**Stalactite Repair**

Jim C. Werker

Most stalactite repairs require a support pin since gravity is working against the epoxy. After confirming alignment of the broken pieces, clean and dry the break joints, then make inky guide dots for drilling the holes that will receive the pin. Some speleothems also need alignment tick marks across the break joint. (See cave-safe epoxies and adhesives, pages 445-447; also see marking pieces to facilitate alignment, page 455.)

**General Stalactite Procedure**

In the upper section of the stalactite, drill a hole that matches the diameter of the stainless all-thread pin. Clean drill dust from the hole, apply epoxy to the pin, insert the pin in the drill hole, and allow curing to begin while drilling the lower section. (Some stalactite repairs will need 24 hours for the pin to begin to dry in the upper section.)

Drill a slightly oversized hole in the lower section, remove the drill dust, and half fill the hole with an archival epoxy such as Epon® 828 with Epi-cure® 3234. Also apply a thin layer of epoxy to the broken joint of the lower piece, but avoid spreading the glue all the way to the edges. Fit the upper and lower pieces together and brace, prop, or wire with the methods described in illustrations on the following pages.

**Tiny Stal Repairs**

Tiny broken stalactites are easy to repair with a pure form of cyanoacrylate adhesive such as Hot Stuff® Super T. (See cave-safe epoxies and adhesives, page 446.) Check to make sure the pieces are clean and will snap-fit. Then apply a dot of Super T to the broken piece, attach to its mate, and hold in place for 60-90 seconds. For soda straws, apply two or three minuscule dots of Super T around the edge to leave the central canal open. (See fragile speleothem repair, page 485.)

**Alternate Technique**

Sometimes, an approved cyanoacrylate adhesive is used in conjunction with epoxy, even on speleothems that require a support pin. Applied correctly, the quick-set glue can help hold the speleothem in place until the epoxy cures.

For example, after half filling the lower section drill hole with epoxy, spread a thin layer of epoxy in a circle outside of the hole, and then apply drops of Super T quick-setting adhesive on the inner circle adjacent to the drill hole and around the outer inside edge of the broken joint. (If a pin is required, overfilling the bottom drill hole with epoxy will result in overflow into the inner circle and will negate the effectiveness of the cyanoacrylate adhesive.)

Quickly align the two broken pieces and manually hold in place until the quick-set adhesive dries. Minor bracing may be beneficial. Allow 24-72 hours for the epoxy to cure before touching the speleothem.

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**Figure 1.** When stalactites are too thin to install a support pin, and when the broken section is not too heavy, try repairing the joint with an archival epoxy. Use bracing devices to assure proper mating as the adhesive cures.
Stalactite Repair—Epoxy and Prop

Figure 2. Brace with upward pressure and allow time for the epoxy to cure thoroughly. Steve Wilsey holds the joint in place while Sheridan Stone props the stal with a PVC pipe.

Figure 3. Measure the length needed for proper bracing and cut PVC pipe to size.

Figure 4. Two custom-cut PVC pipes brace stalactite repairs in Box Cave, Arizona.

Figure 5. Steve Smith and Jim Werker first check to make sure the broken speleothem properly click-fits and mates.

Figure 6. After using the ink-dot marking technique, Jim Werker drills a hole for the support pin.

Figure 7. Stainless steel all-thread is epoxied into the drill hole to provide stabilization for the stalactite repair.

Figure 8. A larger hole is drilled in the lower piece.
Stalactite Repair—Pin, Epoxy, and Prop

- Drill and install support pin.
- Use archival epoxy and stainless steel all-thread pin.
- Prop or brace to hold a tight-fitting joint while epoxy dries.
- Remove propping devices after epoxy cures.

Figure 9. The lower drill hole is half filled with epoxy and positioned to receive the pin and reattach to the mating piece.

Figure 10. The repaired stalactite is supported with a PVC brace.

Figure 11. Steve Smith and Jim Werker prepare a second stalactite for reassembly.

Figure 12. Stalactites were pinned, epoxied, and braced with PVC during a speleothem repair workshop at Box Cave, Arizona. Epoxy was allowed several days to cure before cavers returned to remove the PVC.
Stalactite Repair—Pin, Epoxy and Wire

1. Drill, install support pin, and use soft, temporary wire.
2. Use archival epoxy and stainless steel all-thread pin.
3. Wire around the outside of stalactite to hold it in place while epoxy cures.
4. Remove wires after epoxy thoroughly cures.

Figure 14. Drill the hole for a support pin in the top stal section that remains attached to the ceiling. Jim Werker is drilling to prepare a site for repair in Lower Cave, Carlsbad Caverns National Park, NM.

Figure 15. Reattach the stalactite with archival epoxy and a stainless stabilization pin. Support the repair with external wire. Clean up the epoxy ooze and drips.

Figure 16. Allow epoxy to cure thoroughly before removing the external wire support.
Pin, Epoxy, and Wire through Small Holes

Drill to fit all-thread and epoxy it into upper section.

1. Drill, install support pin, and wire in place.
2. Use archival epoxy and stainless all-thread pin.
3. Drill small holes for wires on both sides of joint.
4. Support stalactite with wire threaded through small drill holes.
5. Remove wire after epoxy cures.
6. Fill small holes with epoxy and rock dust mixture.

Drill small holes through stalactite and wire pieces together. Remove wire after epoxy cures.

Drill oversized hole in lower mating piece to facilitate alignment. Half fill with epoxy.

Figure 18. Install a stabilization pin if necessary and drill small holes above and below the break joint to accept supporting wires.

Figure 19. Thread wires through the small holes to hold the epoxied click-fit in place. Add bracing below the stalactite.

Figure 20. After the epoxy cures, remove support wires and bracing. Fill the holes with a color-matched epoxy and rock dust mixture.
**Pin Through Adjacent Formations**

1. Drill holes through adjoining speleothems to support the broken piece.
2. Epoxy stainless all-thread through the adjacent formations.
3. Cut off pins, then fill holes and gaps with epoxy and rock dust mixture.

**Figure 22.** Visible in this photo are the original drill holes made for internal stabilization pins that were used the first time the formation was repaired.

**Figure 23.** After vandals struck a second time, we reinforced the repair with stainless support pins installed through adjacent speleothems.

**Figure 24.** To provide support for another broken stal in the group, we threaded stainless wire through small holes drilled above and below the break. Pins were cut off after the epoxy dried.

**Figure 25.** Because these stalactites receive intermittent mud flow, we partially filled the holes and gaps with a mud mixture. Time and new deposition will continue the healing process.