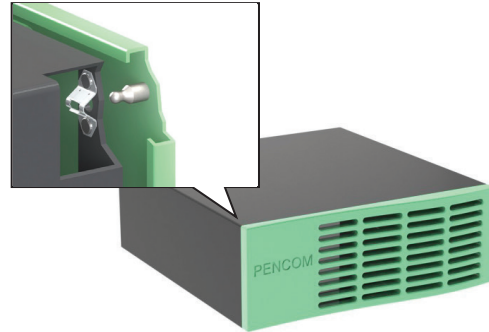


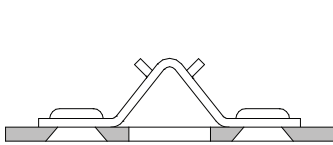
Ball Studs and Clips

FEATURES

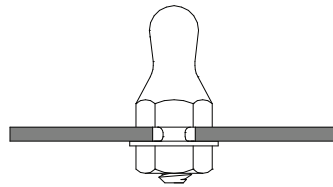
- A convenient spring catch fastener for cabinet doors, inspection panels, etc. requiring repeated disengagement.
- No direct contact between panel surfaces eliminates damaged panel finishes.
- Accommodate different panel thicknesses by varying ball stud lengths.
- Vary ball stud pull-out tension by using different clip material thicknesses.
- Ball studs and clips available in RoHS-compliant plated carbon steel and stainless steel.



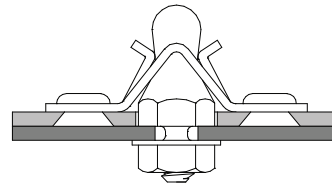
APPLICATION GUIDE



Rivet the ball stud clip onto the panel with either plain or countersunk head rivets; or threaded fasteners (plain rivets shown)



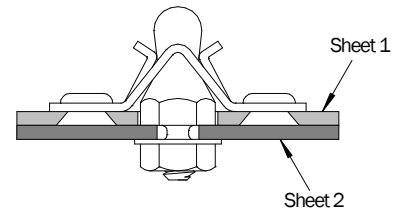
Install the ball stud onto the mating panel according to the appropriate installation method



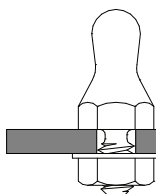
Snap panels together

SELECTION GUIDE

1. Choose a ball stud clip based on the mounting hole diameter, pull-out tension, material, and finish from pages 12 and 13. **All clips fit all ball studs.** Pull-out tension varies according to the clip material thickness.
2. Select a ball stud type from the installation styles below. Go to the appropriate page and choose a ball stud based on length, material and finish. Vary ball stud length to accommodate Sheet 1 thickness.

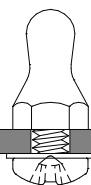


BS10
Male Thread



Page 2

BS11
Female Thread



Page 4

BS12
Self-Clinching



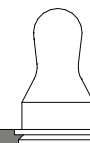
Page 6

BS13
Flare/Swage-In



Page 8

BS14
Concealed Head



Page 10



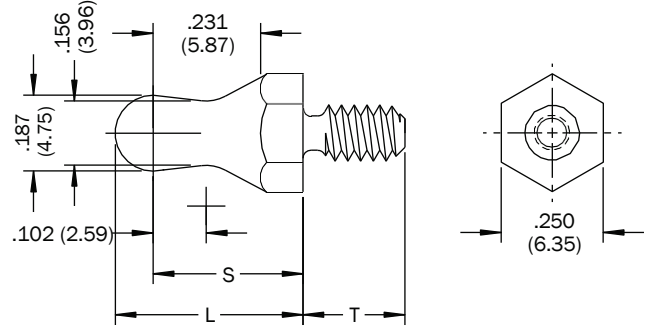
BS10

Male Thread Ball Studs

PART DESCRIPTION EXAMPLE

BS10 — 473 — 8 — STL — Z

Length Code Thread Length Code Material Code Finish Code



Example above for 6-32 unified thread. For M3.5 metric thread use series code BS10M.

