

Salt Lake Climbers Alliance

Professional Anchor Replacement Initiative

saltlakeclimbers.org

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The technical graphics used in this handbook are available in the product and technical resources found at:

Dewalt.com

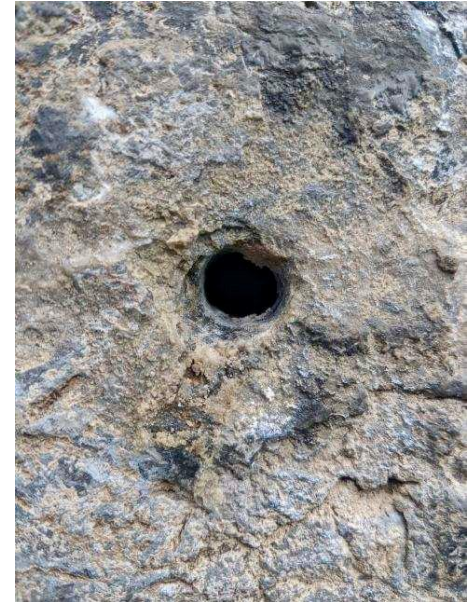
Hilti.com

ClimbTech.com

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Professional Anchor Replacement Initiative Anchor Replacement Handbook and Assessment



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The SLCA Anchor Replacement Initiative facilitates the responsible replacement of previously installed climbing anchors to preserve and conserve climbing resources that are cherished by its membership community.

The Initiative is limited in scope to **replacement of existing anchors**- aka '*hole for hole*' - whenever practicable- for the goal of resource conservation and sustainable recreation management.

The Initiative also seeks to inform new route developers with the [Best Practices](#), based on similar community standards for sustainable anchor installation.



QUALITY ASSURANCE

Climbing anchors are NOT intentionally load tested in place, or during installation, to avoid damaging the placement.

'Competency' - documented training, knowledge and assessment in the installation procedures, tools and materials - is the primary quality assurance for anchor installation.

For definitive guidance, refer to the respective anchor manufacturers' **Instructions For Use**.

The SLCA uses only **stainless steel** anchors & hardware, for maximum resistance to corrosion.

Expansion bolts are torqued to **manufacturer's specifications** on installation.

Epoxy adhesives are selected, stored, applied, cured, and documented according to **manufacturer's instructions**.



RESPONSIBILITIES

Workers performing anchor replacement or installation must:

- Prioritize the importance of quality control in anchor replacement.
- Participate in a pre-work meeting and review the Work Safety Plan with the team.
- Assemble and prepare all necessary equipment and materials prior to starting work.
- Correct or communicate any unsafe practices or conditions immediately.
- Adhere to training and procedures.
- Install anchors and equipment according to manufacturer's instructions, including material storage, handling and inventory management.
- Complete work records and document all anchor installations and materials used.
- Continuously educate and improve through updates in work practices, standards and equipment.

WORK PLANNING AND PREPARATION

1. [ANCHOR OBSERVATION FORM](#) is used to report anchor condition and site details.
2. [ANCHOR REPLACEMENT PROPOSAL](#) is used to confirm community input, assess the relative priority and potential scope of replacement work.
3. [WORK SAFETY PLAN](#) - written by Coordinator- surveys site and job hazards, and prescribes the specific tools and materials, fall protection systems and the work sequencing. It identifies a communication and rescue plan for the team, documents the materials used, and is signed by all workers.
4. [INCIDENT REPORT FORM](#) is used to document any/all incidents or near-misses. This includes any/all dropped objects on the work site.
5. [ANCHOR REPLACEMENT WORK LOG](#) summarizes the project from proposal to completion, and the estimated and actual costs of labor, anchors and materials used.
6. [WARI WEB REPORT](#): Coordinator completes and work is archived and posted publicly on the [SLCA website](#).

