The following excerpt are pages from the North American Product Technical Guide, Volume 2: Anchor Fastening, Edition 22.

Please refer to the publication in its entirety for complete details on this product including data development, product specifications, general suitability, installation, corrosion and spacing and edge distance guidelines.
US&CA: https://submittals.us.hilti.com/PTGVol2/

To consult directly with a team member regarding our anchor fastening products, contact Hilti's team of technical support specialists between the hours of 7:00am – 6:00pm CST.
US: 877-749-6337 or HNATechnicalServices@hilti.com
CA: 1-800-363-4458, ext. 6 or CATechnicalServices@hilti.com

Hilti, Inc.
7250 Dallas Parkway, Suite 1000
Plano, TX 75024

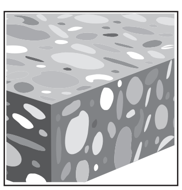
1-800-879-8000
www.hilti.com

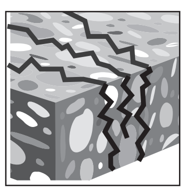
3.3.3 HSL-3-R HEAVY-DUTY STAINLESS STEEL EXPANSION ANCHORS

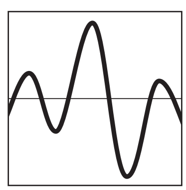
PRODUCT DESCRIPTION

HSL–3-R Heavy-duty Expansion Anchor

Anchor System	Features and Benefits
 HSL-3-R  HSL-3-GR  HSL-3-SKR	• Approved for use in cracked tension zone (cracked concrete) • Data for use with the Strength Design provisions of ACI 318 Chapter 17 and CSA A23.3 Annex D. • High load capacity • Force-controlled expansion which allows for follow-up expansion • Reliable clamping of part fastened to help overcome gap • No spinning of the anchor in hole when tightening bolt or nut • Seismic qualification per ICC-ES AC 193 and the requirements of ACI 318 Chapter 17 • Simplified tables for edge distance and spacing provided


Uncracked concrete


Cracked concrete


Seismic Desing Categories A-F

PROFIS Anchor design software

Listings/Approvals	
ICC-ES (International Code Council)	ESR-1545
European Technical Approval	ETA-02/0042
City of Los Angeles	LABD Supplement to ESR

MATERIAL SPECIFICATIONS

- Stainless steel bolt or threaded rod per DIN EN 10088-3.
- Stainless steel washer per DIN EN 10088-3.
- Stainless steel expansion sleeve per ASTM A 276/276A.
- Stainless steel spacing sleeve per ASTM A 511/A 511M.
- Stainless steel expansion cone per ASTM A 511/A 511M.
- Collapsible sleeve is made from acetal polyoxymethylene (POM) resin.

INSTALLATION PARAMETERS

Table 1 — HSL-3-R Specifications

Details	Symbol	Units	Nominal anchor diameter									
			M8		M10		M12		M16		M20	
Nominal drill bit diameter	d_{bit}	mm	12		15		18		24		28	
Minimum concrete thickness	h_{min}	mm (in)	120 (4-3/4)		140 (5-1/2)		150 (5-7/8)		200 (7-7/8)		250 (9-7/8)	
Minimum hole depth	h_o	mm (in)	80 (3-1/8)		90 (3-9/16)		105 (4-1/8)		125 (4-15/16)		155 (6-1/8)	
Effective minimum embedment	$h_{ef,min}$	mm (in)	60 (2.36)		70 (2.76)		80 (3.15)		100 (3.94)		125 (4.92)	
Minimum fixture hole diameter	d_h	mm (in)	14 (9/16)		17 (11/16)		20 (13/16)		26 (1)		31 (1-1/4)	
Diameter of countersunk hole in the fixture HSL-3-SKR	d_{SK}	mm (in)	22.5 (7/8)		25.5 (1)		32.9 (1-5/16)		N/A		N/A	
Height of countersunk head in the fixture HSL-3-SKR	h_{SK}	mm (in)	5.8 (1/4)		6 (1/4)		8 (5/16)		N/A		N/A	
Max. cumulative gap between part(s) being fastened and concrete surface	-	mm (in)	4 (1/8)		5 (3/16)		8 (5/16)		9 (3/8)		12 (1/2)	
Maximum thickness of part fastened HSL-3-R	$t_{fix,max}$	mm (in)	20 (3/4)	40 (1-1/2)	20 (3/4)	40 (1-1/2)	25 (1)	50 (2)	25 (1)	50 (2)	30 (1-1/8)	60 (2-1/4)
Overall length of anchor HSL-3-R	ℓ	mm (in)	98 (3-7/8)	118 (4-5/8)	110 (4-3/8)	130 (5-1/8)	131 (5-1/8)	156 (6-1/8)	153 (6)	178 (7)	183 (7-1/4)	213 (8-3/8)
Maximum thickness of part fastened HSL-3-GR	$t_{fix,max}$	mm (in)	20 (3/4)	100 (4)	20 (3/4)	100 (4)	25 (1)	100 (4)	25 (1)	100 (4)	30 (1-1/8)	100 (4)
Overall length of anchor HSL-3-GR	ℓ	mm (in)	102 (4)	182 (7-1/8)	115 (4-1/2)	197 (7-3/4)	139 (5-1/2)	214 (8-1/2)	163 (6-3/8)	238 (9-3/8)	190 (7-1/2)	260 (10-1/4)
Maximum thickness of part fastened HSL-3-SKR	$t_{fix,max}$	mm (in)	20 (3/4)		20 (3/4)		25 (1)		N/A		N/A	
Overall length of anchor HSL-3-SKR	ℓ	mm (in)	98 (3-7/8)		110 (4-3/8)		131 (5-1/8)		N/A		N/A	
Installation torque HSL-3-R	T_{inst}	Nm (ft-lb)	25 (18)		35 (26)		80 (59)		120 (89)		200 (148)	
Installation torque HSL-3-GR	T_{inst}	Nm (ft-lb)	30 (22)		50 (37)		80 (59)		120 (89)		200 (148)	
Installation torque HSL-3-SKR	T_{inst}	Nm (ft-lb)	18 (13)		50 (37)		80 (59)		N/A		N/A	
Wrench size, HSL-3-R, HSL-3-GR	SW	mm	13		17		19		24		30	
Allen wrench size, HSL-3-SKR	SW	mm	5		6		8		N/A		N/A	

