATIONS

Dimension	Notation	Nominal Anchor Size				
		3/8"	1/2"	5/8"	3/4"	7/8"
Typical Drill Bit Diameter for Deck	in.	7/16 or 1/2	9/16 or 5/8	11/16 or 3/4	13/16 or 7/8	15/16 or 1
Overall Length of Metal Plate	in.	12	12	12	12	12
Approximate Width of Metal Plate	in.	1-1/4	1-1/4	1-1/4	2	2
Approximate Thickness of Metal Plate	in.	3/16	3/16	3/16	3/8	3/8
Bolt Thread Size (UNC)	in.	3/8-16	1/2-13	5/8-11	3/4-10	7/8-9
Length of Hex Head Bolt	in.	8	8	8	8	8
Effective Embedment Depth	in.	1-1/2	1-3/4	2	2-1/8	2-1/16
Nominal Embedment Depth	in.	1-3/4	2	2-3/8	2-5/8	2-5/8
Approx. Thread Projection (through 3-inch-deep deck)	Over Upper Flute	6-1/4	6	5-5/8	5-3/8	5-3/8
	Over Lower Flute	3-1/4	3	2-5/8	2-3/8	2-3/8

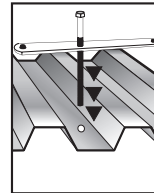
Dimension	Size	Point Style	Drill Range	RPM (Max)
Self-Drilling Screw	8-18	#2	18 Gage Max	2500

INSTALLATION INSTRUCTIONS

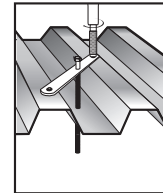
Cut (e.g. drill/punch) a hole in the steel deck to the hole size required by the threaded bolt of the insert.



Place the threaded bolt of the insert through the hole in the steel deck.



The metal plate of the insert must be on the top of the deck flutes. The metal plate can (optionally) be secured to the deck using the pre-assembled size drilling screws.



REFERENCE DATA (ASD)

Ultimate and Allowable Load Capacities for DDI+ (Deck Insert) Installed in the Soffit of Sand-lightweight or Normal Weight Concrete over Metal Deck Floor and Roof Assemblies^{1,2,3,4}



Nominal Anchor Diameter in.	Nominal Embed. Depth h _{nom} (in.)	Min. Concrete Topping Thickness (in.)	Min. Insert Spacing (in.)	Min. End Distance (in.)	Normal-weight or Sand-lightweight concrete, f' _c ≥ 3,000 psi											
					3-7/8" or 4-1/2" Wide Deck											
					Installed Over Upper Flute				Installed Over Flute Incline				Installed Over Lower Flute			
					Ultimate Load		Allowable Load		Ultimate Load		Allowable Load		Ultimate Load		Allowable Load	
Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.					
3/8	1-3/4	2	4-1/2	9	3,420	1,985	1,140	660	5,230	1,985	1,745	660	5,230	2,610	1,745	870
1/2	2	2-1/2	5-1/4	10-1/2	4,310	4,205	1,435	1,400	6,235	4,205	2,080	1,400	6,235	5,155	2,080	1,720
5/8	2-3/8	3-1/4	6	12	5,265	6,450	1,755	2,150	8,630	6,450	2,875	2,150	8,630	6,820	2,875	2,275
3/4	2-5/8	3-1/4	6-3/8	12-3/4	5,770	6,450	1,925	2,150	8,630	6,450	2,875	2,150	8,630	6,820	2,875	2,275
7/8	2-5/8	3-1/4	6-3/8	12-3/4	5,770	6,450	1,925	2,150	8,630	6,450	2,875	2,150	8,630	6,820	2,875	2,275

- Allowable load capacities listed are calculated using an applied safety factor of 3.0
- Nominal embedment depth is measured from the bottom of the insert plate to the top of the insert bolt head.
- Insert spacing and end distances are measured from the centerline of the insert bolt head.
- Shear loads may be applied in any direction. For inserts installed over the upper flute, if the shear load is parallel to the flute the tabulated allowable load values may be increased by 20 percent (multiplied by 1.2)