WORK (SAFETY) PLAN

The [Work Safety Plan](#) indicates work tasks and the fall protection systems to be used, and considers:

- Overall scope of work
- Route characteristics: Is the terrain steep enough to require directional anchors for work positioning?
- The priority of 'hole for hole' replacement
- Potential use of Removable Bolts as temporary directional anchors in a 'hole for hole' replacement sequence
- Minimizing transitions between adhesive installations
- Required time for adhesive anchors to cure before use
- Use of existing anchors as directionals to install new (co-located) anchors, and then abandon and patch. (i.e. NOT 'hole for hole')

The Work Safety Plan indicates a corresponding WORK SEQUENCE:

- Removal- top down
- Removal- bottom up
- Replacement/Installation- bottom up
- Replacement/Installation- top-down
- Removal & Replacement- (lead/follow on traverse)

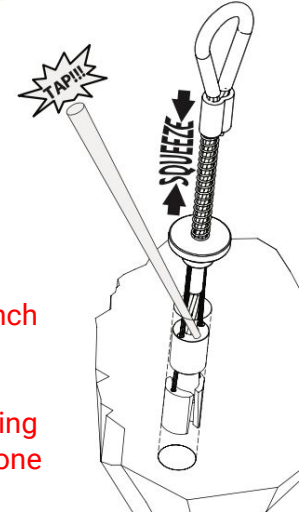
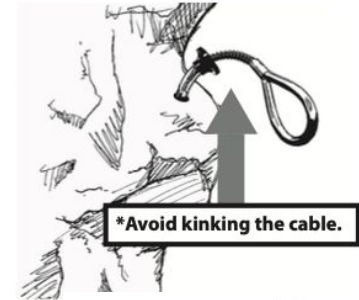
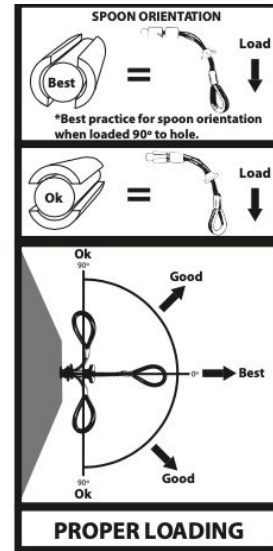
TOOL and MATERIAL HANDLING

- ❑ PPE for hand, eye, ear & respiratory protection (if warranted for stone dust, or infection control)
- ❑ Redundant Fall Protection systems for any/all drilling, cutting or grinding operations
- ❑ Bring the appropriate selection of tools and hardware for removal, patching and installation.
- ❑ All tools and materials in industrial work bags w/ continuous attachment to either haul rope, anchor or rope device for drop/loss prevention.
- ❑ Workers are issued an elastic tool lanyard with connector. All tools have dedicated lanyards or lanyard attachment point for drop/loss prevention.
- ❑ Adhesive installation kit includes latex gloves, putty knife, paper towels, sample and waste disposal bag(s).
- ❑ Adhesive handling includes proper storage, insulated transport and batch documentation.

The full SLCA Managed Inventory of Tools & Fall Protection Equipment, is available in the [shared GoogleDrive](#).

REMOVABLE BOLTS

Use removable bolts as temporary directional anchors in prepared, clean and dry, ½" holes. Be careful not to over place the wedges, or install too deep to remove.



*If anchor becomes stuck, insert a punch into the hole until it touches top of the cleaning bushing. Lightly tap with a hammer making sure the tool is touching the top of the cleaning bushing until cone disengages from spoons.

INSTALLATION TOOLS	APPLICATION
<i>Stainless Steel</i> climbing hammer	Install mechanical and adhesive anchors, general hammering
Plastic/hard rubber mallet	Non-corrosive install of SS adhesive anchors
Cordless rotary hammer drill (36V) w/ appropriate diameter bit(s)	Drilling or re-drilling holes, spinning wedge removal
Adhesive dispenser gun	Apply adhesive into holes
Pump blower	Clean dust & debris from holes
<u>Nylon</u> pipe brush (same diameter as hole and anchor)	Clean holes & debris, confirm accurate hole sizing
½" drive socket wrench w/corresponding diameter (½" and 9/16") sockets	Tighten mechanical bolts (w/ torque limiter) or shear off mechanical bolts
Perf A Torq - ½" drive preset torque limiter	Manufacturer spec = (20-25 ft/lbs for Powers sleeve bolt)

REMOVAL TOOLS	APPLICATION
Slide Puller (w/ threaded female draw stud connection)	Remove (spun) stud anchors or draw studs into sleeve or cone
Hurley threaded extractor Sizes = Jr., Sr, Burley	Remove (spun) stud anchors or draw studs into sleeve or cone
⅝ " Ratcheting wrench	Secure threaded connections and drive threaded extractors
Needle nose pliers (thin nose)	Extracting sleeve components
Needle nose pliers (locking)	Extracting sleeve components
Small adjustable wrench	Second wrench for connections, removing improvised anchors or field tightening existing anchors.
Metal punch / nail set	Extracting components and RBs, countersinking patch holes
SDS drive, female threaded stud spinner	Spinning and removing wedge anchors