3.3.3

Figure 1 — HSL-3-R and HSL-3-GR in the installed condition (HSL-3-R shown)

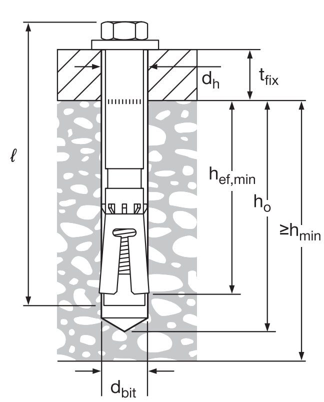
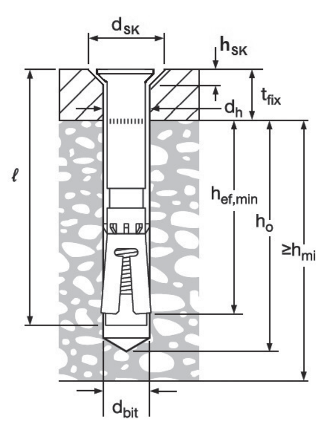


Figure 2 — HSL-3-SKR in the installed condition



DESIGN DATA IN CONCRETE PER ACI 318

ACI 318 Chapter 17 design

The load values in this section are Hilti Simplified Design Tables. The load tables in this section were developed using the Strength Design parameters and variables of ESR 1545 and the equations within ACI 318 Chapter 17. For a detailed explanation of the Hilti Simplified Design Tables, refer to section 3.1.8 of Hilti Product Technical Guide Volume 2-21. Data tables from ESR 1545 are not contained in this section, but can be found at **www.icc-es.org** or at **www.hilti.com**.

Table 2 — Hilti HSL-3-R design strength with concrete / pullout failure in uncracked concrete [1,2,3,4,5]

Nominal Anchor Diameter mm	Effective Embed. Depth mm (in.)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2500 psi (17.2 MPa) lb (kN)	f'_c = 3000 psi (20.7 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 6000 psi (41.4 MPa) lb (kN)	f'_c = 2500 psi (17.2 MPa) lb (kN)	f'_c = 3000 psi (20.7 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 6000 psi (41.4 MPa) lb (kN)
M8	60 (2.36)	1,700 (7.6)	1,730 (7.7)	1,780 (7.9)	1,855 (8.3)	3,050 (13.6)	3,340 (14.9)	3,860 (17.2)	4,725 (21.0)
M10	70 (2.76)	3,020 (13.4)	3,310 (14.7)	3,820 (17.0)	4,680 (20.8)	7,685 (34.2)	8,420 (37.5)	9,720 (43.2)	11,905 (53.0)
M12	80 (3.15)	3,690 (16.4)	4,040 (18.0)	4,665 (20.8)	5,715 (25.4)	9,390 (41.8)	10,285 (45.7)	11,880 (52.8)	14,550 (64.7)
M16	100 (3.94)	6,855 (30.5)	7,510 (33.4)	8,670 (38.6)	10,620 (47.2)	14,765 (65.7)	16,175 (71.9)	18,675 (83.1)	22,875 (101.8)
M20	125 (4.92)	10,645 (47.4)	11,660 (51.9)	13,465 (59.9)	16,490 (73.4)	22,925 (102.0)	25,115 (111.7)	29,000 (129.0)	35,515 (158.0)

Table 3 — Hilti HSL-3-R design strength with concrete / pullout failure in cracked concrete [1,2,3,4,5,6]

Nominal Anchor Diameter mm	Effective Embed. Depth mm (in.)	Tension — ΦN_n				Shear — ΦV_n			
		f'_c = 2500 psi (17.2 MPa) lb (kN)	f'_c = 3000 psi (20.7 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 6000 psi (41.4 MPa) lb (kN)	f'_c = 2500 psi (17.2 MPa) lb (kN)	f'_c = 3000 psi (20.7 MPa) lb (kN)	f'_c = 4000 psi (27.6 MPa) lb (kN)	f'_c = 6000 psi (41.4 MPa) lb (kN)
M8	60 (2.36)	1,390 (6.2)	1,520 (6.8)	1,755 (7.8)	2,150 (9.6)	2,160 (9.6)	2,365 (10.5)	2,730 (12.1)	3,345 (14.9)
M10	70 (2.76)	2,495 (11.1)	2,735 (12.2)	3,160 (14.1)	3,865 (17.2)	6,725 (29.9)	7,365 (32.8)	8,505 (37.8)	10,420 (46.4)
M12	80 (3.15)	3,690 (16.4)	4,040 (18.0)	4,665 (20.8)	5,715 (25.4)	9,390 (41.8)	10,285 (45.7)	11,880 (52.8)	14,550 (64.7)
M16	100 (3.94)	6,095 (27.1)	6,675 (29.7)	7,705 (34.3)	9,440 (42.0)	13,125 (58.4)	14,375 (63.9)	16,600 (73.8)	20,330 (90.4)
M20	125 (4.92)	7,715 (34.3)	8,450 (37.6)	9,760 (43.4)	11,950 (53.2)	18,340 (81.6)	20,090 (89.4)	23,200 (103.2)	28,415 (126.4)

1 See Section 3.1.6 for explanation on development of load values.
2 See Section 3.1.9 to convert design strength value to ASD value.
3 Linear interpolation between concrete compressive strengths is not permitted.
4 Apply spacing, edge distance, and concrete thickness factors in tables 6 to 9 as necessary. Compare to the steel values in table 4. The lesser of the values is to be used for the design.
5 Tabular values are for normal weight concrete only. For lightweight concrete multiply design strength by λ_a as follows: For sand-lightweight, λ_a = 0.68. For all-lightweight, λ_a = 0.60.
6 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete. For seismic tension loads, multiply cracked concrete tabular values in tension only by $\alpha_{N,seis}$ = 0.75. See Section 3.1.9 of Hilti Product Technical Guide Volume 2-19 for additional information on seismic applications.

