Alcoa Fastening Systems

ALCOA

LGP® Lockbolts

PROCESS MANUAL

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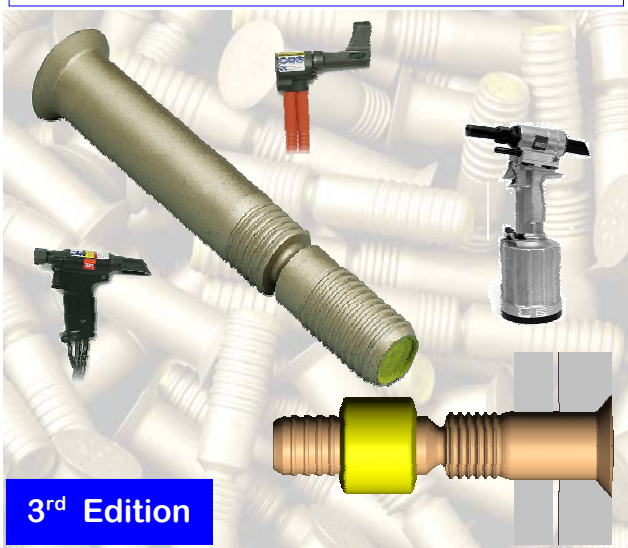


3rd Edition

The purpose of this manual is to provide general guidelines regarding the use of the LGP® Lockbolt fastening system. In the event of conflict between this manual and the user's company policies, the user should refer to his/her own company's policies.

Recommendations for Hole Preparation

- Drill sizes should be chosen to generate holes within the diameter ranges shown on drawings, installation specs or standards.
- Lockbolts are installed in a variety of hole diameters. Typically interference of .001" to .003" is used for Aluminum structure, slight clearance for Composite or Titanium structure.

Suggestions for hole preparation and installation practice:
Clean round holes within tolerance and with minimal burrs are fundamental for good joint durability. Below are a few suggestions which should help to achieve good installations:

- Clamping of the structure with temporary devices is very helpful in avoiding sheet separation, burrs/chips between the sheets and hole misalignment.
- Drills should be sharp. Optimized drill point geometry has surprising benefits for hole quality, productivity and minimizing operator fatigue.
- Drill speeds are critical to achieve hole quality and productivity, while minimizing operator fatigue.
    - Aluminum structure 4,000 to 6,000 RPM are recommended.
    - For stainless or titanium 300 to 1,000 RPM are recommended.
    - For Composite structure, carbide drills and c'sink cutters are recommended.
- Lubrication of drills is very helpful in reducing drill wear, burrs and effort. Each shop has its favorite drill lubes.
- Excessive "push" on the drill motor (dull drill) can create sheet separation, burrs and chips between the sheets and should be avoided.
- Hole normality is important. Angularity beyond 2° should be avoided.
- Countersink concentricity is critical. Generally, countersinks are normal to the structural surface. Angularity problems are caused by hole angularity beyond the 2° limit. Undersize countersink pilots are the most common cause of eccentricity problems and resulting cosmetics issues.

Recommendations for Hole Preparation

- A fillet relief radius is generally not required to provide head seating in Aluminum structure. The pull-in force generated during swaging typically seats flush or protruding heads properly.
- "Straightening-out" misaligned holes with a drill or reamer can cause "figure 8" holes and must be done with great caution.
- The trigger must be depressed until pin break indicates completion of the installation swage cycle.
- Worn and dirty installation tools can cause bad installations. Of particular importance are gripping jaws. Worn and dirty jaws may cause stripping of pull grooves and pin fracture in the pull groove area.

Installation Hints

- Correct collar lubrication is essential to the proper installation of Lockbolt fasteners. The swaging action that takes place during installation can only properly occur with correctly lubricated collars, and using a nose assembly having swaging anvil that is in good condition. The best practice is to order collars, which have been heat sealed in polyethylene bags, and to store them unopened away from heat. Heating the collars to a temperature in excess of 100°F may melt off the lubrication. The bags are capable of protecting the collar lubrication for at least several years under proper storage conditions. The bags should only be opened when the collars are about to be installed. Collars not protected by bagging and left exposed to heat, oil, oil mists, dust, or dirt may not swage properly.
- The collar lubricant generally applied to collars is "cetyl alcohol" which may appear as a whitish film or coating, and should never be removed. The application of other lubricants is not recommended, and is likely to lead to installation problems.