(All dimensions in inches (millimeters))

GENERAL

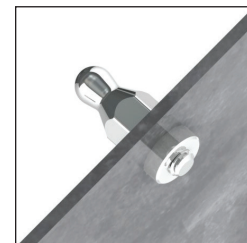
All dimensions in inches

INCH	Thread	Series	Sheet 1 Thickness	Length Code	L ±.010	S ±.005
	6-32 UNC-2A	BS10	.025-.051	421	.421	.328
.052-.078			447	.447	.354	
.079-.105			473	.473	.380	
.106-.132			499	.499	.406	
.133-.159			525	.525	.432	
.160-.187			551	.551	.458	
.177-.203			570	.570	.477	
.230-.256			625	.625	.532	



All dimensions in millimeters

METRIC	Thread	Series	Sheet 1 Thickness	Length Code	L ±0.25	S ±0.13
	M3.5 x 0.6 6g	BS10M	0.64-1.30	1069	10.69	8.33
1.31-1.98			1135	11.35	8.99	
1.99-2.67			1201	12.01	9.65	
2.68-3.35			1267	12.67	10.31	
3.36-4.04			1334	13.34	10.97	
4.05-4.75			1400	14.00	11.63	
4.50-5.16			1448	14.48	12.12	
5.84-6.50			1588	15.88	13.51	



PENCOM carries a wide assortment of standard and self-clinching nut and washer assemblies and components. Contact a PENCOM Account Manager for recommendations and more information.

BS10 Male Thread Ball Studs

(1) Refer to page 1 for sheet description.

THREAD LENGTH

INCH	Thread Length Code	T +.010 -.000
	5	.156
	6	.187
	7	.218
	8	.250
	10	.312
	12	.375
	14	.437
	16	.500
	18	.562
	20	.625
22	.687	

All dimensions in inches

METRIC	Thread Length Code	T +0.25 -0.00
	400	4.00
	500	5.00
	600	6.00
	750	7.50
	900	9.00
	1050	10.50
	1200	12.00
	1350	13.50
	1500	15.00
	1650	16.50
1800	18.00	

All dimensions in millimeters



A variety of thread locking and lubricating materials can be applied to the threads. Nylon (shown), micro-encapsulated epoxy and other locking elements prevent loosening due to vibration. Lubricating coatings reduce friction, heat buildup and galling during installation of mating fasteners. To specify a nylon locking element, insert PATCH at the end of the part description. Other locking and lubricating materials available by request.

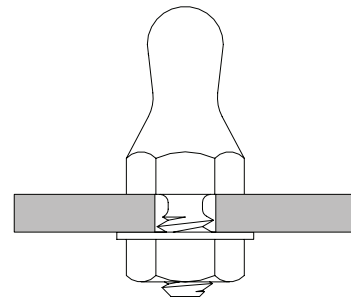
Ex: BS10-473-8-STL-Z-PATCH

MATERIAL & FINISH

Material Code	Material Description	Finish Code	Finish Description
STL	Carbon Steel	Z	Zinc SC1 with Type III Clear Chromate per ASTM B633
SS	300-Series Stainless Steel	P	Passivated and/or Tested per ASTM A967

INSTALLATION

1. Punch or drill hole in sheet. Insert the ball stud male thread through hole in sheet and secure with female threaded fastener. In some applications it may be desirable to install a washer between the female threaded fastener and sheet.
2. Tighten the assembly by torquing the female threaded fastener 5.8 to 7.9 in-lbs (6-32) or 0.53 to 0.72 N-m (M3.5). PENCOM recommends a minimum thread engagement of .138 in (6-32) or 3.5 mm (M3.5) between the male and female threads. Installation torques are for zinc-plated carbon steel ball studs and nuts, and for reference only. PENCOM recommends testing in the application.
3. Due to the inelastic nature and unpredictable friction coefficients of stainless steel, torque calculations for this material can be unreliable. One method of determining the installation torque uses 50% of the failure torque as developed through testing in the application and applying a ±20% tolerance.



BS10 Male Thread Ball Studs



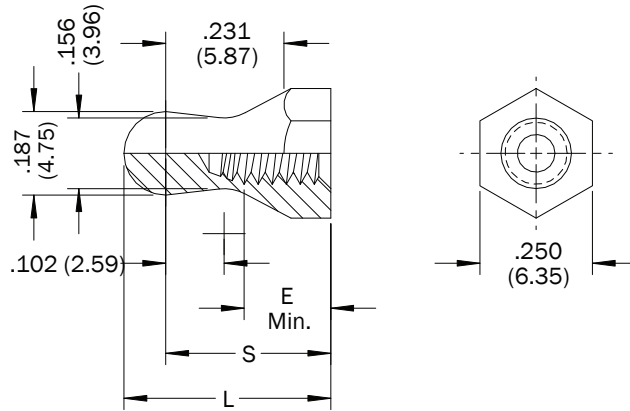
BS11

Female Thread Ball Studs

PART DESCRIPTION EXAMPLE

BS11 — 473 — STL — Z

| Length Code | Material Code | Finish Code



(All dimensions in inches (millimeters))

Example above for 6-32 unified thread. For M3.5 metric thread use series code BS11M.

