Drop-In *Internally Threaded Expansion Shell Anchor*

Drop-in anchors are internally threaded, deformation-controlled expansion anchors with a preassembled expander plug, suitable for flush mount applications in solid base materials. The anchor is set by driving the expansion plug towards the bottom of the anchor using the setting tool. Drop-in anchors are also available in coil-threaded versions for ½" and ¾" coil threaded rod.

The Lipped Drop-In (DIAL) features a lip at the top of the anchor body that keeps the top of the anchor flush with the concrete. This eliminates the need for precisely drilled hole depths and allows for easier flush installation, consistent embedment and uniform rod lengths.

Short Drop-In anchors are for use in solid and hollow concrete. The short length permits shallow embedment that helps to avoid drilling into rebar or prestressing strands. The wide surface flange enables the Short Drop-In to be installed in deep or bottomless holes. Fixed-depth drill bits are also available to take the guesswork out of drilling to the correct depth for these ⅜" and ½" Short Drop-Ins. Using the fixed-depth bit drill bit prevents overdrilling, which saves time and prolongs bit life.

MATERIAL: Carbon and stainless steel
(DIA37S and DIA50S available in zinc-plated, carbon steel only)

FINISH: Carbon steel: Zinc plated

INSTALLATION:

- Drill a hole in the base material using the appropriate diameter carbide drill bit as specified in the table. Drill the hole to the specified embedment depth plus ⅛" for flush mounting. Blow the hole clean using compressed air. Overhead installations need not be blown clean.

Caution: Oversized holes will make it difficult to set the anchor and will reduce the anchor's load capacity.

- Insert designated anchor into hole. Tap with hammer until flush against surface.
- Using the designated Drop-In setting tool, drive expander plug towards the bottom of the anchor until shoulder of setting tool makes contact with the top of the anchor.
- Minimum thread engagement should be equal to the nominal diameter of the threaded insert.

CODES: Drop-In: City of L.A. RR24682; Factory Mutual 3017082; Underwriters Laboratories File Ex3605. Meets requirements of Federal Specifications A-A-55614, Type I. Short Drop-In: Factory Mutual 3017082 and Underwriters Laboratories File Ex3605.

The load tables list values based upon results from the most recent testing and may not reflect those in current code reports. Where code jurisdictions apply, consult the current reports for applicable load values.

TEST CRITERIA: The Drop-In anchor has been tested in accordance with ICC-ES's Acceptance Criteria for Expansion Anchors (AC01) for the following:

- Seismic/wind loading
- Combination tension and shear loads
- Critical and minimum edge distance and spacing

SUGGESTED SPECIFICATIONS: Drop-In anchors shall be internally threaded, expanding shell anchors. The anchor shell shall be zinc plated carbon steel with a minimum 70,000 psi tensile strength, type 303 or 316 stainless steel, as called for on the drawings. Drop-In anchors shall meet Federal Specification A-A-55614, Type I. Anchors shall be Drop-In anchors from Simpson Strong-Tie, Pleasanton, CA. Anchors shall be installed following the Simpson Strong-Tie instructions for Drop-In internally threaded expansion shell anchors.

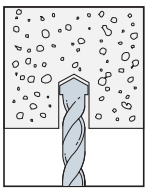
Drop-In

Lipped Drop-In

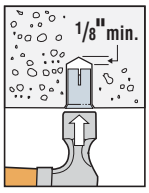
Short Drop-In

Coil-Thread Drop-In

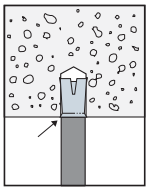
Installation Sequence



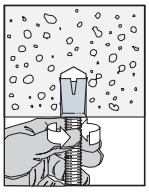
1. Drill a hole using the specified diameter carbide bit into the base material to a depth of at least ⅛" deeper than the required embedment. Then blow the hole clean of dust and debris using compressed air.