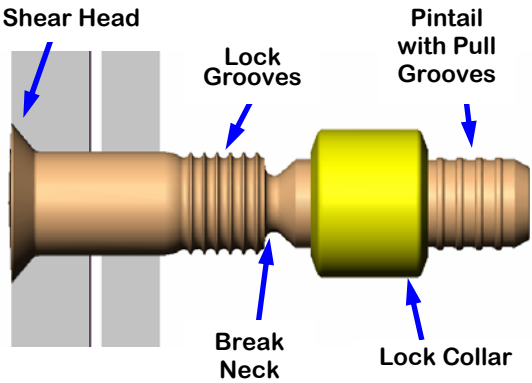
- The condition of the nose assembly anvil is equally important. The anvil swage cavity should be examined frequently for evidence of wear and buildup or transfer of collar material to the anvil. This examination is especially important if the swaged collars appear to have their coating being scrapped off, or if the swage gage rejects installations. The anvil cavity should have the appearance of a well polished surface. Any buildup of material that occurs should be removed using steel wool followed by wiping with a clean cloth or paper towel. If this cleaning does not restore the anvil cavity to a bright polished appearance galling or wear the anvil needs to be replaced. Frequently the first indication of anvil cavity wear is the eroding of a "ring" on the anvil cavity surface. The swaging anvil needs to be replaced with a new one when the wear starts to become severe. Anvil swaging cavities have highly engineered forms and dimensions which should not be altered by anything more than a "light" polish.

Basic Part Numbers

Lockbolt Pins			Mating Collars		
Product Description	**Manuf. P/Ns**	**Customer P/Ns**	**Product Description**	**Manuf. P/Ns**	**Customer P/Ns**
100° shear head Titanium, standard tolerance head	LGPL2SC-V	BACB30VM	Alu Collar	3SLC-C	BACC30BK
100° shear head Titanium, Precision tolerance head	LGPL18SCV	BACB30XT	Alu Collar	3SLC-C	BACC30BK
100° special head Titanium	LGPL4SC-V	ABS0548	Alu Collar	3SLC-C	ASNA2025
Protruding shear head	LGPL2SP-V	BACB30VN	Alu Collar	3SLC-C	BACC30BK
Protruding special head	LGPL4SP-V	ASNA2392	Alu Collar	3SLC-C	ASNA2025
100° flush head Titanium	LGPL8SC-V	BACB30WD	Ti Flange Collar	SLFC-MV	BACC30BN
130° shear head Titanium	LGPL9SC-V	BACB30WB	Ti Flange Collar	SLFC-MV	BACC30BN
Protruding large dia head	LGPL9SP-V	BACB30VY	Ti Flange Collar	SLFC-MV	BACC30BN

Notes: 1) The above part number team combinations are the basic types. Other configurations are used as shown on airframe assembly drawings.
2) LGPL indicates "Pull Type" Lockbolts.
3) LGPS indicates "Stump Type" Lockbolts intended for automated installation

Anatomy of LGPL Lockbolt



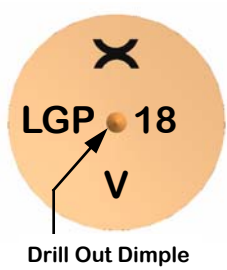
Identification Head Markings

Lockbolts carry the following identification head markings:

The special X as manufacturer's identification symbol.

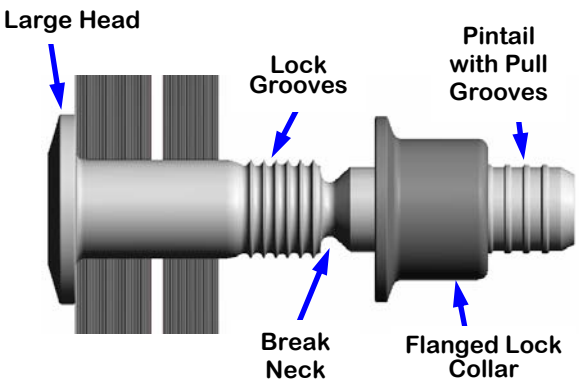
The basic part number.

The letter "V" to indicate Titanium alloy 6Al-4V.



Collars are identified with the special X symbol only.