Table 4 — Steel strength for Hilti HSL-3-R stainless steel anchors [1,2]

Nominal Anchor Diameter mm	HSL-3-R			HSL-3-GR			HSL-3-SKR		
	Tensile[3] ΦN_{sa} lb (kN)	Shear[4] ΦV_{sa} lb (kN)	Seismic Shear[5] ΦV_{sa} lb (kN)	Tensile[3] ΦN_{sa} lb (kN)	Shear[4] ΦV_{sa} lb (kN)	Seismic Shear[5] ΦV_{sa} lb (kN)	Tensile[3] ΦN_{sa} lb (kN)	Shear[4] ΦV_{sa} lb (kN)	Seismic Shear[5] ΦV_{sa} lb (kN)
M8	4,320 (19.2)	6,490 (28.9)	1,770 (7.9)	4,320 (19.2)	5,890 (26.2)	1,770 (7.9)	4,320 (19.2)	6,490 (28.9)	1,770 (7.9)
M10	6,845 (30.4)	9,160 (40.7)	4,310 (19.2)	6,845 (30.4)	8,620 (38.3)	4,310 (19.2)	6,845 (30.4)	9,160 (40.7)	4,310 (19.2)
M12	9,950 (44.3)	11,895 (52.9)	4,605 (20.5)	9,950 (44.3)	11,515 (51.2)	4,605 (20.5)	9,950 (44.3)	11,895 (52.9)	4,605 (20.5)
M16	18,530 (82.4)	18,735 (83.3)	9,350 (41.6)	18,530 (82.4)	18,940 (84.2)	9,350 (41.6)	-	-	-
M20	28,915 (128.6)	21,215 (94.4)	9,350 (41.6)	28,915 (128.6)	23,380 (104.0)	9,350 (41.6)	-	-	-

1 See Section 3.1.9 to convert design strength value to ASD value.
2 Hilti HSL-3 Stainless Steel anchors are to be considered ductile steel elements.
3 Tensile = $\Phi A_{se,N} f_{uta}$ as noted in ACI 318 Chapter 17
4 Shear values determined by static shear tests with $\Phi V_{sa} \le \Phi\ 0.60\ A_{se,V} f_{uta}$ as noted in ACI 318 Chapter 17.
5 Seismic shear values determined by seismic shear tests with $\Phi V_{sa} < \Phi\ 0.60\ A_{se,V} f_{uta}$ as noted in ACI 318 Chapter 17. See Section 3.1.9 of Hilti Product Technical Guide Volume 2-21 for additional information on seismic applications.

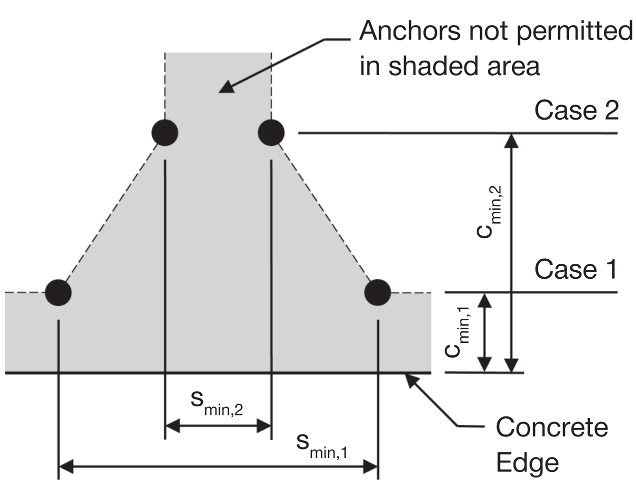
Table 5 — Edge distance, spacing and member thickness requirements [1]

Dimensional Parameter		Symbol	Units	Nominal anchor diameter				
				M8	M10	M12	M16	M20
Minimum concrete thickness		h_{min}	in. (mm)	4-3/4 (120)	5-1/2 (140)	5-7/8 (150)	7-7/8 (200)	9-7/8 (250)
Critical edge distance		c_{ac}	in. (mm)	7-7/8 (200)	11 (280)	8-5/8 (220)	9-1/2 (240)	15 (380)
Case 1	Minimum edge distance	$c_{min,1}$	in. (mm)	2-3/4 (70)	3-1/2 (90)	3-1/2 (90)	4 (100)	5-7/8 (150)
	Minimum anchor spacing	$s_{min,1}$	in. (mm)	5-1/2 (140)	6-1/4 160)	9-7/8 (250)	9-1/2 (240)	11-7/8 (300)
Case 2	Minimum edge distance	$c_{min,2}$	in. (mm)	4-3/4 (120)	5-1/8 (130)	6-1/4 (160)	9-1/2 (240)	11-7/8 (300)
	Minimum anchor spacing	$s_{min,2}$	in. (mm)	2-3/4 (70)	3-1/2 (90)	4 (100)	4 (100)	5 (125)

1 Linear interpolation is permitted to establish an edge distance and spacing combination between Case 1 and Case 2.
Linear interpolation for a specific edge distance c, where $c_{min,1} < c < c_{min,2}$ will determine the permissable spacing s as follows:

$$s \ge s_{min,2} + \frac{(s_{min,1} - s_{min,2})}{(c_{min,1} - c_{min,2})}(c - c_{min,2})$$

Figure 3 — Interpolation of Minimum Edge Distance and Anchor Spacing



For a specific edge distance, the permitted spacing is calculated as follows:

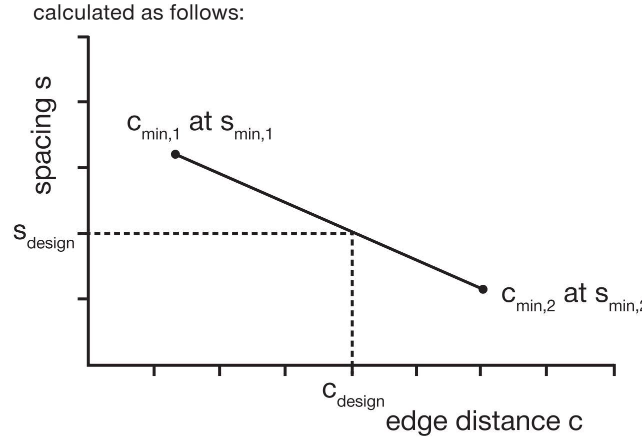


Table 6 — Load adjustment factors for M8, M10, and M12 HSL-3-R anchors in uncracked concrete [1,4]

M8, M10 and M12 HSL-3-R Uncracked Concrete		Spacing Factor in Tension f_{AN}			Edge Distance Factor in Tension f_{RN}			Spacing Factor in Shear [2] f_{AV}			Edge Distance in Shear ⊥ Toward Edge f_{RV}			Edge Distance in Shear ‖ To Edge f_{RV}			Conc. Thickness Factor in Shear [3] f_{HV}		
Nominal Diameter mm		M8	M10	M12	M8	M10	M12	M8	M10	M12	M8	M10	M12	M8	M10	M12	M8	M10	M12
Effective Embed. h_{ef} mm (in)		60 (2.36)	70 (2.76)	80 (3.15)	60 (2.36)	70 (2.76)	80 (3.15)	60 (2.36)	70 (2.76)	80 (3.15)	60 (2.36)	70 (2.76)	80 (3.15)	60 (2.36)	70 (2.76)	80 (3.15)	60 (2.36)	70 (2.76)	80 (3.15)
Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h) - in. (mm)																			
2-3/4	(70)	0.69	n/a	n/a	0.37	n/a	n/a	0.56	n/a	n/a	0.21	n/a	n/a	0.37	n/a	n/a	n/a	n/a	n/a
3	(76)	0.71	n/a	n/a	0.40	n/a	n/a	0.56	n/a	n/a	0.24	n/a	n/a	0.40	n/a	n/a	n/a	n/a	n/a
3-1/2	(89)	0.75	0.71	n/a	0.45	0.33	0.44	0.57	0.55	n/a	0.30	0.18	0.23	0.45	0.33	0.44	n/a	n/a	n/a
4	(102)	0.78	0.74	0.71	0.51	0.37	0.48	0.58	0.56	0.57	0.36	0.22	0.28	0.51	0.37	0.48	n/a	n/a	n/a
4-3/4	(121)	0.84	0.79	0.75	0.60	0.43	0.55	0.60	0.57	0.59	0.47	0.28	0.37	0.60	0.43	0.55	0.63	n/a	n/a
5	(127)	0.85	0.80	0.76	0.63	0.45	0.58	0.61	0.58	0.59	0.51	0.31	0.40	0.63	0.45	0.58	0.65	n/a	n/a
5-1/8	(130)	0.86	0.81	0.77	0.65	0.47	0.59	0.61	0.58	0.59	0.53	0.32	0.41	0.65	0.47	0.59	0.66	n/a	n/a
5-1/2	(140)	0.89	0.83	0.79	0.70	0.50	0.64	0.62	0.58	0.60	0.58	0.35	0.46	0.70	0.50	0.64	0.68	0.58	n/a
6	(152)	0.92	0.86	0.82	0.76	0.55	0.70	0.63	0.59	0.61	0.67	0.40	0.52	0.76	0.55	0.70	0.71	0.60	n/a
6-1/4	(159)	0.94	0.88	0.83	0.79	0.57	0.72	0.63	0.59	0.61	0.71	0.43	0.55	0.79	0.57	0.72	0.73	0.62	0.67
6-1/2	(165)	0.96	0.89	0.84	0.83	0.59	0.75	0.64	0.60	0.62	0.75	0.45	0.59	0.83	0.59	0.75	0.74	0.63	0.68
7	(178)	0.99	0.92	0.87	0.89	0.64	0.81	0.65	0.61	0.63	0.84	0.51	0.65	0.89	0.64	0.81	0.77	0.65	0.71
8	(203)	1.00	0.98	0.92	1.00	0.73	0.93	0.67	0.62	0.64	1.00	0.62	0.80	1.00	0.73	0.93	0.82	0.70	0.76
9	(229)		1.00	0.98		0.82	1.00	0.69	0.64	0.66		0.74	0.95		0.82	1.00	0.87	0.74	0.80
9-7/8	(251)			1.00		0.90		0.71	0.65	0.68		0.85	1.00		0.90		0.91	0.77	0.84
10	(254)					0.91		0.71	0.65	0.68		0.87			0.91		0.92	0.78	0.85
11	(279)					1.00		0.73	0.67	0.70		1.00			1.00		0.96	0.82	0.89
12	(305)							0.75	0.68	0.72							1.00	0.85	0.93
14	(356)							0.80	0.71	0.75								0.92	1.00
16	(406)							0.84	0.74	0.79								0.98	
18	(457)							0.88	0.77	0.82								1.00	
20	(508)							0.92	0.80	0.86									
24	(610)							1.00	0.86	0.93									
> 30	(762)								0.95	1.00									

Table 7 — Load adjustment factors for M8, M10, and M12 HSL-3-R anchors in cracked concrete [1,4]