STRENGTH DESIGN (SD)

CODE LISTED
ICC-ES ESR-3958



DDI+ Insert Installation Information and Supplemental Information^{1,2}

Design Information		Symbol	Units	3/8-inch	1/2-inch	5/8-inch
Nominal bolt diameter		d_a	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)
Length of insert bolt		ℓ_{bolt}	in. (mm)	8 (203)	8 (203)	8 (203)
Typical drill bit diameter		d_{bit}	in.	7/16 or 1/2	9/16 or 5/8	11/16 or 3/4
Nominal overall length of insert plate		ℓ_{plate}	in. ² (mm ²)	12 (305)	12 (305)	12 (305)
Nominal width of insert plate		W_{plate}	in. ² (mm ²)	1-1/4 (32)	1-1/4 (32)	1-1/4 (32)
Approximate thickness of insert plate		t_{plate}	in. (mm)	3/16 (4.8)	3/16 (4.8)	3/16 (4.8)
Minimum nominal embedment depth	Over upper flute	$h_{\text{nom}}(\text{upperflute})$	in. (mm)	1-3/4 (45)	2 (51)	2-3/8 (60)
	Over flute incline	$h_{\text{nom}}(\text{upperincline})$	in. (mm)			
	Over lower flute	$h_{\text{nom}}(\text{lowerflute})$	in. (mm)			
Minimum effective embedment depth	Over upper flute	$h_{\text{ef}}(\text{upperflute})$	in. (mm)	1.50 (38)	1.75 (45)	2.00 (51)
	Over flute incline	$h_{\text{ef}}(\text{upperincline})$	in. (mm)			
	Over lower flute	$h_{\text{ef}}(\text{lowerflute})$	in. (mm)			
Minimum concrete member thickness (topping thickness)	Over upper flute	$h_{\text{min}}(\text{upperflute})$	in. (mm)	2 (51)	2-1/2 (64)	3-1/4 (83)
	Over flute incline	$h_{\text{min}}(\text{upperincline})$	in. (mm)			
	Over lower flute	$h_{\text{min}}(\text{lowerflute})$	in. (mm)			
Minimum flute edge distance (insert bolt)	Over upper flute	$C_{\text{min,deck}}(\text{upperflute})$	in. (mm)	N/A	N/A	N/A
	Over flute incline	$C_{\text{min,deck}}(\text{upperincline})$	in. (mm)			
	Over lower flute	$C_{\text{min,deck}}(\text{lowerflute})$	in. (mm)			
Minimum spacing distance (bolt spacing, center-to-center)	Over upper flute	$S_{\text{min}}(\text{upperflute})$	in. (mm)	4-1/2 (114)	5-1/4 (133)	6 (152)
	Over flute incline	$S_{\text{min}}(\text{upperincline})$	in. (mm)			
	Over lower flute	$S_{\text{min}}(\text{lowerflute})$	in. (mm)			
Minimum deck end distance	Over upper flute	$C_{\text{min}}(\text{upperflute})$	in. (mm)	Specified cover requirements for reinforcement in accordance with ACI 318-14 17.7.2 or ACI 318-11 7.7, as applicable.		
	Over flute incline	$C_{\text{min}}(\text{upperincline})$	in. (mm)			
	Over lower flute	$C_{\text{min}}(\text{lowerflute})$	in. (mm)			
Effective tensile stress area (insert bolt)		A_{se}	in. ² (mm ²)	0.078 (50)	0.142 (92)	0.226 (146)
Insert head net bearing area		A_{brg}	in. ² (mm ²)	0.17 (110)	0.28 (181)	0.45 (290)
Minimum specified ultimate strength		f_{uta}	psi (N/mm ²)	60,000 (400)		
Minimum specified yield strength		f_{ya}	psi (N/mm ²)	36,000 (248)		

For SI: 1 inch = 25.4 mm, 1 ft-lb = 1.356 N-m

- The information presented in this table is to be used in conjunction with the design criteria of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
- For installation detail for inserts in concrete-filled steel deck assemblies, see Figures A, B and C (i.e. over upper flute, over flute incline, over lower flute).