Anatomy of the *HUCKCOMP®*



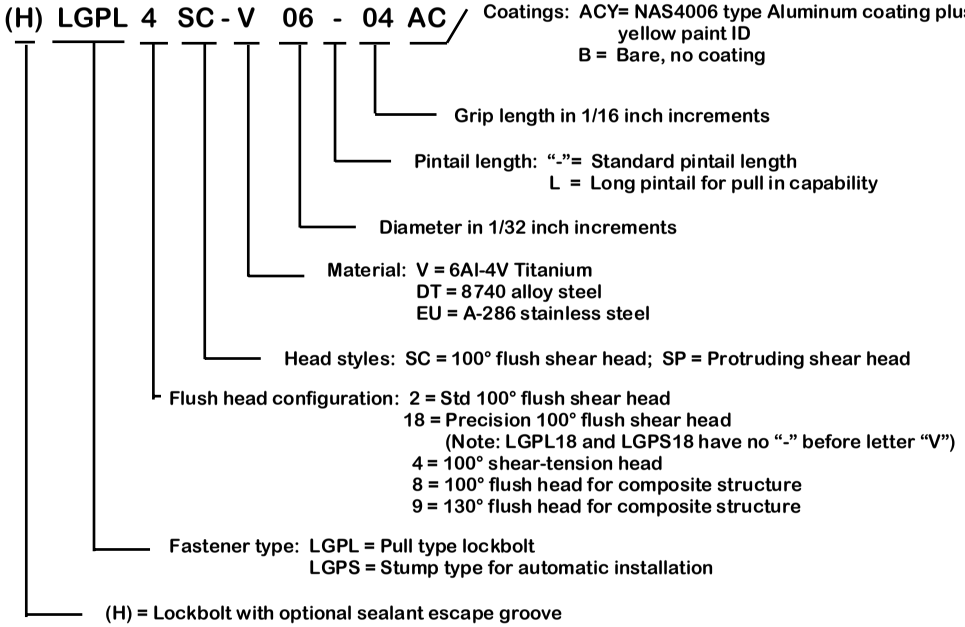
LGPL9SP & SLFC-MV

Recommended Hole Diameters

Nominal Fastener Dash	Nominal Fastener Diameter	Aluminum Structure	Steel, Titanium or Composite Structure
-05	.164	.161/.164	.164/.167
-06	.190	.187/.190	.190/.193
-08	.250	.247/.250	.250/.253
-10	.312	.309/.313	.313/.316
-12	.375	.371./375	.375/.378

Note: In Aluminum structure, .001 to .003" hole interference is beneficial to the durability of the structure. In addition, interference fit eases installation.

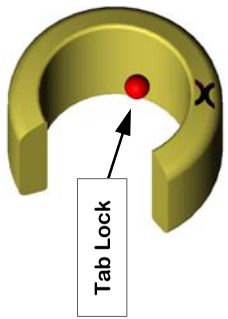
Part Number Logic (Pins)



Part Number Logic (Collars)

3 SLC - C 06 (SR) — Optional Tab Lock

- 06 — Diameter in 1/32 inch increments
- C — Material: C = 2024 Aluminum; EU = A-286 stainless steel; M = Monel
- SLC = Shear double ended light weight collar
- 3 = Double ended "symmetrical" sealing collar



3SLC-C06SR Lockbolt Collar with optional "Tab Lock"; Collar is symmetrical and does not need to be oriented. (Sectioned for illustration)

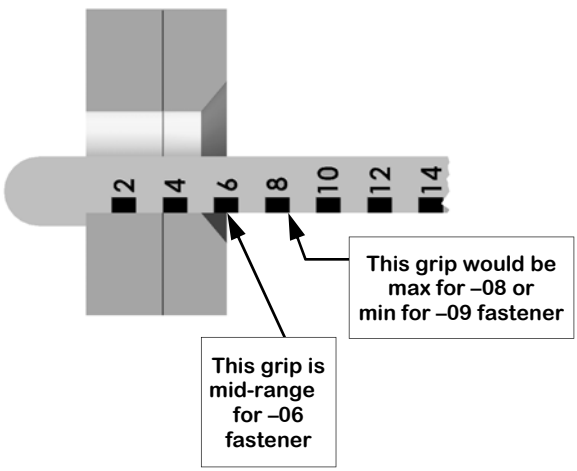
Recommended Grip Ranges

Nominal Fastener Grip Dash	Minimum permissible Grip "Underlap"	Grip Design Range		Maximum permissible Grip "Overlap"
		Min	Max	
-02	.047	**.063**	**.125**	.141
-03	.109	**.126**	**.188**	.203
-04	.172	**.189**	**.250**	.266
-05	.234	**.251**	**.313**	.328
-06	.297	**.314**	**.375**	.391
-07	.359	**.376**	**.438**	.453
-08	.422	**.439**	**.500**	.516
-09	.484	**.501**	**.563**	.578
-10	.547	**.564**	**.625**	.641
-11	.609	**.626**	**.688**	.703
-12	.672	**.689**	**.750**	.766