M8, M10 and M12 HSL-3-R Cracked Concrete		Spacing Factor in Tension f_{AN}			Edge Distance Factor in Tension f_{RN}			Spacing Factor in Shear [2] f_{AV}			Edge Distance in Shear ⊥ Toward Edge f_{RV}			Edge Distance in Shear ‖ To Edge f_{RV}			Conc. Thickness Factor in Shear [3] f_{HV}		
Nominal Diameter mm		M8	M10	M12	M8	M10	M12	M8	M10	M12	M8	M10	M12	M8	M10	M12	M8	M10	M12
Effective Embed. h_{ef} mm (in)		60 (2.36)	70 (2.76)	80 (3.15)	60 (2.36)	70 (2.76)	80 (3.15)	60 (2.36)	70 (2.76)	80 (3.15)	60 (2.36)	70 (2.76)	80 (3.15)	60 (2.36)	70 (2.76)	80 (3.15)	60 (2.36)	70 (2.76)	80 (3.15)
Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h) - in. (mm)																			
2-3/4	(70)	0.69	n/a	n/a	0.83	n/a	n/a	0.59	n/a	n/a	0.41	n/a	n/a	0.82	n/a	n/a	n/a	n/a	n/a
3	(76)	0.71	n/a	n/a	0.88	n/a	n/a	0.60	n/a	n/a	0.46	n/a	n/a	0.88	n/a	n/a	n/a	n/a	n/a
3-1/2	(89)	0.75	0.71	n/a	0.99	0.88	0.80	0.62	0.56	n/a	0.59	0.21	0.17	0.99	0.42	0.33	n/a	n/a	n/a
4	(102)	0.78	0.74	0.71	1.00	0.97	0.88	0.63	0.57	0.56	0.72	0.26	0.20	1.00	0.51	0.40	n/a	n/a	n/a
4-3/4	(121)	0.84	0.79	0.75		1.00	1.00	0.66	0.58	0.57	0.93	0.33	0.26		0.67	0.52	0.80	n/a	n/a
5	(127)	0.85	0.80	0.76		1.00	1.00	0.67	0.58	0.57	1.00	0.36	0.28		0.72	0.56	0.82	n/a	n/a
5-1/8	(130)	0.86	0.81	0.77		1.00	1.00	0.67	0.59	0.57		0.37	0.29		0.75	0.59	0.83	n/a	n/a
5-1/2	(140)	0.89	0.83	0.79			1.00	0.68	0.59	0.58		0.41	0.33		0.83	0.65	0.86	0.61	n/a
6	(152)	0.92	0.86	0.82			1.00	0.70	0.60	0.59		0.47	0.37		0.95	0.74	0.89	0.64	n/a
6-1/4	(159)	0.94	0.88	0.83			1.00	0.71	0.61	0.59		0.50	0.39		1.00	0.79	0.91	0.65	0.60
6-1/2	(165)	0.96	0.89	0.84				0.72	0.61	0.59		0.53	0.42			0.84	0.93	0.66	0.61
7	(178)	0.99	0.92	0.87				0.73	0.62	0.60		0.60	0.47			0.93	0.97	0.69	0.63
8	(203)	1.00	0.98	0.92				0.77	0.63	0.61		0.73	0.57			1.00	1.00	0.73	0.68
9	(229)		1.00	0.98				0.80	0.65	0.63		0.87	0.68					0.78	0.72
9-7/8	(251)			1.00				0.83	0.67	0.64		1.00	0.78					0.82	0.75
10	(254)							0.83	0.67	0.64			0.80					0.82	0.76
11	(279)							0.87	0.69	0.66			0.92					0.86	0.79
12	(305)							0.90	0.70	0.67			1.00					0.90	0.83
14	(356)							0.97	0.74	0.70								0.97	0.90
16	(406)							1.00	0.77	0.73								1.00	0.96
18	(457)								0.80	0.76									1.00
20	(508)								0.84	0.79									
24	(610)								0.90	0.84									
> 30	(762)								1.00	0.93									

1 Linear interpolation not permitted.
2 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.
3 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.
4 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Engineering software or perform anchor calculation using design equations from ACI 318 Chapter 17 or CSA A23.3 Annex D.

(shaded cell) — If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with Figure 2 of this section to calculate permissable edge distance and spacing combinations.

Table 8 — Load adjustment factors for M16 and M20, HSL-3-R anchors in uncracked concrete [1,4]

M16 and M20 HSL-3-R Uncracked Concrete		Spacing Factor in Tension f_{AN}		Edge Distance Factor in Tension f_{RN}		Spacing Factor in Shear [2] f_{AV}		Edge Distance in Shear ⊥ Toward Edge f_{RV}		Edge Distance in Shear ‖ To Edge f_{RV}		Conc. Thickness Factor in Shear [3] f_{HV}	
Nominal Diameter mm		M16	M20	M16	M20	M16	M20	M16	M20	M16	M20	M16	M20
Effective Embed. h_{ef} mm (in)		100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)
Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h) - in. (mm)	4 (102)	0.67	n/a	0.47	n/a	0.56	n/a	0.21	n/a	0.42	n/a	n/a	n/a
	5 (127)	0.71	0.67	0.55	n/a	0.57	0.56	0.29	n/a	0.55	n/a	n/a	n/a
	5-7/8 (149)	0.75	0.70	0.62	0.41	0.59	0.57	0.37	0.26	0.62	0.41	n/a	n/a
	6 (152)	0.75	0.70	0.63	0.42	0.59	0.57	0.38	0.27	0.63	0.42	n/a	n/a
	7 (178)	0.80	0.74	0.74	0.47	0.60	0.58	0.48	0.33	0.74	0.47	n/a	n/a
	7-7/8 (200)	0.83	0.77	0.83	0.53	0.62	0.59	0.57	0.40	0.83	0.53	0.68	n/a
	8 (203)	0.84	0.77	0.84	0.53	0.62	0.59	0.59	0.41	0.84	0.53	0.68	n/a
	9 (229)	0.88	0.80	0.95	0.60	0.63	0.60	0.70	0.49	0.95	0.60	0.73	n/a
	9-1/2 (241)	0.90	0.82	1.00	0.63	0.64	0.61	0.76	0.53	1.00	0.63	0.74	n/a
	9-7/8 (251)	0.92	0.83		0.66	0.64	0.61	0.80	0.56		0.66	0.76	0.67
	10 (254)	0.92	0.84		0.67	0.65	0.61	0.82	0.57		0.67	0.76	0.68
	11 (279)	0.97	0.87		0.73	0.66	0.63	0.95	0.66		0.73	0.80	0.71
	11-7/8 (302)	1.00	0.90		0.79	0.67	0.64	1.00	0.74		0.79	0.83	0.74
	12 (305)		0.91		0.80	0.68	0.64		0.75		0.80	0.84	0.74
	13 (330)		0.94		0.87	0.69	0.65		0.85		0.87	0.87	0.77
	14 (356)		0.97		0.93	0.70	0.66		0.94		0.94	0.90	0.80
	15 (381)		1.00		1.00	0.72	0.67		1.00		1.00	0.94	0.83
	16 (406)					0.73	0.68					0.97	0.86
	18 (457)					0.76	0.71					1.00	0.91
	20 (508)					0.79	0.73						0.96
	24 (610)					0.85	0.78						1.00
	30 (762)					0.94	0.84						
	36 (914)					1.00	0.91						
	> 48 (1219)						1.00						