DDI+ Insert Design Information^{1,2,3,4,5,6}

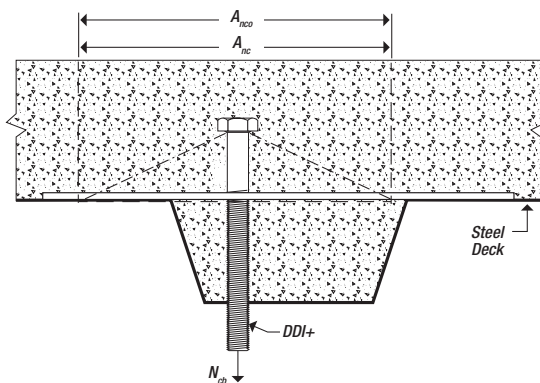
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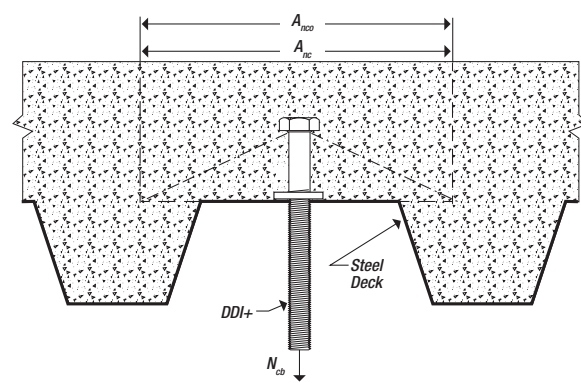
Design Information		Symbol	Units	3/8-inch	1/2-inch	5/8-inch
Insert O.D. (nominal bolt diameter)		d_a	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)
Insert head net bearing area		A_{brg}	in ² (mm ²)	0.17 (110)	0.28 (181)	0.45 (290)
Effective tensile stress area		A_{se}	in. ² (mm ²)	0.078 (50)	0.142 (92)	0.226 (146)
Effective embedment depth	Over upper flute	h_{ef} (upperflute)	in. (mm)	1.50 (38)	1.75 (45)	2.00 (51)
	Over flute incline	h_{ef} (fluteincline)	in. (mm)			
	Over lower flute	h_{ef} (lowerflute)	in. (mm)			
Minimum concrete member thickness (topping thickness over upper flute)		h_{min}	in. (mm)	2.00 (51)	2.50 (64)	3.25 (83)
Minimum spacing and edge distance		S_{min}, C_{min}	in. (mm)	See Installation Information Table and Figures A, B and C		
Effectiveness factor for cracked concrete		k_c	- (SI)	24 (10)		
Modification factor for tension strength in uncracked concrete		$\Psi_{C,N}$	-	1.25		
According to Figures A, B or C	Nominal tension strength of single insert as governed by steel strength	$N_{sa,insert}$	lb (kN)	4,650 (20.7)	8,520 (37.9)	13,560 (60.3)
	Nominal tension strength of single insert as governed by steel strength, seismic	$N_{sa,insert,eq}$	lb (kN)			
According to Figure A (over upper flute)	Nominal steel shear strength of single insert in the soffit of concrete on steel deck	$V_{sa,insert,deck}$ (upperflute)	lb (kN)	2,280 (10.1)	4,260 (18.9)	7,245 (32.2)
	Nominal steel shear strength of single insert in the soffit of concrete on steel deck, seismic	$V_{sa,insert,deck,eq}$ (upperflute)	lb (kN)	1,825 (8.1)	3,410 (15.2)	
According to Figure B (over flute incline)	Nominal steel shear strength of single insert in the soffit of concrete on steel deck	$V_{sa,insert,deck}$ (fluteincline)	lb (kN)	1,310 (5.8)	3,410 (15.2)	5,240 (23.3)
	Nominal steel shear strength of single insert in the soffit of concrete on steel deck, seismic	$V_{sa,insert,deck,eq}$ (fluteincline)	lb (kN)	1,045 (4.6)	2,860 (12.7)	
According to Figure C (over lower flute)	Nominal steel shear strength of single insert in the soffit of concrete on steel deck	$V_{sa,insert,deck}$ (lowerflute)	lb (kN)	2,280 (10.1)	4,260 (18.9)	5,735 (25.5)
	Nominal steel shear strength of single insert in the soffit of concrete on steel deck, seismic	$V_{sa,insert,deck,eq}$ (lowerflute)	lb (kN)	2,015 (9.0)	3,410 (15.2)	