2. Insert Drop-In anchor into hole. Tap with hammer until flush against surface.



3. Using the Drop-In anchor setting tool, drive expander plug toward the bottom of the anchor until the shoulder of setting tool makes contact with the top of the anchor.



4. Install threaded rod into the anchor to support pipes, wiring, etc.

Material Specifications

Anchor Component	Component Material		
	Zinc Plated Carbon Steel	Type 303 Stainless Steel	Type 316 Stainless Steel
Anchor Body	Meets minimum 70,000 psi tensile	AISI 303. Meets chemical requirements of ASTM A-582	Type 316
Expander Plug	Meets minimum 50,000 psi tensile	AISI 303	Type 316
Thread	UNC/Coil-thread	UNC	UNC

Note: DIA37S, DIA50C and DIA75C are not available in stainless steel.

Drop-In *Internally Threaded Expansion Shell Anchor*

Drop-In Anchor Product Data - Carbon and Stainless Steel

Rod Size (in.)	Carbon Steel Model No.	303 Stainless Model No.	316 Stainless Model No.	Drill Bit Diameter (in.)	Bolt Threads (per in.)	Body Length (in.)	Thread Length (in.)	Quantity	
								Box	Ctn.
¼	DIA25	DIA25SS	DIA256SS	⅜	20	1	⅜	100	500
⅜	DIA37	DIA37SS	DIA376SS	½	16	1½	⅝	50	250
½	DIA50	DIA50SS	DIA506SS	⅝	13	2	¾	50	200
⅝	DIA62	DIA62SS	—	⅞	11	2½	1	25	100
¾	DIA75	DIA75SS	—	1	10	3⅛	1¼	20	80

Drop-In Anchor

Lipped Drop-In Anchor Product Data

Rod Size (in.)	Carbon Steel Model No.	Drill Bit Diameter (in.)	Bolt Threads (per in.)	Body Length (in.)	Thread Length (in.)	Quantity	
						Box	Ctn.
¼	DIAL25	⅜	20	1	⅜	100	500
⅜	DIAL37	½	16	1½	⅝	50	250
½	DIAL50	⅝	13	2	¾	50	200

Lipped Drop-In Anchor

Short Drop-In Anchor Product Data

Rod Size (in.)	Model No.	Drill Bit Diameter (in.)	Bolt Threads (per in.)	Body Length (in.)	Thread Length (in.)	Quantity	
						Box	Carton
⅜	DIA37S[1]	½	16	¾	¼	100	500
½	DIA50S[1]	⅝	13	1	5⁄16	50	200

1. A dedicated setting tool is included with each box of DIA37S and DIA50S.

Short Drop-In Anchor

Coil-Thread Drop-In Anchor Product Data

Rod Size (in.)	Carbon Steel Model No.	Drill Bit Diameter (in.)	Bolt Threads (per in.)	Body Length (in.)	Thread Length (in.)	Quantity	
						Box	Ctn.
½	DIA50C[1]	⅝	6	2	¾	50	200
¾	DIA75C[1]	1	5	3⅛	1¼	20	80

1. DIA50C and DIA75C accept ½" and ¾" coil-thread rod, respectively.

Coil-Thread Drop-In Anchor

Drop-In Anchor Setting Tool Product Data

Model No.	For use With	Box Qty.
DIAST25	DIA25, DIAL25	10
DIAST37	DIA37, DIAL37	10
DIAST50	DIA50, DIA50C, DIAL50	10
DIAST62	DIA62	5
DIAST75	DIA75, DIA75C	5

1. Setting Tools sold separately except for DIA37S and DIA50S.
2. Setting Tools for use with carbon and stainless-steel Drop-In anchors.