DRILL BITS & CUTTING TOOLS	APPLICATION
SDS ½" diam. x 6" length (min.) stone/masonry drill bits	Drilling new or enlarged installation holes
Tap Wrench	Cutting threads in sleeves and cones for draw stud
Thread taps: 7/16 - 20, M9 x 1	Cutting threads ½" sleeve = 7/16, or ¾" sleeve = M9
Sleeve draw studs: 7/16 -20 for ½" sleeves, M9 for ¾" sleeves	Threaded into (tapped) sleeve for puller extraction
Cone draw studs: ¾ - 16 for ½" cones, 5/16 x 18 for ¾" cones	Screw into (intact) cone threads for puller extraction
Magnetic pen	Removing metallic shavings during & after thread cutting
Cordless angle grinder w/ metal cut-off wheel	Cut-off and removal of abandoned anchors

ADHESIVE MATERIALS	APPLICATION
Adhesive epoxy	Install new anchors (see 'installation' for selection)
Mixing applicator tips + screw cap	Replacement tips ensure consistent mixing
Putty knife	Clean excess epoxy during installation, hole patching
Thread locker ('LocTite')	Secure threads on stainless screw links
Latex or nitrile disposable gloves	Clean epoxy handling & application
Paper Towels	Clean epoxy handling & application
Trash Bags, Ziploc bags	Epoxy test samples, clean epoxy handling & application
Epoxy Putty or Gel	Hole patch & camouflage

ADHESIVE SELECTION

PRODUCT	STORAGE	INSTALL CONDITIONS
DeWalt Powers AC100+	- Dry, dark - 32 - 86° F - 18 months	Dry or wet 14 - 104° F Cartridge temp= 23-95°F Pre- warm cartridge > 68°F if surface <23°F * BEST ALL AROUND PERFORMANCE
DeWalt Powers AC200+	Dry, dark 41 - 90 °F 18 months	Dry or wet 14-104 °F Cartridge temp= 41-104° F Pre- warm cartridge >50° F if surface <23°F * EASIER HANDLING & FASTER CURE IN COLD TEMPERATURES.

AC 100+ GEL & CURE TIMES

REFERENCE TABLES FOR INSTALLATION



ADHESIVES

REFERENCE TABLES FOR INSTALLATION

Gel (working) Time and Curing Table

Temperature of Base Material		Gel (working) Time	Full Curing Time
°F	°C		
14	-10	90 minutes	24 hours
23	-5	90 minutes	14 hours
32	0	45 minutes	7 hours
41	5	25 minutes	2 hours
50	10	15 minutes	90 minutes
68	20	6 minutes	45 minutes
86	30	4 minutes	25 minutes
95	35	2 minutes	20 minutes
104	40	1.5 minutes	15 minutes

The gel (working) times listed for 32F to 95F are also applicable for the temperature of the adhesive and use of mixing nozzles during installation. For installations in base material temperatures between 14F and 23F (-10C and -5C) the cartridge temperature must be conditioned to between 68F and 95F (20C - 35 C).

AC 200+ GEL & CURE TIMES



REFERENCE INSTALLATION TABLES

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Gel (working) Time and Curing Table

Temperature of base material	Gel (working) time	Full curing time
14°F (-10°C) to 22°F (-6°C)	60 minutes	24 hours
23°F (-5°C) to 31°F (-1°C)	50 minutes	5 hours
32°F (0°C) to 40°F (4°C)	25 minutes	3.5 hours
41°F (5°C) to 49°F (9°C)	15 minutes	2 hours
50°F (10°C) to 58°F (14°C)	10 minutes	1 hour
59°F (15°C) to 67°F (19°C)	6 minutes	40 minutes
68°F (20°C) to 85°F (29°C)	3 minutes	30 minutes
86°F (30°C) to 104°F (40°C)	2 minutes	30 minutes








Linear interpolation for intermediate base material temperature is possible. Cartridge temperature must be between 41°F (5°C) and 104°F (40°C) when in use; except for installations in base material temperatures between 14°F and 23°F (-10°C and -5°C) the cartridge temperature must be conditioned to 50°F (10°C) minimum.