GENERAL

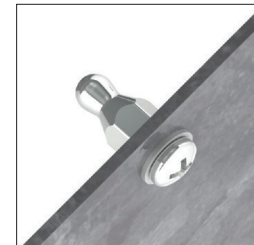
All dimensions in inches

INCH	Thread	Series	Sheet 1 Thickness	Length Code	L ±.010	S ±.005	E Min. Full Thread
	6-32 UNC-2B	BS11	.025-.051	421	.421	.328	.115
.052-.078			447	.447	.354	.141	
.079-.105			473	.473	.380	.167	
.106-.132			499	.499	.406	.193	
.133-.159			525	.525	.432	.219	
.160-.187			551	.551	.458	.245	
.177-.203			570	.570	.477	.264	
.230-.256			625	.625	.532	.319	



All dimensions in millimeters

METRIC	Thread	Series	Sheet 1 Thickness	Length Code	L ±0.25	S ±0.13	E Min. Full Thread
	M3.5 x 0.6 6H	BS11M	0.64-1.30	1069	10.69	8.33	2.92
1.31-1.98			1135	11.35	8.99	3.58	
1.99-2.67			1201	12.01	9.65	4.24	
2.68-3.35			1267	12.67	10.31	4.90	
3.36-4.04			1334	13.34	10.97	5.56	
4.05-4.75			1400	14.00	11.63	6.22	
4.50-5.16			1448	14.48	12.12	6.71	
5.84-6.50			1588	15.58	13.51	8.10	



PENCOM carries a wide assortment of screw and washer assemblies and components. Contact a PENCOM Account Manager for recommendations and more information.

BS11 Female Thread Ball Studs

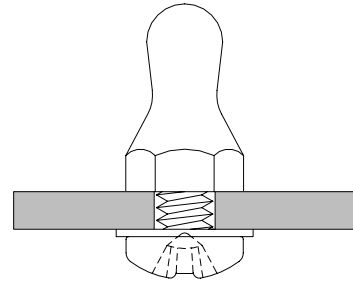
(1) Refer to page 1 for sheet description.

MATERIAL & FINISH

Material Code	Material Description	Finish Code	Finish Description
STL	Carbon Steel	Z	Zinc SC1 with Type III Clear Chromate per ASTM B633
SS	300-Series Stainless Steel	P	Passivated and/or Tested per ASTM A967

INSTALLATION

1. Punch or drill hole in sheet. Insert a male thread fastener through hole in the sheet and secure the ball stud. In some applications it may be desirable to install a washer between the head of the male threaded fastener and sheet.
2. Tighten the assembly by torquing the male threaded fastener 7 to 10 in-lbs (6-32) or 0.8 to 1.1 N-m (M3.5). PENCOM recommends a minimum thread engagement of .138 in (6-32) or 3.5 mm (M3.5) between the male and female threads. Installation torques are for zinc-plated Grade 2 (inch) or Class 4.8 (metric) carbon steel screws and for reference only. PENCOM recommends testing in the application.
3. Due to the inelastic nature and unpredictable friction coefficients of stainless steel, torque calculations for this material can be unreliable. One method of determining the installation torque uses 50% of the failure torque as developed through testing in the application and applying a $\pm 20\%$ tolerance.



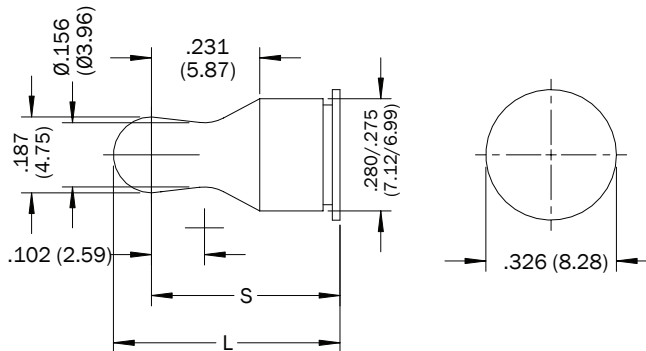


BS12

Self-Clinching Ball Studs

PART DESCRIPTION EXAMPLE

BS12 — 466 — STL — Z
 Length Code Material Code Finish Code

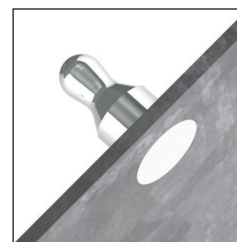


(All dimensions in inches (millimeters))