3.3.3

Table 9 — Load adjustment factors for M16, and M20, HSL-3-R anchors in cracked concrete [1,4]

M16 and M20 HSL-3-R Uncracked Concrete		Spacing Factor in Tension f_{AN}		Edge Distance Factor in Tension f_{RN}		Spacing Factor in Shear [2] f_{AV}		Edge Distance in Shear ⊥ Toward Edge f_{RV}		Edge Distance in Shear ‖ ‖ To Edge f_{RV}		Conc. Thickness Factor in Shear [3] f_{HV}	
Nominal Diameter mm		M16	M20	M16	M20	M16	M20	M16	M20	M16	M20	M16	M20
Effective Embed. h_{ef} mm (in)		100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)
Spacing (s) / Edge Distance (c_a) / Concrete Thickness (h) - in. (mm)	4 (102)	0.67	n/a	0.76	n/a	0.55	n/a	0.17	n/a	0.33	n/a	n/a	n/a
	5 (127)	0.71	0.67	0.88	n/a	0.56	0.55	0.23	n/a	0.47	n/a	n/a	n/a
	5-7/8 (149)	0.75	0.70	1.00	0.84	0.57	0.56	0.30	0.23	0.59	0.46	n/a	n/a
	6 (152)	0.75	0.70	1.00	0.86	0.58	0.56	0.31	0.24	0.61	0.47	n/a	n/a
	7 (178)	0.80	0.74	1.00	0.96	0.59	0.57	0.39	0.30	0.77	0.60	n/a	n/a
	7-7/8 (200)	0.83	0.77	1.00	1.00	0.60	0.58	0.46	0.36	0.92	0.71	0.63	n/a
	8 (203)	0.84	0.77	1.00	1.00	0.60	0.59	0.47	0.36	0.94	0.73	0.64	n/a
	9 (229)	0.88	0.80	1.00	1.00	0.61	0.60	0.56	0.43	1.00	0.87	0.67	n/a
	9-1/2 (241)	0.90	0.82	1.00	1.00	0.62	0.60	0.61	0.47	1.00	0.94	0.69	n/a
	9-7/8 (251)	0.92	0.83		1.00	0.62	0.60	0.65	0.50		1.00	0.71	0.65
	10 (254)	0.92	0.84		1.00	0.63	0.61	0.66	0.51		1.00	0.71	0.65
	11 (279)	0.97	0.87		1.00	0.64	0.62	0.76	0.59		1.00	0.75	0.68
	11-7/8 (302)	1.00	0.90		1.00	0.65	0.63	0.85	0.66		1.00	0.77	0.71
	12 (305)		0.91			0.65	0.63	0.87	0.67			0.78	0.71
	13 (330)		0.94			0.66	0.64	0.98	0.75			0.81	0.74
	14 (356)		0.97			0.68	0.65	1.00	0.84			0.84	0.77
	15 (381)		1.00			0.69	0.66		0.94			0.87	0.80
	16 (406)					0.70	0.67		1.00			0.90	0.82
	18 (457)					0.73	0.69					0.95	0.87
	20 (508)					0.75	0.71					1.00	0.92
	24 (610)					0.80	0.76						1.00
	30 (762)					0.88	0.82						
	36 (914)					0.95	0.88						
	> 48 (1219)					1.00	1.00						

1 Linear interpolation not permitted.2 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.
3 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then $f_{HV} = 1.0$.
4 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use Hilti PROFIS Engineering software or perform anchor calculation using design equations from ACI 318 Chapter 17 or CSA A23.3 Annex D.

[shaded box] — If a reduction factor value is in a shaded cell, this indicates that this specific edge distance may not be permitted with a certain spacing (or vice versa). Check with Figure 2 of this section to calculate permissable edge distance and spacing combinations.

DESIGN INFORMATION IN CONCRETE PER CSA A23.3

Limit State Design of anchors is described in the provisions of CSA A23.3 Annex D for post-installed anchors tested and assessed in accordance with ACI 355.2 for mechanical anchors. This section contains the Limit State Design tables with unfactored characteristic loads that are based on the published loads in ICC Evaluation Services ESR-1545. These tables are followed by factored resistance tables. The factored resistance tables have characteristic design loads that are prefactored by the applicable reduction factors for a single anchor with no anchor-to-anchor spacing or edge distance adjustments for the convenience of the user of this document. All the figures in the previous ACI 318 Chapter 17 design section are applicable to Limit State Design and the tables will reference these figures. For a detailed explanation of the tables developed in accordance with CSA A23.3 Annex D, refer to Section 3.1.8. Technical assistance is available by contacting Hilti Canada at (800) 363-4458 or at www.hilti.ca.