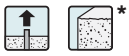
Drop-In Anchor Setting Tool

Fixed-Depth Drill Bit Product Data

Drill Bit Diameter (in.)	Drop-In Anchor (in.)	Model No.	Drill Depth (in.)
½	⅜	MDPL050DIAS	15⁄16
⅝	½	MDPL062DIAS	1¼

Fixed-Depth Drill Bit

Tension Loads for Drop-In (Carbon and Stainless Steel), Lipped Drop-In (Carbon Steel) and Coil-Thread Drop-In (Carbon Steel) Anchors in Normal-Weight Concrete

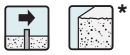


Rod Size in. (mm)	Drill Bit Dia. (in.)	Embed. Depth in. (mm)	Critical Edge Dist. in. (mm)	Critical Spacing in. (mm)	Tension Load						
					$f'_c \geq 2000$ psi (13.8 MPa) Concrete			$f'_c \geq 3000$ psi (20.7 MPa) Concrete	$f'_c \geq 4000$ psi (27.6 MPa) Concrete		
					Ultimate lbs. (kN)	Std. Dev. lbs. (kN)	Allowable lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Std. Dev. lbs. (kN)	Allowable lbs. (kN)
¼ (6.4)	⅜	1 (25)	3 (76)	4 (102)	1,400 (6.2)	201 (0.9)	350 (1.6)	405 (1.8)	1,840 (8.2)	451 (2.0)	460 (2.0)
⅜ (9.5)	½	1½ (38)	4½ (114)	6 (152)	2,400 (10.7)	251 (1.1)	600 (2.7)	795 (3.5)	3,960 (17.6)	367 (1.6)	990 (4.4)
½ (12.7)	⅝	2 (51)	6 (152)	8 (203)	3,320 (14.8)	372 (1.7)	830 (3.7)	1,178 (5.2)	6,100 (27.1)	422 (1.9)	1,525 (6.8)
⅝ (15.9)	⅞	2½ (64)	7½ (191)	10 (254)	5,040 (22.4)	689 (3.1)	1,260 (5.6)	1,715 (7.6)	8,680 (38.6)	971 (4.3)	2,170 (9.7)
¾ (19.1)	1	3⅛ (79)	9 (229)	12½ (318)	8,160 (36.3)	961 (4.3)	2,040 (9.1)	2,365 (10.5)	10,760 (47.9)	1,696 (7.5)	2,690 (12.0)

1. The allowable loads listed are based on a safety factor of 4.0.
2. Refer to allowable load-adjustment factors for edge distance and spacing on page 155.
3. Allowable loads may be linearly interpolated between concrete strengths listed.
4. The minimum concrete thickness is 1½ times the embedment depth.

*See page 13 for an explanation of the load table icons

Shear Loads for Drop-In (Carbon and Stainless Steel), Lipped Drop-In (Carbon Steel) and Coil-Thread Drop-In (Carbon Steel) Anchors in Normal-Weight Concrete



Rod Size in. (mm)	Drill Bit Dia. in.	Embed. Depth in. (mm)	Critical Edge Dist. in. (mm)	Critical Spacing in. (mm)	Shear Load				
					$f'_c \geq 2000$ psi (13.8 MPa) Concrete			$f'_c \geq 3000$ psi (20.7 MPa) Concrete	$f'_c \geq 4000$ psi (27.6 MPa) Concrete
					Ultimate lbs. (kN)	Std. Dev. lbs. (kN)	Allowable lbs. (kN)	Allowable lbs. (kN)	Allowable lbs. (kN)
¼ (6.4)	⅜	1 (25)	3½ (89)	4 (102)	1,960 (8.7)	178 (0.8)	490 (2.2)	490 (2.2)	490 (2.2)
⅜ (9.5)	½	1½ (38)	5¼ (133)	6 (152)	3,240 (14.4)	351 (1.6)	810 (3.6)	925 (4.1)	1,040 (4.6)
½ (12.7)	⅝	2 (51)	7 (178)	8 (203)	7,000 (31.1)	562 (2.5)	1,750 (7.8)	1,750 (7.8)	1,750 (7.8)
⅝ (15.9)	⅞	2½ (64)	8¾ (222)	10 (254)	11,080 (49.3)	923 (4.1)	2,770 (12.3)	2,770 (12.3)	2,770 (12.3)
¾ (19.1)	1	3⅛ (79)	10½ (267)	12½ (318)	13,800 (61.4)	1,781 (7.9)	3,450 (15.3)	3,725 (16.6)	4,000 (17.8)