ADHESIVES

ADHESIVE SELECTION

PRODUCT	STORAGE	INSTALL CONDITIONS
Hilti HIT RE500 v3 *requires Hilti applicator gun	Dry, dark 41-77° F	Dry or wet 23-105°F *Only product that cures below 32°F *LONGEST HANDLING TIMES IN HIGH TEMPERATURES. SLOW CURE TIMES IN LOW TEMPERATURES.

Hilti HIT-RE 500 V3

					
	[°F]	[°C]	 t _{work}	 t _{cure, ini}	 t _{cure, full}
	23	-5	2 h	48 h	168 h
	32	0	2 h	24 h	36 h
	40	4	2 h	16 h	24 h
	50	10	1.5 h	12 h	16 h
	60	16	1 h	8 h	16 h
	72	22	25 min	4 h	6.5 h
	85	29	15 min	2.5 h	5 h
	95	35	12 min	2 h	4.5 h
	105	41	10 min	2 h	4 h

 ≥ +5 °C / 41 °F

   = 2x t_{cure}

ADHESIVE HANDLING

- ❑ Select appropriate adhesive for the conditions and work. Plan for adequate handling time and cure time before use.
- ❑ Confirm proper storage (or purchase new). Note the Batch Identification Number and Expiration Date in pre- Work Plan and post- Work Log.
- ❑ Insulate the cartridge from temperature extremes during transport and on-site. Note the application temperature in the pre-work Plan and post-work Log.
- ❑ Use the screw cap to secure the cartridge and remaining adhesive during extended work pauses.
- ❑ Use a new applicator tip as needed, and bring spares.
- ❑ Use a dedicated holster to handle dispenser during installation, and to collect any leaking or excess adhesive.
- ❑ Collect and save a 'test sample' of adhesive before each bolt installation. Monitor for correct curing.



REMOVAL OF WEDGE / STUD BOLTS



Wedge bolts, with a nut on a threaded stud through the hanger, may be difficult to remove but are attempted first in a 'hole for hole' replacement.

An SDS drive stud spinner can be used on the drill to spin the bolt and score the wedge in place, limiting it's expansion. An extractor can then be used to pull the stud.

PROCEDURES

1. Loosen the nut or bolt head, then lightly tap on the stud with hammer to disengage the wedge.
2. Remove the nut and hanger.
3. Install the threaded 'stud spinner' onto the stud.
4. Spin the stud with the drill (NO hammer) at high speed, while lightly pulling in & out on the stud.

5. Friction and heat will be generated. Use a small spray water bottle to cool the bit, create an abrasive slurry, and lubricate the hole.
6. Spin and score the stud until sufficient to hold the cone in place and minimize expansion.
7. An extractor (slide or threaded) is used to extract the stud.
8. The process may be repeated until successful, depending on the priority of 'hole for hole' replacement efforts.
9. If unable to extract, the anchor may be abandoned, countersunk and patched (see relevant section.)



REMOVAL OF EXPANSION SLEEVE BOLTS



Hex head sleeve bolts can be disassembled and individual components removed from the hole, or abandoned and patched.

Corrosion and wear may require cutting threads into the sleeve(s) to extract it with a puller.

If sleeve removal fails, use an old drill bit(s) to remove, and (if necessary, enlarge the hole) for an adhesive bolt installation.

PROCEDURES

1. Loosen the bolt head, tap lightly to release the cone from the sleeve. Remove the bolt.
2. Remove the sleeve with a punch and locking needle nose pliers- if possible.
3. If the sleeve is corroded or stuck, cut threads into the sleeve with the appropriate diameter tap.
4. Periodically remove thread cuttings with magnetic pen.

5. Insert and thread appropriate diameter draw stud into the sleeve. Extract with a slide or threaded puller.
6. Clean any debris left in the hole with magnet pen.
7. Insert and thread the (corresponding diameter) draw stud or threaded bolt into the cone, and extract it with a slide or threaded puller.
8. If cone removal fails- (carefully) use an old drill bit(s) to enlarge the hole (if appropriate) and remove the cone.
Note: This enlarged hole may be non-uniform, requiring replacement only with an adhesive anchor.



