SECTION 31 32 00.11
DEEP LOCK® SOIL STABILIZATION

Basis of Design: AP Lift 440 | Revision 2 | Issued 2026-11-04

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes stabilization of weak soil and filling of voids at depth by injection of two-component structural polyurethane foam through injection tubes driven to one or more design depths. The expanding foam compacts the soil and fills voids to stabilize the supported construction without excavation.

B. Work of this Section corrects loss of bearing capacity in soil at depth. Completion is judged by placement of the design volume at each tube, or by refusal, or by movement of the supported element, whichever occurs first.

C. Raising of settled slabs to design elevation, void filling, and permeation grouting with single-component resin are specified separately.

1.2 RELATED REQUIREMENTS

A. Division 01 - Product Requirements, including controlled substitution procedures.

B. Division 01 - Quality Requirements.

C. Geotechnical report and soil boring data, where furnished.

D. Division 03 - Concrete, for repair of concrete surfaces at injection holes.

E. Repair of asphalt paving at injection holes: As required by the Contract Documents.

1.3 REFERENCES

A. ASTM International:

1. ASTM C273 - Standard Test Method for Shear Properties of Sandwich Core Materials.
2. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
3. ASTM D732 - Standard Test Method for Shear Strength of Plastics by Punch Tool.
4. ASTM D756 - Standard Practice for Determination of Weight and Shape Changes of Plastics Under Accelerated Service Conditions.
5. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics.
6. ASTM D1042 - Standard Test Method for Linear Dimensional Changes of Plastics.
7. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
8. ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics.
9. ASTM D1623 - Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
10. ASTM D4878 - Standard Test Methods for Polyurethane Raw Materials: Determination of Viscosity of Polyols.
11. ASTM D6226 - Standard Test Method for Open Cell Content of Rigid Cellular Plastics.
12. ASTM D7487 - Standard Practice for Polyurethane Raw Materials: Polyurethane Foam Cup Test.

B. NSF International:

1. NSF/ANSI/CAN 61 - Drinking Water System Components: Health Effects.
2. NSF/ANSI/CAN 372 - Drinking Water System Components: Lead Content.

1.4 PREINSTALLATION MEETINGS

A. Convene a preinstallation meeting before starting work of this Section. Review at minimum:

1. Current Technical Data Sheets and Safety Data Sheets for each product to be used.
2. Geotechnical report and soil boring data, where furnished, and results of dynamic cone penetrometer and ground penetrating radar investigation under Article 3.1.
3. Results of utility location.
4. Injection grid spacing, depth levels, and design quantity per tube.
5. The shallow-to-deep sequence under Article 3.4.
6. Movement monitoring method and the reference benchmark.
7. Staging of the work and access or lane restrictions, where the work is performed under traffic.
8. Disposition of injection tubes on completion.
9. Material temperature, equipment heat settings, and cold-weather provisions.

1.5 ACTION SUBMITTALS

A. Submit under provisions of Division 01.

B. Product Data: Current Technical Data Sheet for each product and accessory to be used, including revision date.

C. Safety Data Sheet for each product and accessory to be delivered to the site.

D. Injection Plan: Drawing showing treatment area, injection grid and spacing, depth levels, design quantity per tube, injection sequence, no-drill zones, and utility locations.

E. Movement Monitoring Plan: Reference benchmark, instrument type, and monitoring locations.

F. Where the work occurs within a drinking water source or its zone of influence, submit current NSF/ANSI/CAN 61 and 372 certification of the injected material.

1.6 INFORMATIONAL SUBMITTALS

A. Site Investigation Report: Results of utility location, ground penetrating radar, and dynamic cone penetrometer investigation, including void locations, soil profile, and depth of the identified condition.

B. Injection Record: For each tube, identification, depth, quantity placed, movement observed, and reason injection was stopped.

C. Abandoned Tube Record: Location of each abandoned tube and each tube that could not be extracted.

D. Installer Qualification: Evidence that the Installer satisfies Article 1.7.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Installer shall have completed Alchatek contractor training, or Alchatek Technical Service shall be present at the start of the work.

B. Utility Locate: Contact the applicable one-call utility locate service on every project before driving any tube or drilling any hole.

C. Cold Weather: Crew shall understand frost and permeation limits before working in cold conditions.

D. Safety Data Sheets: Personnel shall review the Safety Data Sheet for each product before handling or injecting.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in unopened original containers bearing the product name and manufacturer identification.