GENERAL

All dimensions in inches (millimeters)

Sheet 1 Thickness	Sheet 2 Thickness	Length Code	L ±.010 (±0.25)	S ±.005 (±0.13)
.025-.051 (0.64-1.30)	.040-.049 (1.02-1.25)	466	.466 (11.84)	.373 (9.47)
	.050-.059 (1.27-1.50)	476	.476 (12.09)	.383 (9.73)
.052-.078 (1.31-1.98)	.040-.049 (1.02-1.25)	492	.492 (12.50)	.399 (10.13)
	.050-.059 (1.27-1.50)	502	.502 (12.75)	.409 (10.39)
.079-.105 (1.99-2.67)	.040-.049 (1.02-1.25)	518	.518 (13.16)	.425 (10.80)
	.050-.059 (1.27-1.50)	528	.528 (13.41)	.435 (11.05)
.106-.132 (2.68-3.35)	.040-.049 (1.02-1.25)	544	.544 (13.82)	.451 (11.46)
	.050-.059 (1.27-1.50)	554	.554 (14.07)	.461 (11.71)
.133-.159 (3.36-4.04)	.040-.049 (1.02-1.25)	570	.570 (14.48)	.477 (12.12)
	.050-.059 (1.27-1.50)	580	.580 (14.73)	.487 (12.37)
.160-.187 (4.05-4.75)	.040-.049 (1.02-1.25)	596	.596 (15.14)	.503 (12.78)
	.050-.059 (1.27-1.50)	606	.606 (15.39)	.513 (13.03)
.177-.203 (4.50-5.16)	.040-.049 (1.02-1.25)	615	.615 (15.62)	.522 (13.26)
	.050-.059 (1.27-1.50)	625	.625 (15.88)	.532 (13.51)
.230-.256 (5.84-6.50)	.040-.049 (1.02-1.25)	670	.670 (17.02)	.577 (14.66)
	.050-.059 (1.27-1.50)	680	.680 (17.27)	.587 (14.91)



BS12 Self-Clinching Ball Studs provide a permanent and reliable installation that creates a flush appearance on the back side of aluminum, carbon steel and stainless steel sheets.

BS12 Self-Clinching Ball Studs

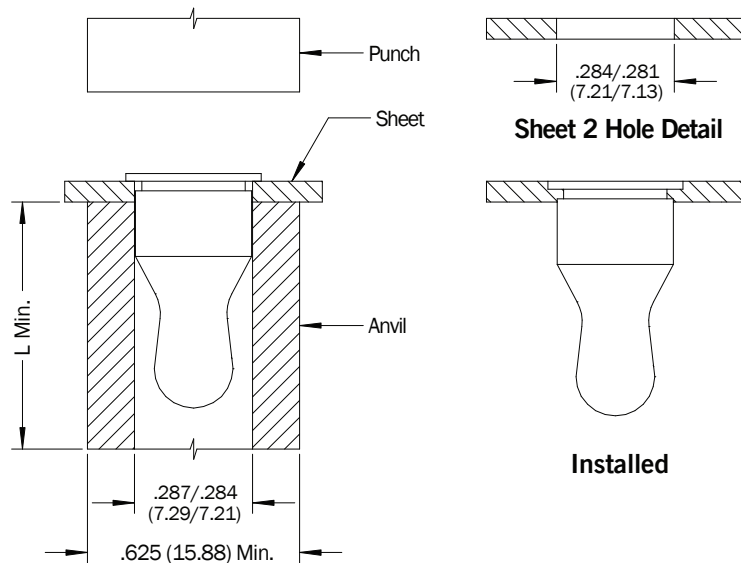
(1) Refer to page 1 for sheet descriptions. Ball studs mount in sheet 2.