SLEEVE BOLTS- DRILL EXCAVATION & REMOVAL

If sleeve or damaged cone are not removable, and Project Proposal and specific characteristics indicate a community priority of 'hole for hole' replacement - a remaining solution is to excavate the steel components out of the hole, with the drill and an older (used) bit:

- This generates friction, heat and steel shavings, and care must be taken to cool the bit, and protect the rope system. There is potential hazard of breaking or binding a drill bit.
- Take care not to enlarge or deform the hole.
- Use a compatible, carbide tipped stone cutting bit to excavate an abandoned $\frac{3}{8}$ " sleeve or cone, and enlarge a hole to $\frac{1}{2}$ ".
- The hole diameter may be affected by drilling. *Replace excavated holes only with adhesive anchors.*
- Due to the hazards and inefficiency, attempt drill excavation (instead of abandonment & patching) only when specified in the Work Safety Plan, and a 'hole for hole' replacement is top priority.

REMOVAL OF ADHESIVE ANCHORS

Removal will be difficult if they are installed correctly.

If abandoned,, cut off with a hammer and grinder- one leg at a time. Remove remaining material to below rock surface, patch the hole and camouflage with a mixture of epoxy and native sand/rock dust material.

Current SLCA practices favor the use of adhesive anchors as a non-replaceable long-term (25-50 yr) installation. While removal methods exist, they require specialized, hardened equipment and are labor intensive. **Consider adhesive anchor installations to be permanent and non-replaceable, intended for 50+ years.**

Removal methods use a small diameter drill bit to excavate each side of the Wave Bolt. A large bar/lever can be used to loosen the placement, and a large threaded puller ('Burley') can be used to deform and then extract the bolt.



HOLE RE-USE ASSESSMENT

Replaced anchors must be reliable and intended for a **50 year lifespan**. Expansion bolts and (to a lesser extent) adhesive bolts rely on specific tolerances of hole diameter for correct and full-strength installation.

Assuming the rock quality is good, the quality of the hole has to be assessed if it can be reused with a sleeve anchor.



- ❑ What diameter is the hole?
- ❑ Is the hole damaged, misshapen or enlarged?
- ❑ Is the hole deep enough for the replacement anchor?
- ❑ How difficult was the existing anchor to remove? If hole is appropriate diameter, it will be difficult.
- ❑ Clean the hole repeatedly with the corresponding diameter ($\frac{1}{2}$ ") nylon pipe brush. It should be a snug fit.
- ❑ Alternating with brushing, blast the hole repeatedly with a blower to remove any debris.
- ❑ Confirm the diameter by installing a (*new*) drill bit by hand, rotating and checking for excessive play.
- ❑ A $\frac{3}{8}$ " diameter (or smaller) hole can be enlarged with a clean, straight $\frac{1}{2}$ " diameter hole and replaced with a new $\frac{1}{2}$ " sleeve or adhesive bolt.
- ❑ * The hole for a $\frac{1}{2}$ " diameter sleeve bolt replacement must be carefully evaluated before re-use with another $\frac{1}{2}$ " diameter sleeve bolt. **If in doubt of the quality of a re-used $\frac{1}{2}$ " hole, replace it with an adhesive anchor instead, or abandon and patch the hole.**

ANCHOR ABANDONMENT and PATCHING

If the removal fails, or will result in an unreliable hole, use one of several options to abandon and camouflage the hole:

- If the hole is deep enough, the bolt or sleeve may be driven below the surface of the rock and patched.
- OR- Break the head off the bolt by overtightening with a ratchet and/or breaker bar. Drill or hammer punch any remaining material to create a 'pocket' for the patch material.
- OR- hammer the bolt back and forth in small strikes, until it breaks. Do not hammer the bolt flat, which will then be harder to remove.
- OR- Use a cordless grinder and cutoff wheel to cut the bolt near the rock surface. Use a drill or punch to countersink for patching.

Broken grinder discs are hazardous! Consider a steel cutoff wheel. Take care not to crack a fiber wheel, and wear the industrial (PPE) helmet with full face guard and safety glasses for face protection.

PATCHING SUPPLIES

- ❑ 2 part epoxy patch putty
- ❑ small plastic bag of sand/rock dust from base of route
- ❑ rubber or work gloves
- ❑ putty knife or disposable plastic spoon
- ❑ paper towel

PREPARATION

Prior to work on rope, use a small ziploc bag to collect sand and native rock dust from the work site base area.

Use a two-part patch putty (in the tool kit) for incidental patches.

- Break off the desired amount.
- Twist and knead the inner and outer materials until the two colors mix into a uniform gray.
- Use a thumb spoon or putty knife to fill the hole at least ½" and then the blend patch onto the surrounding surface.
- Apply native stone dust and fragments to blend the surfaces.
- Let epoxy cure before touching.