B. Store products between 50 and 80 deg F (10 and 26 deg C). Shelf life is 24 months in unopened containers stored within this temperature range.

C. Dispose of surplus material in accordance with local regulations.

1.9 FIELD CONDITIONS

A. Precondition material to 70 deg F (21 deg C) before use.

B. Equipment Heat Settings: For optimal performance, set the A-side to 100 deg F (38 deg C), the B-side to 110 deg F (43 deg C), and hose heat to 105 deg F (41 deg C).

C. Cold Weather:

1. Stop work when temperature falls below minus 4 deg F (minus 20 deg C). Frozen ground will cause post-thaw settlement. Resume only when conditions improve.
2. Below 50 deg F (10 deg C), extend wait times between injections and monitor material cure rates.
3. Maintain drums, lines, and hoses at the recommended temperatures. Insulate hoses to prevent freezing and protect the work area with concrete blankets.

D. Excessive foam build-up can result in degraded material properties or, in rare cases, fire, due to high internal temperatures.

E. Quantity of material is assessed on site and is influenced by soil conditions, void content, and treatment depth.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Manufacturer: Alchatek (www.alchatek.com).

B. Substitution of products from other manufacturers is governed by the controlled substitution procedures of Division 01.

2.2 BASIS-OF-DESIGN PRODUCT

A. Basis-of-Design Product: AP Lift 440.

B. Description: Two-component, high-strength, high-density, hydro-insensitive structural polyurethane foam. Unconfined density 4 lb/cu ft (64 kg/m3). Low viscosity. Closed cell. Works in wet environments and displaces water. Bonds with soil and concrete. Traffic ready in 15 minutes.

2.3 SUBSTITUTIONS

A. AP Lift 440 is the product specified for this Section.

B. A product proposed for substitution shall satisfy every requirement of Article 2.4 and shall be supported by current published technical data demonstrating compliance.

C. Where drinking water certification is required, a product not carrying NSF/ANSI/CAN 61 and 372 certification is not an acceptable substitution.

2.4 PERFORMANCE REQUIREMENTS

A. Injected material shall be closed cell in the cured state.

B. Injected material shall be hydro-insensitive, shall displace water, and shall cure in wet conditions.

C. Injected material shall bond with soil and concrete.

D. Injected material shall reach 90 percent of full strength within 15 minutes.

E. Where the work occurs within a drinking water source or its zone of influence, injected material shall be certified to NSF/ANSI/CAN 61 and 372.

2.5 PRODUCT PROPERTIES

A. AP Lift 440, cured (Technical Data Sheet Rev. 1/20/2026):

1. Density, ASTM D1622: 4 +/- 0.25 lb/cu ft (64.07 +/- 4.00 kg/m3).
2. A-side specific gravity: 1.23. B-side specific gravity: 1.03.
3. Viscosity at 110 deg F, ASTM D4878: 200 cP (200 mPa-s).
4. Cream time at 105 deg F, ASTM D7487: 2 seconds. Tack free time: 22 seconds. Rise time: 27 seconds.
5. Free rise compressive strength, ASTM D1621 / D1622: 80 psi (552 kPa).
6. Free rise tensile strength, ASTM D638: 90 psi (621 kPa).
7. Free rise shear strength, ASTM C273: 40 psi (276 kPa).
8. Flexural strength, ASTM D790: 130 psi (896 kPa).
9. Closed cell content, ASTM D6226: 85.2 percent.
10. Shrinkage, ASTM D1042 / D756: Negligible.
11. Unconfined expansion: 18 times.
12. 90 percent of full strength: 15 minutes.

B. Confined strength by compression ratio (compressive, ASTM D1621 / D1623; shear, ASTM D732):

1. 1.5 times: Compressive 165.3 psi (1,140 kPa); shear 82.6 psi (570 kPa).
2. 2 times: Compressive 193.2 psi (1,330 kPa); shear 96.6 psi (666 kPa).
3. 3 times: Compressive 216.1 psi (1,490 kPa); shear 108.1 psi (745 kPa).

C. Certification: NSF/ANSI/CAN 61 and 372, safe for contact with drinking water.

D. Properties will vary depending on application conditions.

2.6 ACCESSORIES

A. Injection Tubes: 1/2 inch outside diameter steel or composite injection tubes, with carriage bolt or pointed drive tips.