MATERIAL & FINISH

Material Code	Material Description	Finish Code	Finish Description	For Use in Sheet Hardness		
				HRB 70 Max.	HRB 80 Max.	HRB 88 Max.
STL	Heat Treated Carbon Steel	Z	Zinc SC1 with Type III Clear Chromate per ASTM B633		•	
SS	300-Series Stainless Steel	P	Passivated and/or Tested per ASTM A967	•		
S4	Heat Treated Stainless Steel	P	Passivated and/or Tested per ASTM A967			•

INSTALLATION

1. Prepare hole in sheet a minimum distance of .37" (9.4mm) from the hole center to edge of sheet. Do not deburr edges.
2. Insert the ball stud through hole in punch side of sheet and into the anvil as shown.
3. Squeeze the sheet and ball stud head between parallel anvil and punch surfaces. Use only enough pressure to seat the ball stud flange flush with the sheet. Anvil and punch should be made from hardened tool steel, or may be ordered using PENCOM p/n's TL1366 (anvil) and TL1695 (punch).



(All dimensions in inches (millimeters))

PERFORMANCE

Ball Stud Material Code	Test Sheet Material					
	5052-H32 Aluminum		1008 Carbon Steel HRB 60		304 Stainless Steel HRB 70	
	Installation lbs (kN)	Push-out lbs (N)	Installation lbs (kN)	Push-out lbs (N)	Installation lbs (kN)	Push-out lbs (N)
STL	1700-2000 (7.6-8.9)	230 (1023)	3600-4400 (16.0-19.6)	360 (1601)	(2)	(2)
SS	1700-2000 (7.6-8.9)	230 (1023)	3600-4400 (16.0-19.6)	360 (1601)	(2)	(2)
S4	—	—	—	—	5900-7200 (26.2-32.0)	470 (2090)

(1) Performance data represents the average destructive result when all installation specifications are strictly followed. Variations in sheet hole size, thickness, material and installation methods will affect the loads. PENCOM strongly encourages testing in the application.

(2) Not recommended.



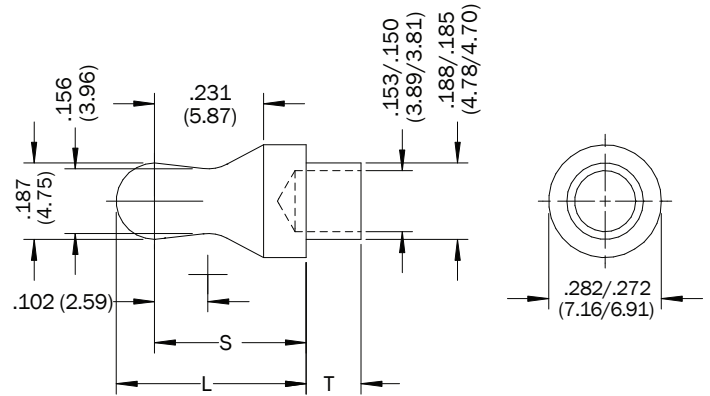
BS13

Flare/Swage-In Ball Studs

PART DESCRIPTION EXAMPLE

BS13 — 473 — B — SS — P

Length Code Shank Length Code Material Code Finish Code



(All dimensions in inches (millimeters))

GENERAL

All dimensions in inches (millimeters)

Sheet 1 Thickness	Length Code	L ±.010 (±0.25)	S ±.005 (±0.13)	Anvil	
				A ±.005 (±0.13)	Part Number
.025-.051 (0.64-1.30)	421	.421 (10.69)	.328 (8.33)	.313 (7.95)	TL1854
.052-.078 (1.31-1.98)	447	.447 (11.35)	.354 (8.99)	.339 (8.61)	TL1855
.079-.105 (1.99-2.67)	473	.473 (12.01)	.380 (9.65)	.365 (9.27)	TL1856
.106-.132 (2.68-3.35)	499	.499 (12.67)	.406 (10.31)	.391 (9.93)	TL1857
.133-.159 (3.36-4.04)	525	.525 (13.34)	.432 (10.97)	.417 (10.59)	TL1858
.160-.187 (4.05-4.75)	551	.551 (14.00)	.458 (11.63)	.443 (11.25)	TL1859
.177-.203 (4.50-5.16)	570	.570 (14.48)	.477 (12.12)	.462 (11.73)	TL1860
.230-.256 (5.84-6.50)	625	.625 (15.88)	.532 (13.51)	.517 (13.13)	TL1861

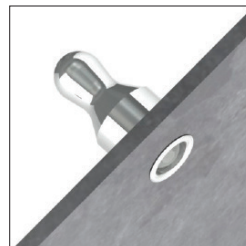
(1) Refer to page 1 for sheet description.