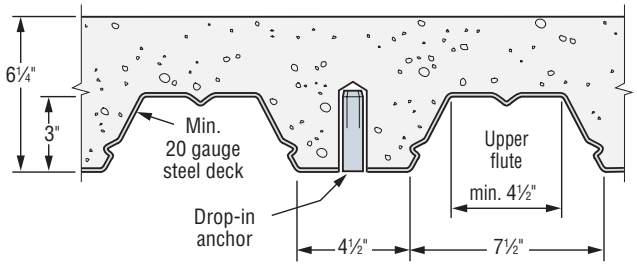
1. The allowable loads listed are based on a safety factor of 4.0.
2. Refer to allowable load-adjustment factors for edge distance and spacing on page 155.
3. Allowable loads may be linearly interpolated between concrete strengths listed.
4. The minimum concrete thickness is 1½ times the embedment depth.

Tension and Shear Loads for Drop-In (Carbon Steel) and Lipped Drop-In (Carbon Steel) Anchors in Sand-Lightweight Concrete over Metal Deck

Model No.	Rod Size in. (mm)	Drill Bit Dia. in.	Embed. Depth in. (mm)	Tension Critical Edge Dist. in. (mm)	Shear Critical Edge Dist. in. (mm)	Critical Spacing in. (mm)	Tension Load (Install through Metal Deck) $f'_c \geq 3000$ psi (20.7 MPa) Concrete			Shear Load (Install through Metal Deck) $f'_c \geq 3000$ psi (20.7 MPa) Concrete		
							Ultimate lbs. (kN)	Std. Dev. lbs. (kN)	Allowable lbs. (kN)	Ultimate lbs. (kN)	Std. Dev. lbs. (kN)	Allowable lbs. (kN)
DIA37	⅜ (9.5)	½	1½ (38)	6 (152)	7 (178)	8 (203)	3,000 (13.3)	367 (1.6)	750 (3.3)	2,400 (10.7)	187 (0.8)	600 (2.7)
DIA50	½ (12.7)	⅝	2 (51)	8 (203)	9⅜ (238)	10⅝ (270)	3,580 (15.9)	861 (3.8)	895 (4.0)	5,600 (24.9)	200 (0.9)	1,400 (6.2)

1. The allowable loads listed are based on a safety factor of 4.0.
2. Allowable loads may not be increased for short-term loading due to wind or seismic forces.
3. Refer to allowable load-adjustment factors for edge distance and spacing on page 156.

*See page 13 for an explanation of the load table icons

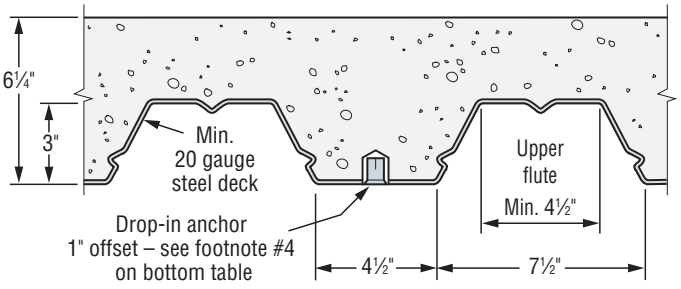


Lightweight Concrete over Metal Deck

Tension and Shear Loads for ⅜" and ½" Short Drop-In Anchor in Sand-Lightweight Concrete Fill over Metal Deck