Table 10 — HSL-3-R stainless steel design information in accordance with CSA A23.3 Annex D [1]

Design parameter	Symbol	Units	Nominal anchor diameter					Ref A23.3
			M8	M10	M12	M16	M20	
Anchor O.D.	d_a	mm (in)	12 (0.47)	15 (0.59)	18 (0.71)	24 (0.94)	28 (1.10)	
Effective min. embedment [2]	h_{ef}	mm (in)	60 (2.36)	70 (2.76)	80 (3.15)	100 (3.94)	125 (4.92)	
Min. concrete thickness	h_{min}	-	See Table 5 of this document, or Table 5 of ESR-1545					
Critical edge distance	c_{ac}	-	See Table 5 of this document, or Table 5 of ESR-1545					
Minimum edge distance	c_{min}	-	See Table 5 of this document, or Table 5 of ESR-1545					
Minimum anchor spacing	s_{min}	-	See Table 5 of this document, or Table 5 of ESR-1545					
Min. specified yield strength HSL-3-R	f_{ya}	psi (N/mm²)	81,200 (560)	65,300 (450)				
Min. specified yield strength HSL-3-GR	f_{ya}	psi (N/mm²)	81,200 (560)					
Min. specified yield strength HSL-3-SKR	f_{ya}	psi (N/mm²)	81,200 (560)	65,300 (450)		NA	NA	
Min. specified ult. strength	f_{ut}	psi (N/mm²)	101,500 (700)					
Effective tensile stress area	$A_{se,N}$	in² (mm²)	0.057 (36.6)	0.090 (58.0)	0.131 (84.3)	0.243 (157.0)	0.380 (245.0)	
Steel embed. material resistance factor for reinforcement	Φ_s	-	0.85					8.4.3
Resistance modification factor for tension, steel failure modes [3]	R	-	0.80					D.5.3
Resistance modification factor for shear, steel failure modes [3]	R	-	0.75					D.5.3
Factored steel resistance in tension	N_{sar}	lb (kN)	3,915 (17.4)	6,205 (27.6)	9,020 (40.1)	16,800 (74.7)	26,215 (116.6)	D.6.1.2
Factored steel resistance in shear HSL-3-R	V_{sar}	lb (kN)	6,365 (28.3)	8,985 (40.0)	11,665 (51.9)	18,375 (81.7)	20,810 (92.6)	D.7.1.2
Factored steel resistance in shear HSL-3-GR	V_{sar}	lb (kN)	5,775 (25.7)	8,455 (37.6)	11,295 (50.2)	18,575 (82.6)	22,930 (102.0)	D.7.1.2
Factored steel resistance in shear HSL-3-SKR	V_{sar}	lb (kN)	4,815 (21.4)	5,345 (23.8)	7,755 (34.5)	NA	NA	D.7.1.2
Factored steel resistance in shear, seismic — all versions	$V_{sar,eq}$	lb (kN)	1,735 (7.7)	4,230 (18.8)	4,515 (20.1)	9,170 (40.8)	9,170 (40.8)	
Coeff. for factored conc. breakout resistance, uncracked concrete	$k_{c,uncr}$	-	10.0			11.3	12.6	D.6.2.2
Coeff. for factored conc. breakout resistance, cracked concrete	$k_{c,cr}$	-	7.1	8.8	10.0			D.6.2.2
Modification factor for anchor resistance, tension, uncracked conc. [4]	$\psi_{c,N}$	-	1.0					D.6.2.6
Anchor category	-	-	3	2	2	1	1	D.5.3 (c)
Concrete material resistance factor	Φ_c	-	0.65					8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B [5]	R	-	0.75	0.85	0.85	1.00	1.00	D.5.3 (c)
Factored pullout resistance in 20 MPa uncracked concrete [6]	$N_{pr,uncr}$	lb (kN)	1,870 (8.3)	NA				D.6.3.2
Factored pullout resistance in 20 MPa cracked concrete [6]	$N_{pr,cr}$	lb (kN)	NA	2,700 (12.0)	NA	NA	8,310 (37.0)	D.6.3.2
Factored seismic pullout resistance in 20 MPa cracked concrete [6]	$N_{pr,eq}$	lb (kN)	1,620 (7.2)	2,700 (12.0)	3,985 (17.7)	6,565 (29.2)	8,310 (37.0)	
Load bearing length of anchor in shear	l_e	mm (in)	24 (0.94)	30 (1.18)	36 (1.42)	48 (1.89)	56 (2.20)	D.7.2.2

1 Design information in this table is taken from ICC-ES ESR-1545, table 4, and converted for use with CSA A23.3 Annex D.
2 See Figure 1 and 2.
3 The HSL-3-R is considered a ductile steel element as defined by CSA A23.3 Annex D section D.2.
4 For all design cases, $\psi_{c,N}$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete (kc,cr) or uncracked concrete ($k_{c,uncr}$) must be used.
5 For use with the load combinations of CSA A23.3 chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.
6 For all design cases, $\psi_{c,P}$ = 1.0. NA (not applicable) denotes that this value does not control for design. See section 4.1.4 of ESR-1545 for additional information.

Table 11 — Hilti HSL-3-R factored resistance with concrete / pullout failure in uncracked concrete [1,2,3,4]

Nominal anchor diameter	Effective embed. mm (in)	Tension - N_r				Shear - V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
M8	60 (2.36)	1,870 (8.3)	1,910 (8.5)	1,945 (8.7)	2,005 (8.9)	2,280 (10.1)	2,545 (11.3)	2,790 (12.4)	3,220 (14.3)
M10	70 (2.76)	3,255 (14.5)	3,635 (16.2)	3,985 (17.7)	4,600 (20.5)	6,505 (28.9)	7,275 (32.4)	7,970 (35.4)	9,200 (40.9)
M12	80 (3.15)	3,975 (17.7)	4,445 (19.8)	4,870 (21.7)	5,620 (25.0)	7,950 (35.4)	8,890 (39.5)	9,735 (43.3)	11,240 (50.0)
M16	100 (3.94)	7,385 (32.8)	8,255 (36.7)	9,045 (40.2)	10,445 (46.5)	14,770 (65.7)	16,510 (73.5)	18,090 (80.5)	20,885 (92.9)
M20	125 (4.92)	11,505 (51.2)	12,865 (57.2)	14,095 (62.7)	16,275 (72.4)	23,015 (102.4)	25,730 (114.5)	28,185 (125.4)	32,550 (144.8)

Table 12 — Hilti HSL-3-R factored resistance with concrete / pullout failure in cracked concrete [1,2,3,4,5]