SHANK LENGTH

All dimensions in inches (millimeters)

Sheet 2 Thickness		Shank Length Code	T ±.003 (±0.08)	Sheet B
Flare-In Min.	Swage-In			
.095 (2.41)	.031 (0.79)	A	.075 (1.91)	.015 (0.38)
.125 (3.18)	.062 (1.59)	B	.105 (2.67)	.035 (0.89)
.155 (3.94)	.094 (2.38)	C	.135 (3.43)	.065 (1.65)
.185 (4.70)	.125 (3.18)	D	.165 (4.19)	.095 (2.41)
.250 (6.35)	.187 (4.76)	E	.230 (5.84)	.160 (4.06)
.310 (7.87)	.250 (6.35)	F	.290 (7.37)	.220 (5.59)



BS13 Ball studs can be flared or swaged-in and are popular choices for painted sheets and close-to-edge applications (swaged installation shown).

(1) Refer to page 1 for sheet description.

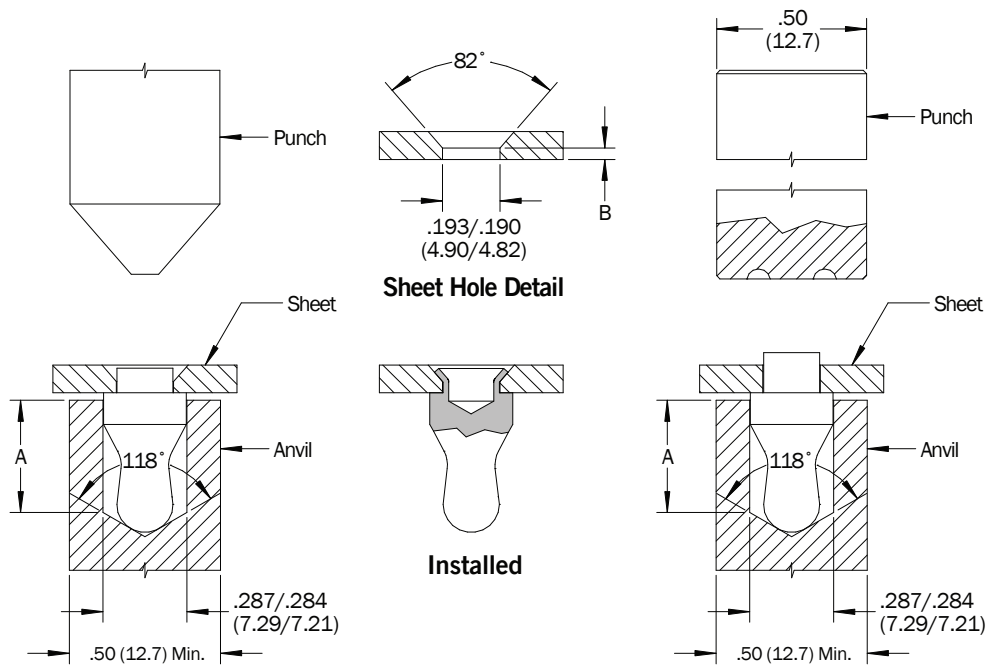
BS13 Flare/Swage-In Ball Studs

MATERIAL & FINISH

Material Code	Material Description	Finish Code	Finish Description
SS	300-Series Stainless Steel	P	Passivated and/or Tested per ASTM A967

FLARE-IN INSTALLATION

1. Prepare the sheet as shown for flare-in installation.
2. Insert the ball stud into recessed anvil and place sheet hole over ball stud shank.
3. Squeeze the ball stud between parallel and concentric anvil and punch. Flare the ball stud shank into the sheet countersink using light pressure. Punch flare angle should match the sheet hole countersink angle. Anvil and punch should be made from hardened steel.



Flare-In Installation

Swage-In Installation

(All dimensions in inches (millimeters))

SWAGE-IN INSTALLATION

1. Prepare the sheet as shown for swage-in installation.
2. Insert the ball stud into recessed anvil and place sheet hole over ball stud shank.
3. Squeeze the ball stud between parallel and concentric anvil and punch. Swage the ball stud shank using light pressure. Anvil and punch should be made from hardened tool steel, or may be ordered using PENCOM p/n's shown on page 8 (anvil) and TL1197 (punch).