Model No.	Rod Size (in.)	Drill Bit Dia. (in.)	Emb. Depth (in.)	Tension Critical End Distance (in.)	Shear Critical End Distance (in.)	Critical Spacing (in.)	Install through the Lower Flute or Upper Flute of Metal Deck, $f'_c \geq 3000$ psi Concrete			
							Tension Load		Shear Load	
							Ultimate (lbs.)	Allowable (lbs.)	Ultimate (lbs.)	Allowable (lbs.)
DIA37S	⅜	½	¾	6	7	8	1344	335	1649	410
DIA50S	½	⅝	1	8	9⅜	10⅝	1711	430	2070	515

1. The allowable loads listed are based on a safety factor of 4.0.
2. Allowable loads may not be increased for short-term loading due to wind or seismic forces.
3. Refer to allowable load-adjustment factors for edge distances and spacing on page 156.
4. Anchors were installed with a 1" offset from the centerline of the flute.



Lightweight Concrete over Metal Deck

Tension and Shear Loads for ⅜" and ½" Short Drop-In Anchor in Normal-Weight Concrete

Model No.	Rod Size (in.)	Drill Bit Dia. (in.)	Emb. Depth (in.)	Tension Critical Edge Distance (in.)	Shear Critical Edge Distance (in.)	Critical Spacing (in.)	Normal-Weight Concrete, $f'_c \geq 2500$ psi				Normal-Weight Concrete, $f'_c \geq 4000$ psi			
							Tension Load		Shear Load		Tension Load		Shear Load	
							Ultimate (lbs.)	Allowable (lbs.)	Ultimate (lbs.)	Allowable (lbs.)	Ultimate (lbs.)	Allowable (lbs.)	Ultimate (lbs.)	Allowable (lbs.)
DIA37S	⅜	½	¾	4½	5¼	3	1,500	375	2,274	570	2,170	540	3,482	870
DIA50S	½	⅝	1	6	7	4	2,039	510	3,224	805	3,420	855	5,173	1,295

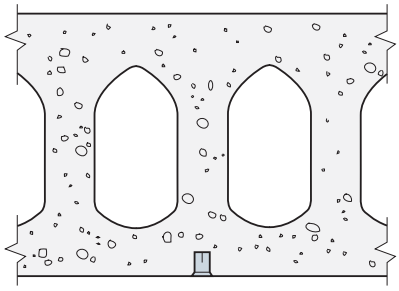
1. The allowable loads listed are based on a safety factor of 4.0.
2. Allowable loads may not be increased for short-term loading due to wind or seismic forces.
3. Refer to allowable load-adjustment factors for edge distances and spacing on page 155.
4. Allowable loads may be linearly interpolated between concrete strengths.
5. The minimum concrete thickness is 1½ times the embedment depth.

Tension and Shear Loads for ⅜" and ½" Short Drop-In Anchor in Hollow Core Concrete Panel

Model No.	Rod Size (in.)	Drill Bit Dia. (in.)	Emb. Depth (in.)	Tension Critical Edge Distance (in.)	Shear Critical Edge Distance (in.)	Critical Spacing (in.)	Hollow Core Concrete Panel, $f'_c \geq 4000$ psi			
							Tension Load		Shear Load	
							Ultimate (lbs.)	Allowable (lbs.)	Ultimate (lbs.)	Allowable (lbs.)
DIA37S	⅜	½	¾	4½	5¼	3	1,860	465	3,308	825
DIA50S	½	⅝	1	6	7	4	2,650	660	4,950	1,235

1. The allowable loads listed are based on a safety factor of 4.0.
2. Allowable loads may not be increased for short-term loading due to wind or seismic forces.
3. Refer to allowable load-adjustment factors for edge distances and spacing on page 155.
4. Allowable loads may be linearly interpolated between concrete strengths.

*See page 13 for an explanation of the load table icons



Hollow Core Concrete Panel
(Anchor can be installed below web or hollow core)

Load-Adjustment Factors for Drop-In (Carbon and Stainless Steel) and Lipped Drop-In (Carbon Steel) Anchors in Normal-Weight Concrete: Edge Distance and Spacing, Tension and Shear Loads

How to use these charts:

1. The following tables are for reduced edge distance and spacing.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the edge distance (C_{act}) or spacing (S_{act}) at which the anchor is to be installed.
4. The load adjustment factor (f_c or f_s) is the intersection of the row and column.
5. Multiply the allowable load by the applicable load adjustment factor.
6. Reduction factors for multiple edges or spacing are multiplied together.