Notes: The system is intended to be used within the "Design Grip Range".
"Underlap" is the lowest permissible grip limit.
"Overlap" is the highest permissible grip limit.
Grips over -12 follow the same logic of grip limits.

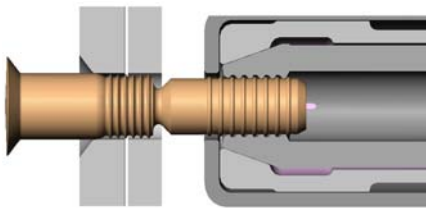
Grip Gauging

Basic LGP Grip Gauge #122666 or #118947

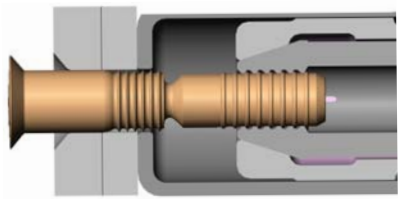


Pull-in Assembly Sequence

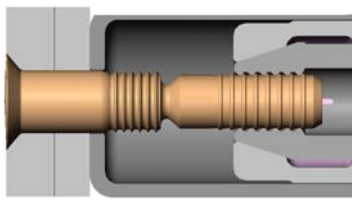
1) Tool engages pintail



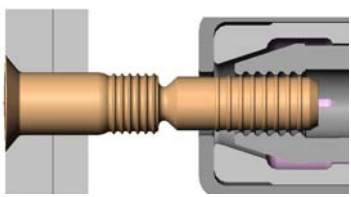
2) Bolt pulled in part way



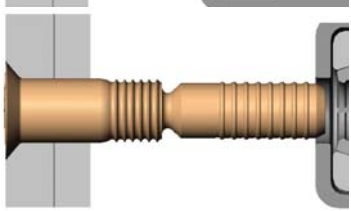
3) Bolt pulled in, head seated, gap closed



4) Self releasing chuck jaws open



5) Pull-in tool removed



Sealant Clean-up Recommendations

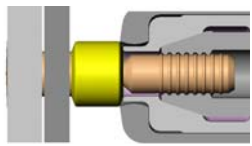
Excess sealant on the pintails contaminate installation tooling and should be wiped off prior to engaging the tool.

Excessive amounts of sealant on the lock grooves may interfere with proper collar swaging and should also be wiped off prior to assembling with the collar.

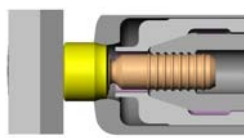
Small traces of sealant remaining in the bottom of the lock grooves after wiping do not affect swaging of the collar and need not be removed.

Swaging Assembly Sequence

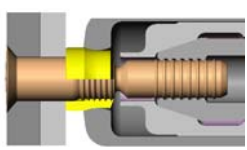
1) Engage lockbolt pintail with installation tool.



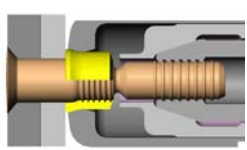
2) Gripper jaws engaged, gap closed, collar swage begins.



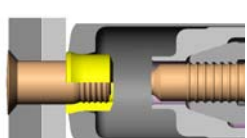
3) Swage process continues, collar material engages the lock grooves, lockbolt stretches and generates clamp-up.



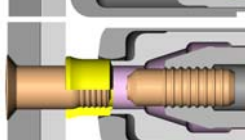
4) Swage process complete, collar material fully engages the lock grooves.



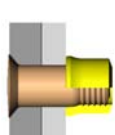
5) Pintail fractures at the break notch.



6) Tool reverses motion and strips the tool anvil off the swaged collar.

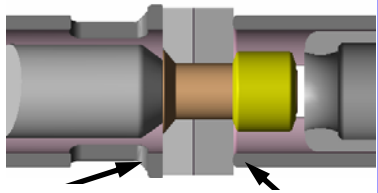


7) Installation complete. The entire operation is completed in 2 seconds or less.