BS13 Flare/Swage-In Ball Studs



BS14

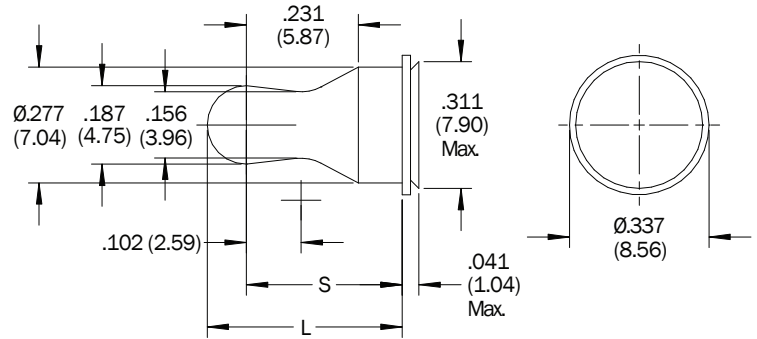
Self-Clinching Concealed-Head Ball Studs

PART DESCRIPTION EXAMPLE

BS14 — 473 — 041 — STL — Z

Length Code Material Code Finish Code

Patent Pending

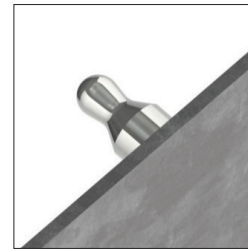


(All dimensions in inches (millimeters))

GENERAL

All dimensions in inches (millimeters)

Sheet 1 Thickness	Length Code	L ±.010 (±0.25)	S ±.005 (±0.13)
.025-.051 (0.64-1.30)	421	.421 (10.69)	.328 (8.33)
.052-.078 (1.31-1.98)	447	.447 (11.35)	.354 (8.99)
.079-.105 (1.99-2.67)	473	.473 (12.01)	.380 (9.65)
.106-.132 (2.68-3.35)	499	.499 (12.67)	.406 (10.31)
.133-.159 (3.36-4.04)	525	.525 (13.34)	.432 (10.97)
.160-.187 (4.05-4.75)	551	.551 (14.00)	.458 (11.63)
.177-.203 (4.50-5.16)	570	.570 (14.48)	.477 (12.12)
.230-.256 (5.84-6.50)	625	.625 (15.88)	.532 (13.51)



BS14 Self-Clinching Concealed-Head Ball Studs install permanently in aluminum or steel sheets and allow the back side to remain smooth and unblemished.

(1) Refer to page 1 for sheet description.

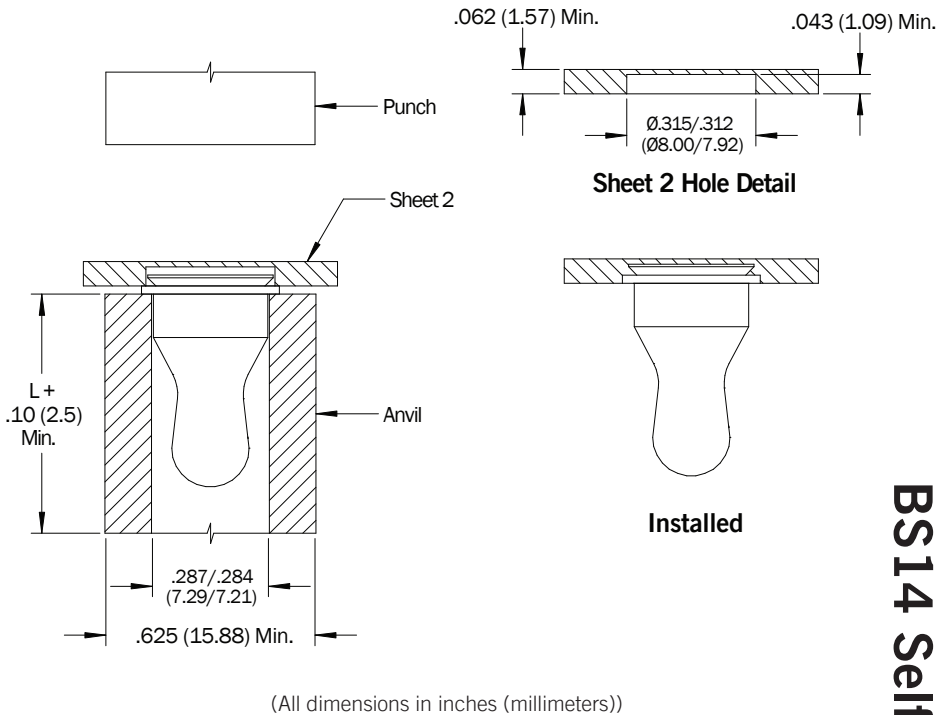
MATERIAL & FINISH

Material Code	Material Description	Finish Code	Finish Description	For Use in Sheet Hardness	
				HRB 70 Max.	HRB 80 Max.
STL	Heat Treated Carbon Steel	Z	Zinc SC1 with Type III Clear Chromate per ASTM B633		•
SS	300-Series Stainless Steel	P	Passivated and/or Testing per ASTM A967	•	