NEW HOLE REPLACEMENT

If removal fails or the anchor is to be abandoned, locate an adjacent area suitable for anchor installation, and confirm the new installation is still within reach of a climber (in position on the route) and does not change the character of the climb. Consult community members for input if a high priority route.

Evaluate the potential install location:

- Look for cracks and weaknesses around the planned bolt location. Confirm it is not a block that may loosen.
- Tap hammer near proposed installation and surrounding area and listen for changes in sound.
- Confirm hanger will mount flush in correct orientation, all connectors will load properly, and rope will not be pinched.
- Feel for changes in rock density while drilling.
- Expansion bolts should tighten up with a few turns of wrench, without spinning or ejecting from the rock.
- Re-check the tightness of any adjacent bolts to confirm new holes have not created weaknesses in the area.
- Manufacturer's specification for spacing between sleeve bolts is **2x bolt length for full strength, in good stone.**

INSTALLATION OF SLEEVE BOLTS

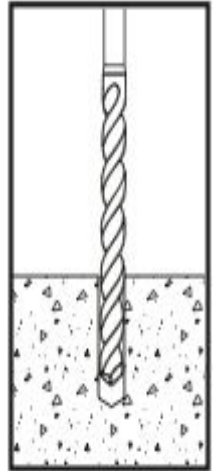


APPLICATION:

- Immediate use after install
- Medium length (2 ¾") for hard stone,
- Longer length (4 ¾") for softer stone
- (*semi ~*) removable / replaceable before corroded.

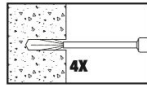
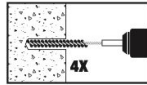
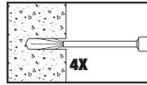
DRILLING

- ❑ Use PPE: eye, ear, hand & respiratory protection
- ❑ Confirm ½" diameter drill bit - new or lightly used
- ❑ For correct depth, mark drill bit at length of bolt + ½" (max)
- ❑ Support drill perpendicular to surface
- ❑ Drill the hole in continuous motion, stop periodically to remove and clean out debris, and to re-insert.
- ❑ Do not enlarge the hole with repeated insertion & removal while spinning.
- ❑ Stop drilling at marked depth.



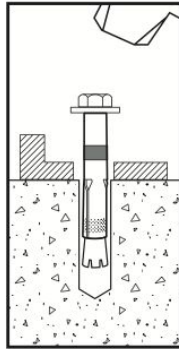
CLEANING

- ❑ Use blower to clean around and eject dust out of hole
- ❑ Insert and spin nylon pipe brush to clean the hole. Fit should be snug.
- ❑ Repeat blow & brush at least 4X and until hole is clean.



ASSEMBLY

- ❑ Pre-assembled with compatible stainless steel hanger and washer.
- ❑ Unscrew bolt slightly, so cone is not expanding the sleeve.
- ❑ Insert bolt assembly carefully in-line with the hole. Use a SS hammer or plastic/rubber mallet to tap into hole, preserving the hanger orientation.



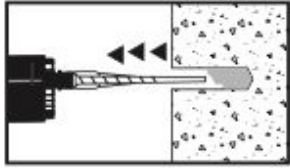
INSTALLATION

- ❑ Use **Stainless Steel hammer** or mallet to drive bolt to full depth, striking the bolt cleanly and straight in-line
- ❑ Orient hanger flush against rock surface, and in direction of loading. Stabilize the orientation while tightening.
- ❑ Tighten with ratchet and torque adapter, until Perf-a-Torq 'clicks' & releases at 20-25 ft lbs (Powers Bolt specification)
- ❑ Confirm bolt is engaging and not spinning, extruding or levering out of the hole.
- ❑ ***For quality control - sleeve anchors are ONLY installed and/or re-tightened with properly calibrated torque wrench.***
- ❑ Document torque and install in the Work Plan notes.

PROBLEMS

- ❑ If bolt will not tighten, cone or sleeve may be spinning in hole. Use funkness or extractor to engage cone expansion and then complete tightening. If unsuccessful, remove and discard bolt. Reassess hole and consider adhesive replacement, or another new sleeve anchor.
- ❑ Shallow holes are due to poor craftsmanship and require removal and redrilling.