Edge Distance Tension (f_c)

Edge Dist. C_{act} (in.)	Size	¼	⅜	½	⅝	¾
	C_{cr}	3	4½	6	7½	9
	C_{min}	1¾	2⅝	3½	4⅜	5¼
	f_{cmin}	0.65	0.65	0.65	0.65	0.65
1¾		0.65				
2		0.72				
2½		0.86				
2⅝		0.90	0.65			
3		1.00	0.72			
3½			0.81	0.65		
4			0.91	0.72		
4⅜			0.98	0.77	0.65	
4½			1.00	0.79	0.66	
5				0.86	0.72	
5¼				0.90	0.75	0.65
5½				0.93	0.78	0.67
6				1.00	0.83	0.72
6½					0.89	0.77
7					0.94	0.81
7½					1.00	0.86
8						0.91
8½						0.95
9						1.00

See Notes Below

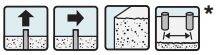
*See page 13 for an explanation of the load table icons

Edge Distance Shear (f_c)

Edge Dist. C_{act} (in.)	Size	¼	⅜	½	⅝	¾
	C_{cr}	3½	5¼	7	8¾	10½
	C_{min}	1¾	2⅝	3½	4⅜	5¼
	f_{cmin}	0.45	0.45	0.45	0.45	0.45
1¾		0.45				
2		0.53				
2½		0.69				
2⅝		0.73	0.45			
3		0.84	0.53			
3½		1.00	0.63	0.45		
4			0.74	0.53		
4⅜			0.82	0.59	0.45	
4½			0.84	0.61	0.47	
5			0.95	0.69	0.53	
5¼			1.00	0.73	0.56	0.45
5½				0.76	0.59	0.48
6				0.84	0.65	0.53
6½				0.92	0.72	0.58
7				1.00	0.78	0.63
7½					0.84	0.69
8					0.91	0.74
8½					0.97	0.79
8¾					1.00	0.82
9						0.84
9½						0.90
10						0.95
10½						1.00

1. C_{act} = actual edge distance at which anchor is installed (inches).
2. C_{cr} = critical edge distance for 100% load (inches).
3. C_{min} = minimum edge distance for reduced load (inches).
4. f_c = adjustment factor for allowable load at actual edge distance.
5. f_{ccr} = adjustment factor for allowable load at critical edge distance. f_{ccr} is always = 1.00.
6. f_{cmin} = adjustment factor for allowable load at minimum edge distance.
7. $f_c = f_{cmin} + [(1 - f_{cmin}) (C_{act} - C_{min}) / (C_{cr} - C_{min})]$.

Spacing Tension and Shear (f_s)



S_{act} (in.)	Size	¼	⅜[9]	⅜	½	⅝	¾
	E	1	¾	1½	2	2½	3⅛
	S_{cr}	4	3	6	8	10	12½
	S_{min}	2	1½	3	4	5	6¼
	f_{smin}	0.50	0.50	0.50	0.50	0.50	0.50
1½			0.50				
2		0.50	0.67				
2½		0.63	0.83				
3		0.75	1.00	0.50			
3½		0.88		0.58			
4		1.00		0.67	0.50		
4½				0.75	0.56		
5				0.83	0.63	0.50	
5½				0.92	0.69	0.55	
6				1.00	0.75	0.60	
6¼					0.78	0.63	0.50
7					0.88	0.70	0.56
8					1.00	0.80	0.64
9						0.90	0.72
10						1.00	0.80
11							0.88
12							0.96
12½							1.00

1. E = Embedment depth (inches).
2. S_{act} = actual spacing distance at which anchors are installed (inches).
3. S_{cr} = critical spacing distance for 100% load (inches).
4. S_{min} = minimum spacing distance for reduced load (inches).
5. f_s = adjustment factor for allowable load at actual spacing distance.
6. f_{scr} = adjustment factor for allowable load at critical spacing distance. f_{scr} is always = 1.00.
7. f_{smin} = adjustment factor for allowable load at minimum spacing distance.
8. $f_s = f_{smin} + [(1 - f_{smin}) (S_{act} - S_{min}) / (S_{cr} - S_{min})]$.
9. ⅜" Short Drop-In (DIA37S).