For SI: 1 inch = 25.4 mm, 1 pound = 4.45 N, 1 psi = 0.006895 MPa. For pound-inch unit: 1 mm = 0.03937 inches.

- Concrete must have a compressive strength f'_c of 3,000 psi (20.7 MPa) minimum.
- Design of headed cast-in specialty inserts shall be in accordance with the provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable, for cast-in headed anchors. Concrete breakout strength must also be in accordance with the Idealization of Concrete Filled Steel Decks Figure.
- Strength reduction factors for the inserts shall be taken from ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, for cast-in headed anchors. Strength reduction factors for load combinations in accordance with ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, governed by steel strength of the insert shall be taken as 0.75 for tension and 0.65 for shear; values correspond to ductile steel elements. The value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.
- Insert O.D. is the nominal bolt diameter of the insert.
- Minimum spacing distance between anchors and minimum edge distances for cast-in headed DDI+ inserts shall be in accordance with the Installation Information Table, Design Information Table, Figures A, B and C and noted provisions.
- Shear loads for concrete inserts in concrete-filled steel deck assemblies may be applied in any direction (i.e. over upper flute, over flute incline, over lower flute).



Idealization of Steel Deck Profile (over lower flute or over flute incline)



Idealization of Steel Deck Profile (over upper flute)

Idealization of Concrete Filled Steel Decks for Determination of Concrete Breakout Strength in Accordance with ACI 318



Tension and Shear Design Strengths for DDI+ Inserts Installed in Uncracked Lightweight Concrete Filled Steel Deck Floor and Roof Assemblies^{1,2,3,4,5,6}

Insert O.D. (Nominal Bolt Diameter) (in.)	Embed. Depth hef (in.)	Minimum Concrete Compressive Strength					
		f'c = 3,000 psi					
		Upper Flute (Figure A)		Flute Incline (Figure B)		Lower Flute (Figure C)	
		ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)
3/8	1-3/4	1,795	1,480	1,795	850	1,795	1,480
1/2	1-3/4	2,265	2,770	2,265	2,215	2,265	2,770
5/8	1-3/4	2,765	4,710	2,765	3,405	2,765	3,730

■ - Anchor Pullout/Pryout Strength Controls
 ■ - Concrete Breakout Strength Controls
 ■ - Steel Strength Controls

Tension and Shear Design Strengths for DDI+ Inserts Installed in Cracked Lightweight Concrete Filled Steel Deck Floor and Roof Assemblies^{1,2,3,4,5,6}

Insert O.D. (Nominal Bolt Diameter) (in.)	Embed. Depth hef (in.)	Minimum Concrete Compressive Strength					
		f'c = 3,000 psi					
		Upper Flute (Figure A)		Flute Incline (Figure B)		Lower Flute (Figure C)	
		ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)
3/8	1-3/4	1,435	1,480	1,435	850	1,435	1,480
1/2	1-3/4	1,810	2,770	1,810	2,215	1,810	2,770
5/8	1-3/4	2,210	4,710	2,210	3,405	2,210	3,730