INSTALLATION OF ADHESIVE ANCHORS

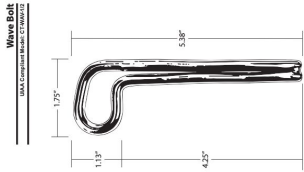


APPLICATION:

- All rock except softest sandstone
- Overhanging terrain
- Sport routes
- Corrosive environments
- Long-term but durable, minimalist

CONSIDERATIONS

- Installation very affected by temperature & conditions
- Delayed use (cure time)



PREPARATION

- Select appropriate adhesive for installation conditions and work plan
- Confirm adhesive has been stored properly. Insulate during transport and on-site, and bring install 'consumable' kits
- Record the brand, lot/i.d. number and expiration date of the adhesive in Work Safety Plan 'Notes'.
- Handling: SS hammer, hard rubber mallet,, holster, spare applicator tips, rubber gloves, putty knife, paper towels, trash bag(s)



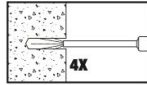
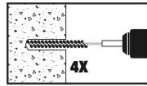
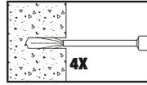
***Best practices for spacing is 6\" between adhesive or existing anchors**

DRILLING

- Use PPE: eye, ear, hand & respiratory protection
- Confirm 1/2\" diameter drill bit - new or lightly used- and adequate length (+6\" is recommended) for Wave Bolt
- Correct depth = mark drill bit at length of bolt + 1/2\" (4 1/2\")
- Support drill with handle, perpendicular to rock surface
- Drill hole in a continuous motion, stopping periodically to remove and clean out debris, and to re-insert.
- Do not enlarge the hole with repeated insertion & removal while spinning.
- Stop drilling at marked depth.

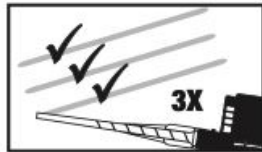
CLEANING

- ❑ Use blower to clean around and eject dust out of hole
- ❑ Insert and spin nylon pipe brush (not metal) to clean the hole. Fit should be snug.
- ❑ Repeat blow & brush at least 4X and until hole is clean.



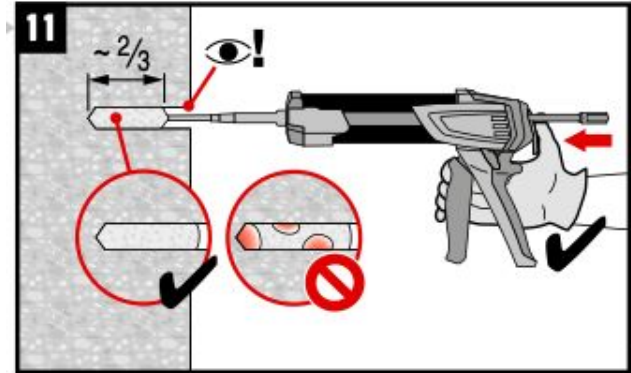
PREPARATION

- ❑ Protect PPE and site from excess adhesive. Have cleaning supplies available.
- ❑ Evaluate the applicator tip is not blocked after any pause in work
- ❑ Apply 3 shots of adhesive in test bag to verify correct mixing. Save and monitor for curing.



INSTALLATION

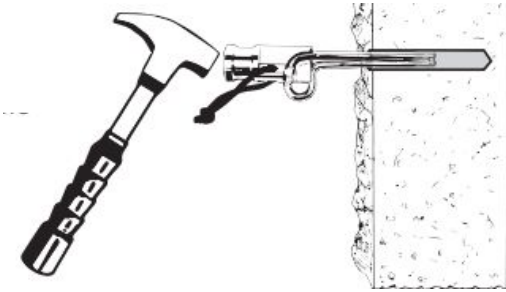
- ❑ Insert applicator to full depth of hole and dispense adhesive, being sure to fill bottom of hole.
- ❑ Dispense epoxy while withdrawing applicator slowly
- ❑ Dispense without voids or gaps until hole is $\frac{2}{3}$ - $\frac{3}{4}$ full.



- ❑ Prepare to capture/clean excess epoxy as ejected.
- ❑ Orient anchor to proper loading and insert by hand as far as possible.