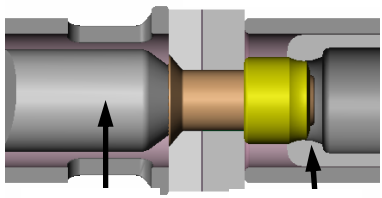


Stump Lockbolts - - - Automation

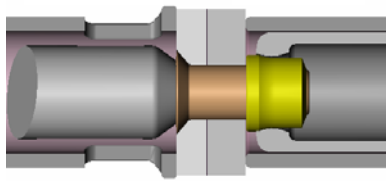
1) Structure clamped. Pin and collar in place



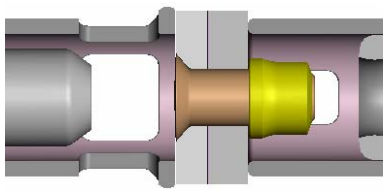
2) Swage begins



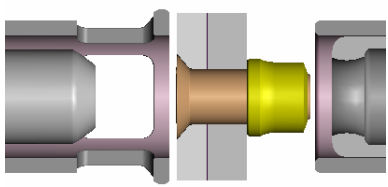
3) Swage complete



4) Swage die and bucking ram retract



5) Process complete, clamp retracts, machine repositions for the next fastener



Automation - - - In Line Tool

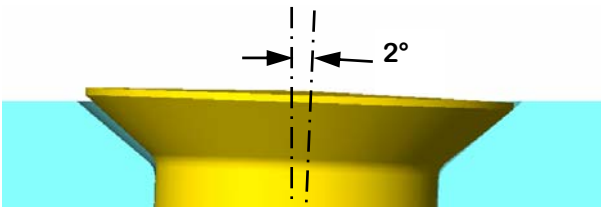
Automatic Feed and Swage Tool for Stump Lockbolts; In-Line Access

Automation - - - Off Set Tool

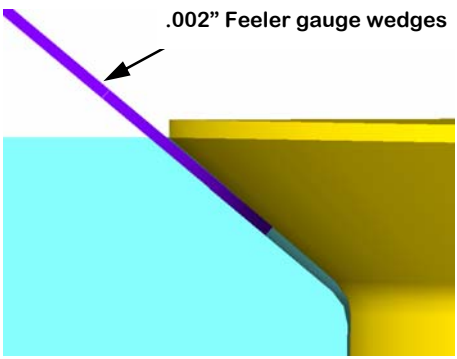
Automatic Feed and Swage Tool for Stump Lockbolts; Off-Set Access

Inspection & Tolerances

Countersink to hole concentricity and angularity are critical. A lockbolt can typically absorb up to 2° of angular misalignment.

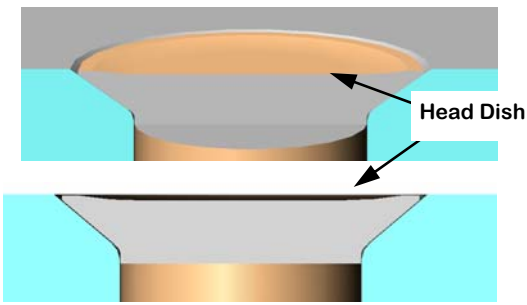


Ideally, the head should contact the countersink to prevent a .002" feeler gauge from entering. The limiting condition is that the feeler gage must wedge before contacting the shank of the fastener.



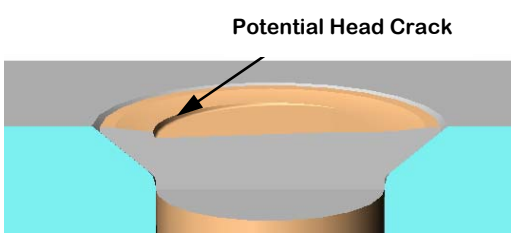
Inspection & Tolerances (Cont'd)

Small degrees of head dishing are common with shear head lockbolts and result from the high retained clamping force of the fasteners. Recommended safe limits for head dishing are shown below.