■ - Anchor Pullout/Pryout Strength Controls
 ■ - Concrete Breakout Strength Controls
 ■ - Steel Strength Controls

- Tabular values are provided for illustration and are applicable for single anchors installed in sand-lightweight concrete with minimum member thickness (topping thickness), $h_a = h_{min}$, and with the following conditions:
 - For Upper Flute and Flute Incline: c_{a1} is greater than or equal to the critical edge distance, c_{ac}
 - For Lower Flute: c_{a1} is equal to the minimum lower flute edge distance
- Calculations were performed following methodology in ACI 318-14 Chapter 17. The load level corresponding to the controlling failure mode listed (e.g. For Tension: steel strength, concrete breakout strength, or pullout strength; For Shear: steel strength). Furthermore, the capacities for concrete breakout strength in tension are calculated using the effective embedment values, h_{ef} , for the selected anchors as noted in the design information table. Please also reference the installation specifications for additional information.
- Strength reduction factors (ϕ) for the inserts are based on ACI 318-14 17.3.3 for cast-in headed anchors. Condition B is assumed. Strength reduction factors for load combinations in accordance with ACI 318-14 Section 5.3 governed by steel strength of the insert are taken as 0.75 for tension and 0.65 for shear; values correspond to ductile steel elements.
- Tabular values are permitted for short-term static loads only, seismic loading is not considered with these tables.
- For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-14 Chapter 17.
- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318-14 Chapter 17 and information contained in this product supplement. For other design conditions including seismic considerations please see ACI 318-14 Chapter 17.

MECHANICAL ANCHORS

DDI+™ (DECK INSERT)
Threaded Insert for Metal Deck

Figure A

DDI+ Concrete Inserts Installed Through the Soffit of Concrete-Filled Steel Deck Floor and Roof Assemblies (Over Upper Flute)^{1,2,3}

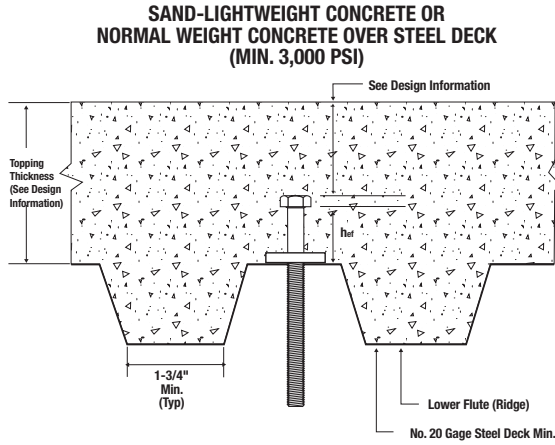


Figure B

DDI+ Concrete Inserts Installed Through the Soffit of Concrete-Filled Steel Deck Floor and Roof Assemblies (Over Flute Incline)^{1,2,4}

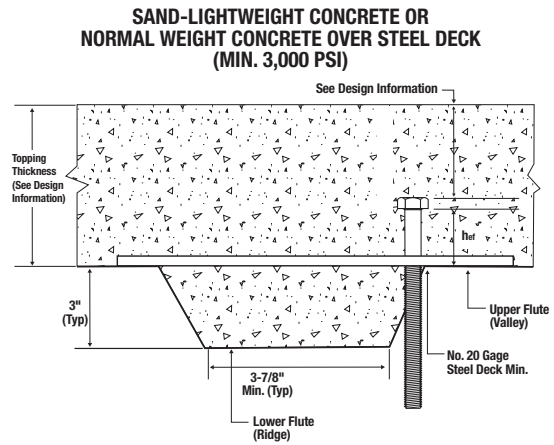
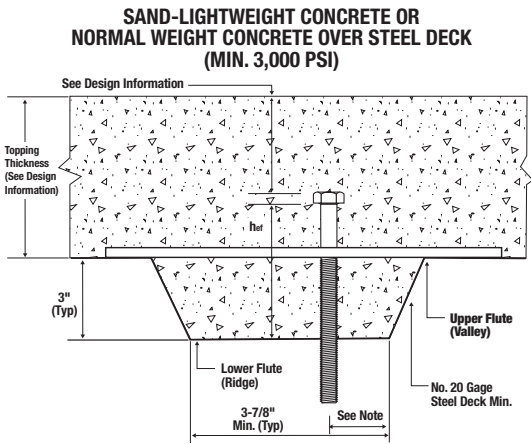