3.3.3

Nominal anchor diameter	Effective embed. mm (in)	Tension - N_r				Shear - V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
M8	60 (2.36)	1,615 (7.2)	1,810 (8.0)	1,980 (8.8)	2,285 (10.2)	1,615 (7.2)	1,810 (8.0)	1,980 (8.8)	2,285 (10.2)
M10	70 (2.76)	2,705 (12.0)	3,020 (13.4)	3,310 (14.7)	3,825 (17.0)	5,725 (25.5)	6,400 (28.5)	7,010 (31.2)	8,095 (36.0)
M12	80 (3.15)	3,975 (17.7)	4,445 (19.8)	4,870 (21.7)	5,620 (25.0)	7,950 (35.4)	8,890 (39.5)	9,735 (43.3)	11,240 (50.0)
M16	100 (3.94)	6,535 (29.1)	7,305 (32.5)	8,005 (35.6)	9,240 (41.1)	13,070 (58.1)	14,615 (65.0)	16,005 (71.2)	18,485 (82.2)
M20	125 (4.92)	8,310 (37.0)	9,295 (41.3)	10,180 (45.3)	11,755 (52.3)	18,265 (81.3)	20,420 (90.8)	22,370 (99.5)	25,830 (114.9)

1 See Section 3.1.9 of Hilti Product Technical Guide Volume 2-21 to convert design strength value to ASD value.
2 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.
3 Apply spacing, edge distance, and concrete thickness factors in Tables 6 through 9 as necessary. Compare to the steel values in Table 13. The lesser of the values is to be used for the design.
4 Tablular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows: For sand-lightweight, λ_a = 0.68; for all-lightweight, λ_a = 0.60.
5 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete. For seismic tension loads, multiply cracked concrete tabular values in tension only by $\alpha_{N,seis}$ = 0.75. See Section 3.1.9 of Hilti Product Technical Guide Volume 2-21 for additional information on seismic applications.

Table 13 — Steel resistance for Hilti HSL-3-R anchors [1,2]

Nominal Anchor Diameter mm	HSL-3-R			HSL-3-GR			HSL-3-SKR		
	Tensile[3] N_{sar} lb (kN)	Shear[4] V_{sar} lb (kN)	Seismic Shear[5] $V_{sar,eq}$ lb (kN)	Tensile[3] Nsar lb (kN)	Shear[4] Vsar lb (kN)	Seismic Shear[5] Vsar,eq lb (kN)	Tensile[3] Nsar lb (kN)	Shear[4] Vsar lb (kN)	Seismic Shear[5] Vsar,eq lb (kN)
M8	3,915 (17.4)	6,365 (28.3)	1,735 (7.7)	3,915 (17.4)	5,775 (25.7)	1,735 (7.7)	3,915 (17.4)	6,365 (28.3)	1,735 (7.7)
M10	6,205 (27.6)	8,985 (40.0)	4,230 (18.8)	6,205 (27.6)	8,455 (37.6)	4,230 (18.8)	6,205 (27.6)	8,985 (40.0)	4,230 (18.8)
M12	9,020 (40.1)	11,665 (51.9)	4,515 (20.1)	9,020 (40.1)	11,295 (50.2)	4,515 (20.1)	9,020 (40.1)	11,665 (51.9)	4,515 (20.1)
M16	16,800 (74.7)	18,375 (81.7)	9,170 (40.8)	16,800 (74.7)	18,575 (82.6)	9,170 (40.8)	-	-	-
M20	26,215 (116.6)	20,810 (92.6)	9,170 (40.8)	26,215 (116.6)	22,930 (102.0)	9,170 (40.8)	-	-	-

1 See Section 3.1.9 of Hilti Product Technical Guide Volume 2-21 to convert design strength value to ASD value.
2 Hilti HSL-3-R anchors are to be considered ductile steel elements.
2 Tensile = $A_{se,N}$ Φ_s f_{uta} R as noted in CSA A23.3 Annex D
4 Shear determined by static shear tests with $V_{sar} \leq 0.6\ A_{se,V}\ \Phi_s\ f_{uta}$ R as noted in CSA A23.3 Annex D.
5 Seismic shear values determined by seismic shear tests with $V_{sar,eq} \leq 0.60\ A_{se,V}\ \Phi_s\ f_{uta}$ R as noted in CSA A23.3 Annex D. See Section 3.1.9 of Hilti Product Technical Guide Volume 2-21 for additional information on seismic applications.

INSTALLATION INSTRUCTIONS

Installation Instructions for Use (IFU) are included with each product package. Because of the possibility of changes, always verify that downloaded IFU are current when used. Proper installation is critical to achieve full performance. Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in the IFU.

ORDERING INFORMATION

HSL-3-R bolt version

Description	Box qty
HSL-3-R M8 20/-/-	40
HSL-3-R M8 40/20/-	40
HSL-3-R M10 20/-/-	20
HSL-3-R M10 40/20/-	20
HSL-3-R M12 25/-/-	20
HSL-3-R M12 50/25/-	20
HSL-3-R M16 25/-/-	10
HSL-3-R M16 50/25/-	10
HSL-3-R M20 30/-/-	6
HSL-3-R M20 60/30/-	6


HSL-3-R

HSL-3-GR stud version

Description	Box qty
HSL-3-GR M8 20/-/-	40
HSL-3-GR M8 100/80/60	40
HSL-3-GR M10 20/-/-	20
HSL-3-GR M10 100/80/60	20
HSL-3-GR M12 25/-/-	20
HSL-3-GR M12 100/75/50	20
HSL-3-GR M16 25/-/-	10
HSL-3-GR M16 100/75/50	10
HSL-3-GR M20 30/-/-	6
HSL-3-GR M20 100/70/40	6


HSL-3-GR

HSL-3-SKR countersunk version

Description
HSL-3-SKR M8/10
HSL-3-SKR M8/20
HSL-3-SKR M10/20
HSL-3-SKR M12/25

HSL-3-SKR available by special order


HSL-3-SKR