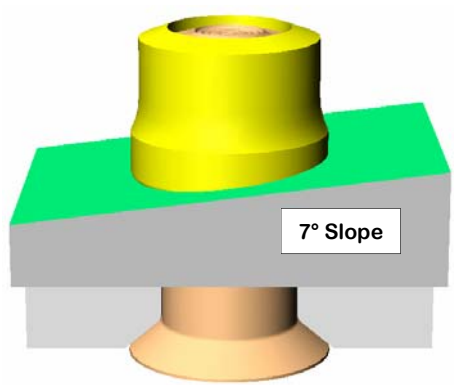
Diameter	Maximum Dish
Up to –06 Dia	.003"
-08 Dia and up	.004"

Figure below illustrates excessive head dishing with probability of head crack. This condition can result from overloading the fastener head during installation due to poor hole/countersink alignment.
Parts exhibiting this degree of head dishing/cracking should be removed and replaced.

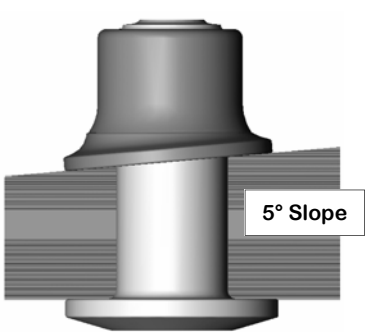


Slope Tolerance

The collar swaging process tends to flow the collar material to adapt to the contour of the structure. As a result, the system with the Aluminum collars can absorb slopes of up to 7° on the collar side.



The flanged Titanium collars can absorb slopes of up to 5° on the collar side.



Swage Gauge Verification

Min Grip Condition

Gauge prongs must contact lockbolt

Gauge contacting collar indicates incomplete swage

If gauge contacts structure surface, bolt is “out of grip”. Remove and replace with next longer bolt.

If gauge prongs contact lockbolt, bolt is “out of grip”. Remove and replace with next shorter bolt.

Gauge contacting collar indicates incomplete swage

Gauge must contact structure surface

LGPL18SCV08-06
& 3SLC-C08

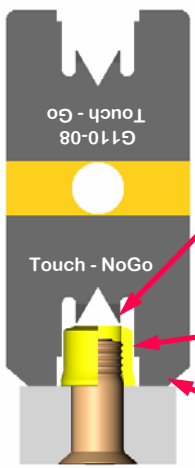
Swage Gauge Verification

Max Grip Condition

Gauge prongs must contact lockbolt

Gauge contacting collar indicates incomplete swage

If gauge contacts structure surface, bolt is “out of grip”. Remove and replace with next longer bolt.



If gauge prongs contact lockbolt, bolt is “out of grip”. Remove and replace with next shorter bolt.

Gauge contacting collar indicates incomplete swage

Gauge must contact structure surface

LGPL18SCV08-06 & 3SLC-C08

Swage Gauge Verification

Min Grip Condition

Gauge prongs must contact lockbolt

Gauge contacting collar indicates incomplete swage

If gauge contacts structure surface, bolt is "out of grip". Remove and replace with next longer bolt.

If gauge prongs contact lockbolt, bolt is "out of grip". Remove and replace with next shorter bolt.

Gauge contacting collar indicates incomplete swage

Gauge must contact structure surface

LGPL9SP-V08B06 & SLFC-MV08

Swage Gauge Verification

Max Grip Condition

Gauge prongs must contact lockbolt

Gauge contacting collar indicates incomplete swage

If gauge contacts structure surface, bolt is “out of grip”. Remove and replace with next longer bolt.

If gauge prongs contact lockbolt, bolt is “out of grip”. Remove and replace with next shorter bolt.

Gauge contacting collar indicates incomplete swage

Gauge must contact structure surface

LGPL9SP-V08B06 & SLFC-MV08

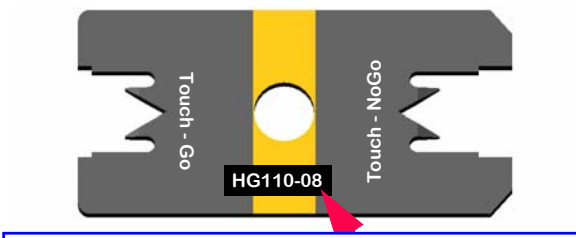
Swage Gauge Reference Matrix

Pull Type LGPL Lockbolts

Pull Type Pin P/N	Mating Collar P/N	Swage Gauge P/N
LGPL2SC-V	3SLC-C	HG 110
LGPL2SP-V	3SLC-C	HG 110
LGPL18SC-V	3SLC-C	HG 110
LGPL4SCV	3SLC-C	HG 110
LGPL4SPV	3SLC-C	HG 110
LGPL4SCV	SLC-M	HG 137
LGPL4SPV	SLC-M	HG 137
LGPL8SC-V	SLFC-MV	HG 118
LGPL9SC-V	SLFC-MV	HG 118
LGPL9SP-V	SLFC-MV	HG 118