Figure C

DDI+ Concrete Inserts Installed Through the Soffit of Concrete-Filled Steel Deck Floor and Roof Assemblies (Over Lower Flute)^{1,2,5}

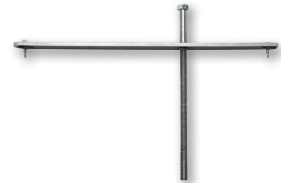


- Installations require a minimum concrete member topping thickness from the top of the upper flute as given in the Design Information Table.
- Inserts may be placed on the upper flute of the steel deck assembly; they may be installed anywhere across upper flute as follows:
(Figure A) - Placed over the upper flute with threaded bolt installed through the upper flute or;
(Figure B) - Placed over the upper flute spanning the lower flute with threaded bolt installed through the inclined section or;
(Figure C) - Placed over the upper flute spanning the lower flute with threaded bolt installed through the lower flute.
- Inserts over the upper flute with threaded bolt installed through the upper flute may be placed in any location and orientation that meets the minimum deck end distance requirements (see Design Information Table). The minimum deck end distance is measured from deck end to the centerline of the insert bolt.
- Inserts over the upper flute spanning the lower flute with threaded bolt installed through the inclined section may be placed in any location and orientation that meets the minimum deck end distance requirements (see Design Information Table). The minimum deck end distance is measured from deck end to the centerline of the insert bolt.
- Inserts over the upper flute spanning the lower flute with threaded bolt installed through the lower flute may be placed in any location that meets the minimum deck end distance and minimum lower flute edge distance requirements. The minimum deck end distance is measured from deck end to the centerline of the insert bolt. For lower flute widths of 3-7/8-inch, a maximum 1-inch centerline bolt offset in either direction from the center of the flute. The offset distance may be increased for flute widths greater than those shown provided the minimum lower flute edge distance of 15/16-inch is also satisfied.

ORDERING INFORMATION

DDI+ (Deck Insert)

Cat. No.	Anchor Size	Rod/Anchor Dia.	Typical Drill Diameter	Box Qty.
PFM2511100	3/8" Metal Deck Insert	3/8"	7/16" or 1/2"	20
PFM2511110	1/2" Metal Deck Insert	1/2"	9/16" or 5/8"	20
PFM2511120	5/8" Metal Deck Insert	5/8"	11/16" or 3/4"	20
PFM2511130	3/4" Metal Deck Insert	3/4"	13/16" or 7/8"	12
PFM2511140	7/8" Metal Deck Insert	7/8"	15/16" or 1"	12



Rod Coupling Nuts - Zinc

Cat. No.	Description	Rod/Anchor Dia.	Hex Diameter	Box Qty.	Ctn. Qty.
030007	3/8"-16 x 1/2" x 1-1/8"	3/8"	1/2"	100	1000
030009	1/2"-13 x 5/8" x 1-1/4"	1/2"	5/8"	50	500
030010	5/8"-13 x 13/16" x 2-1/8"	5/8"	13/16"	25	250
030011	3/4"-13 x 1" x 2-1/4"	3/4"	1"	25	250
030012	7/8"-13 x 1-1/4" x 2-1/2"	7/8"	1-1/4"	10	100