BS14 Self-Clinching Concealed-Head Ball Studs

INSTALLATION

1. Mill a blind hole at a depth of .043" (1.09mm) minimum in a .062" (1.57mm) minimum thickness sheet at a distance from hole center to edge of .250" (6.35mm) minimum.
2. Insert ball stud into the anvil and place sheet mounting hole over the ball stud shank.
3. Squeeze the sheet and ball stud between parallel anvil and punch surfaces using only enough pressure to seat the ball stud flange flush with the sheet. Punch and anvil should be made from hardened tool steel or may be ordered using part numbers TL1366 (anvil) and TL1695 (punch).
4. When blind holes are deeper than the minimum required ensure there is enough material remaining in the sheet particularly when sheet material is at, or near, minimum thickness.



PERFORMANCE

Test Sheet Material	
5052-H32 Aluminum	1008 Carbon Steel HRB 50
Installation lbs (kN)	
1200-1400 (5.3-6.2)	2300-2800 (10.2-12.5)

(1) Performance data represents the average result when all installation specifications are strictly followed. Variations in sheet hole size, thickness, material and installation method will affect the loads. PENCOM strongly encourages testing in the application.

BS14 Self-Clinching Concealed-Head Ball Studs



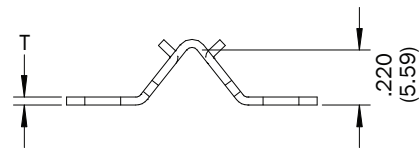
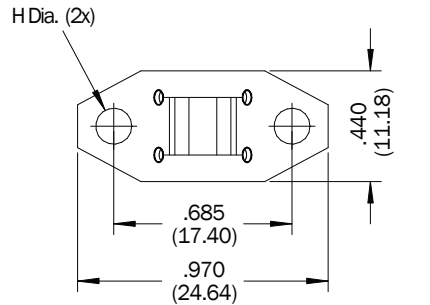
Ball Studs Clips

PART DESCRIPTION EXAMPLE

BSC — 135 — 017 — STL — Z

|
|
|
|
|

Hole Diameter Code Material Thickness Code Material Code Finish Code



(All dimensions in inches (millimeters))

GENERAL

All dimensions in inches (millimeters)

Hole Diameter Code	H Hole Diameter Nom.	Ball Stud Pull-out Tension lbs (N) ±30%	Material Thickness Code	T Material Thickness Nom.
105	.105 (2.67)	3.5 (15)	012	.012 (0.30)
		8.0 (35)	017	.017 (0.43)
		12.0 (53)	022	.022 (0.56)
		18.0 (80)	028	.028 (0.71)
		30.0 (133)	031	.031 (0.79)
135	.135 (3.43)	3.5 (15)	012	.012 (0.30)
		8.0 (35)	017	.017 (0.43)
		12.0 (53)	022	.022 (0.56)
		18.0 (80)	028	.028 (0.71)
		30.0 (133)	031	.031 (0.79)
145	.145 (3.68)	3.5 (15)	012	.012 (0.30)
		8.0 (35)	017	.017 (0.43)
		12.0 (53)	022	.022 (0.56)
		18.0 (80)	028	.028 (0.71)
		30.0 (133)	031	.031 (0.79)

MATERIAL & FINISH

Material Code	Material Description	Finish Code	Finish Description
STL	Heat Treated Carbon Steel	Z	Zinc SC1 with Type III Clear Chromate per ASTM B633
STL	Heat Treated Carbon Steel	OIL	Soluble Oil
STL	Heat Treated Carbon Steel	PHOS-OIL	Phosphate with Oil
SS	300-Series Stainless Steel	P	Passivated and/or Tested per ASTM A967

(1) Other finishes available by request.

INSTALLATION

1. Drill or punch clip mounting and ball stud clearance holes in sheet.
2. Rivet the ball stud clip onto the sheet with either plain or countersunk head rivets (plain rivet installation shown on left) or with threaded fasteners (shown on right).