Load-Adjustment Factors for Drop-In (Carbon and Stainless Steel) and Lipped Drop-In (Carbon Steel) Anchors in Sand-Lightweight Concrete over Metal Deck: Edge Distance and Spacing, Tension and Shear Loads

How to use these charts:

1. The following tables are for reduced edge distance and spacing.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the edge distance (C_{act}) or spacing (S_{act}) at which the anchor is to be installed.
4. The load adjustment factor (f_c or f_s) is the intersection of the row and column.
5. Multiply the allowable load by the applicable load adjustment factor.
6. Reduction factors for multiple edges or spacing are multiplied together.

Edge Distance Tension (f_c)

Edge Dist. C_{act} (in.)	Size	⅜	½
	C_{cr}	6	8
	C_{min}	3½	4¾
	f_{cmin}	0.65	0.65
3½		0.65	
4		0.72	
4½		0.79	
4¾		0.83	0.65
5		0.86	0.68
5½		0.93	0.73
6		1.00	0.78
6½			0.84
7			0.89
7½			0.95
8			1.00

*See page 13 for an explanation of the load table icons

See Notes Below

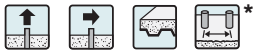
Edge Distance Shear (f_c)

Edge Dist. C_{act} (in.)	Size	⅜	½
	C_{cr}	7	9⅜
	C_{min}	3½	4¾
	f_{cmin}	0.45	0.45
3½		0.45	
4		0.53	
4½		0.61	
4¾		0.65	0.45
5		0.69	0.48
5½		0.76	0.54
6		0.84	0.60
6½		0.92	0.66
7		1.00	0.72
7½			0.78
8			0.84
8½			0.90
9			0.96
9⅜			1.00

1. C_{act} = actual edge distance at which anchor is installed (inches).
2. C_{cr} = critical edge distance for 100% load (inches).
3. C_{min} = minimum edge distance for reduced load (inches).
4. f_c = adjustment factor for allowable load at actual edge distance.
5. f_{ccr} = adjustment factor for allowable load at critical edge distance. f_{ccr} is always = 1.00.
6. f_{cmin} = adjustment factor for allowable load at minimum edge distance.
7. $f_c = f_{cmin} + [(1 - f_{cmin}) (C_{act} - C_{min}) / (C_{cr} - C_{min})]$.

Spacing Tension and Shear (f_s)

S_{act} (in.)	Size	⅜	½
	S_{cr}	8	10⅝
	S_{min}	4	5¼
	f_{smin}	0.50	0.50
4		0.50	
4½		0.56	
5		0.63	
5¼		0.66	0.50
6		0.75	0.57
6½		0.81	0.62
7		0.88	0.66
7½		0.94	0.71
8		1.00	0.76
8½			0.80
9			0.85
9½			0.90
10			0.94
10⅝			1.00



1. S_{act} = actual spacing distance at which anchors are installed (inches).
2. S_{cr} = critical spacing distance for 100% load (inches).
3. S_{min} = minimum spacing distance for reduced load (inches).
4. f_s = adjustment factor for allowable load at actual spacing distance.
5. f_{scr} = adjustment factor for allowable load at critical spacing distance. f_{scr} is always = 1.00.
6. f_{smin} = adjustment factor for allowable load at minimum spacing distance.
7. $f_s = f_{smin} + [(1 - f_{smin}) (S_{act} - S_{min}) / (S_{cr} - S_{min})]$.