Stump Type LGPS Lockbolts

Stump Type Pin P/N	Mating Collar P/N	Swage Gauge P/N
LGPS2SC-V	3SLC-C	HG 113
LGPS2SP-V	3SLC-C	HG 113
LGPS4SCV	3SLC-C	HG 113
LGPS4SPV	3SLC-C	HG 113
LGPS4SCV	SLC-M	HG 113
LGPS4SPV	SLC-M	HG 113
LGPS8SC-V	SLFC-MV	HG 119
LGPS9SC-V	SLFC-MV	HG 119
LGPS9SP-V	SLFC-MV	HG 119



Note: Gauges are diameter specific.
Each fastener diameter has its own specific gauge.

Installation Tooling — Shop Air

Model 244 Pneudraulic Tool

Weight without nose 5.7 lbs
Up to 1/4" Lockbolts
30 strokes per minute

Dia	Pull-In (*) In Line Nose	Swage In Line Nose
-5	99-1825	99-2501
-6	99-1826	99-2507
-8	99-1827	99-2513
-10	99-1831	99-2519
-12	99-1832	99-2522

-10 & -12 Dia require Model 246 Tool

(*) Caution:
Pull–In tool requires reduced air pressure to avoid pin break!
Contact (800) 278-4825 for factory preset regulators 120210-X

Model 244 OS Pneudraulic Tool

Weight without nose 5.7 lbs
Up to 1/4" Lockbolts
30 strokes per minute

Dia	Pull-In (*) Off-Set Nose	Swage Off-Set Nose
-5	99-1833	99-3700
-6	99-1834	99-3701
-8	99-1835	99-3702
-10	99-1836	99-1719
-12	99-1837	99-1754

-10 & -12 Dia require Model 246 Tool

Note: The tools and nose attachments shown on this page are only the most basic styles. For other available configurations refer to www.alcoafasteners.com.

Installation Tooling — Hydraulic

Models 2480, 2502, and 2580 Hydraulic Tools

2480 Weight 2.2 lbs
Up to –8 dia Lockbolts

2502 Weight 4.5 lbs
Up to –12 dia Lockbolts

Fastener Dia	Tool	In Line Nose
-5	2480	99-2501
-6	2480	99-2507
-8	2480	99-2513
-10	2502	99-2519
-12	2502	99-2522

Model 206-375

Weight without nose 3.4 lbs
Up to –8 dia Lockbolts

Fastener Dia	Off-Set Nose
-5	99-3700
-6	99-3701
-8	99-3702
-10	99-1719
-12	99-1754

-10 & -12 dia require Model 208-625 Tool

Note: The tools and nose attachments shown on this page are only the most basic styles. For other available configurations, refer to www.alcoafasteners.com.

Hydraulic Power Pack

Model 940 Hydraulic Power Pack

115V or 220V
5,000 PSI
8,400 PSI max.
1.5 gallons of hydraulic fluid capacity

Note: For additional types of Installation and Removal Tooling or for Hydraulic Power Sources, please refer to www.alcoafasteners.com.

Problem	Possible Cause	Remedy
Swage Gauge rejects installation	Bolt is out of grip or swage is incomplete	Refer to pages 19 - 22
Collar partially swaged	Installation tool anvil worn causing galling	Replace tool anvil
	Poor lube on collar causing galling	Replace with lubed collars
	Fastener out of grip	Measure grip and select proper fastener
Bolt head not seated	Hole not square to surface	Prepare holes within 2° hole angularity limit
	Hole undersize	Check hole diameter to drawing requirement
	Shallow countersink	Measure and correct countersink depth
Pintail stripping	Pintail partially engaged	Assure sufficient pintail is protruding for proper tool engagement
	Gripping jaws worn	Replace gripping jaws in tool
	Gripping jaws contaminated with sealant, chips etc	Clean jaws and remove chips

Personal Notes

For Fastener and Installation Tooling Info
please visit www.alcoafasteners.com

Lockbolt Products and Installation Tools

are offered through authorized Distributors

Alcoa Fastening Systems

Aerospace Products
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Carson, CA.
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Installation Tools
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