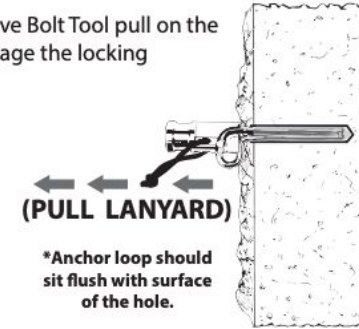
INSTALLATION (cont'd)

- ❑ Use a plastic/rubber mallet to install.
- ❑ **A carbon steel hammer will leave residue and surface corrosion on the new SS bolt. DO NOT USE! Or use the Wave Install Tool.**



- ❑ Tap, then hammer the bolt to full depth, preserving the loop/hanger orientation and ensuring contact flush to the rock surface.
- ❑ Do not damage eyelet. Strike the bolt straight in-line. If resistance is met, or bolt becomes bent or damaged, stop and reassess the hole, and install another bolt.
- ❑ When adhesive has cured, remove the install tool by pulling outward on the lanyard.

To release the Wave Bolt Tool pull on the lanyard to disengage the locking mechanism.



CLEAN-UP

- ❑ Capture and clean excess adhesive as it is ejected.
- ❑ Use putty knife and paper towels to remove excess. Ensure the hanger or eyelet is clean of residue.
- ❑ Cap, store and protect the adhesive between installations.
- ❑ Monitor the temperature and test samples to confirm hardening and curing.
- ❑ Do not load the anchor(s) until adequately cured.
- ❑ Document and archive the installation, including the adhesive brand, batch or lot i.d., and expiration date.

INSTALLATION OF SCREW LINKS AND EXTENSIONS

BELAY / RAPPEL ANCHORS

- Manufacturer's specification for spacing between Powers sleeve anchors is (2X depth) for maximum strength. WARI Best Practices for adhesive anchors is minimum 6" spacing.
- Prioritize reliability and function over strict 'hole-for-hole' replacement. Redundant anchors used during replacement work may require at least one new bolt to allow for replacement of the other 2.
- Minor relocation is ok (if necessary) but no changes to route character, length or difficulty
- Use **Stainless Steel** components **only** to minimize corrosion
- Install **replaceable** stainless steel screw-links, chain lengths and welded rings for **rope-wearing components**
- Use liquid thread locker (Loc-Tite) and adjustable wrench to secure screw links.
- Use chain lengths to extend anchor over sharp edges and facilitate clean rope retrieval. Odd numbers of links (e.g. 3,5,7) allow for the proper orientation of chain ends.
- Consider extensions to create a single focused point for commonly used top-rope anchors. Laterally positioned rings are not recommended for popular top-rope routes.

DOCUMENTATION

NOTES

At the completion of each work session, under 'NOTES' in the Work Safety Plan, record:

- Number of workers
- Number of hours worked
- Number of hours worked 'on rope'
- Number and length of sleeve anchors installed
- Number of adhesive anchors installed
- Number of adhesive cartridges used, and Batch / Lot Identification and expiration
- Number of screw-links, rings and approximate chain length used
- Note and quarantine any tools or materials that need service or replacement
- Note any material or hardware supply shortages
- Coordinator completes WARI Form Report for the SLCA website when route is completed

PRACTICAL SKILLS ASSESSMENT

WORKER: _____

DATE: _____

TRAINER: _____

PREPARATION:

- Explain the Job Hazards in Anchor Replacement and the controls used to mitigate them
- Agree to adhere to Quality Assurance processes
- Complete an Anchor Observation Form
- Complete a Project Proposal Form
- Follow a Work Safety Plan

TOOLS & APPLICATIONS:

- Demonstrate 'drop-proof' tool and material handling
- Identify each tool in the work kit, and it's application
- Demonstrate how to operate a cordless hammer drill
- Demonstrate how to use a blower and pipe brush
- Demonstrate how to operate an SDS stud spinner
- Demonstrate how to operate a slide puller
- Demonstrate how to operate a threaded extractor (Hurley)
- Demonstrate how to tap a (resistant) sleeve and cone
- Demonstrate how to use a torque limiting wrench
- Demonstrate how to use an adhesive dispenser

PRACTICALS:

- Drill an anchor hole
- Clean the anchor hole for installation
- Demonstrate how to assess a hole for re-use
- Install and remove a Removable Bolt
- Remove a stud/wedge anchor
- Remove a (resistant) expansion sleeve anchor
- Remove and patch an adhesive anchor
- Install an expansion sleeve anchor to specifications
- Install an adhesive anchor to specifications
- Construct a belay/rappel anchor with screw-links, chain and/or steel rings

DOCUMENTATION:

- Complete a summary work report (Work Safety Plan: 'Notes')

NOTES