B. Injection Fittings: Nut-and-ferrule compression fitting and button-head coupler forming a quick-connect system.

C. Surface Protection: Alchatek Surface Guard 125.

D. Hole Patching: Concrete patch or hydraulic cement for concrete, cold patch for asphalt, epoxy for interior slabs.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Locate utilities through the applicable one-call service on every project before driving any tube or drilling any hole.

B. Where available, review the geotechnical report and site plan and confirm against field conditions:

1. Soil classification and bearing capacity.
2. Groundwater depth and seasonal fluctuation.
3. Boring log locations and depths.
4. Site-specific hazards and restrictions.

C. Where a concrete slab, asphalt surface, or buried structure is present, investigate with ground penetrating radar to identify voids, buried structures, reinforcing steel, and unmarked utilities.

D. Investigate with a dynamic cone penetrometer to establish void locations, soil profile, and depth of the identified condition.

E. Measure the treatment area. Mark obstacles, utilities, no-drill zones, and likely foam emergence points such as edges, control joints, cracks, and gaps. Identify equipment access.

F. Adjust the Injection Plan where reported conditions do not match field conditions. Do not begin injection until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Injection Grid: Place tubes 3 to 4 feet apart in both directions:

1. 3 feet: Dense or tight clay soil, critical areas, or uncertain soil communication.
2. 4 feet: Standard soil and large areas.

B. Depth Levels: Place one injection level every 4 feet of depth to the depth of the identified condition. Where more than one tube is used at a point, keep tubes 2 to 4 inches apart.

C. Mark and number every injection point where work will be done in phases.

D. Drive Tubes:

1. Attach a carriage bolt or pointed drive tip to each tube.
2. Pre-drill with a 5/8 inch bit through concrete or asphalt, through large rocks or hardpan, or where tubes must be angled to avoid obstructions. Otherwise drive directly.
3. Drive each tube to its design depth with a ground rod driver on a hammer drill.

E. Release Drive Tip:

1. Lift the tube 1 to 2 inches and inject water down the tube to dislodge the tip. Confirm water flows from the tube.
2. Where the water method fails, or where the gun in use requires it, knock out the tip with a punch rod.
3. Where the tip cannot be released, abandon and mark the tube and drive a new tube 6 to 12 inches away.

F. Establish a reference benchmark outside the area of influence and set dial indicators, a zip level, or a laser level to monitor movement of the supported element.

G. Surface Protection: Pre-spray injection points and joints with Alchatek Surface Guard 125 and keep them wet during pumping. Cover finished surfaces with plastic sheeting.

H. Personal Protection: Provide eye and face protection, chemical-resistant gloves, long sleeves and long pants, work boots, and safety vests. Provide respiratory protection in confined spaces.

3.3 MIXING

A. AP Lift 440 is a two-component product proportioned and mixed by the injection equipment. Do not batch mix.

B. Confirm material has been preconditioned and equipment heat settings are as specified in Article 1.9 before injection.

3.4 INSTALLATION

A. Injection Equipment:

1. Plural-component proportioning rig with separately heated A-side and B-side and heated, temperature-controlled hoses.
2. Impingement mix gun with water or air purge.
3. Cycle counter or equivalent means of measuring the quantity delivered to each tube.

B. Injection Sequence:

1. Start at the tube furthest from the equipment so hoses are not dragged through completed work.

2. Complete all shallow tubes first, then the next depth level. Inject the deepest tubes last.

C. Design Quantity: Inject the quantity shown on the Injection Plan. Unless otherwise determined:

1. Shallow tubes, 0 to 4 feet deep: 15 pounds per tube.
2. Deep tubes, deeper than 4 feet: 20 to 30 pounds per tube.

D. Monitor continuously the cycle counter, sound of flow through the gun, pump stroke intensity, the ground surface for heaving or emergence, and monitoring instruments for movement of the supported element.

E. Stop injection at a tube when:

1. The design quantity has been placed.
2. The supported element moves.
3. Material emerges at the surface.
4. The tube reaches refusal and accepts no further material.

F. Where the supported element lifts or material surfaces, switch to timed injection of 5-second bursts with 2- to 3-second pauses. Do not use timed injection deeper than 10 feet.

G. Maintain continuous flow during injection. Where work must pause, move to a new injection point rather than returning to a partially completed tube.

H. Where a tube will not take material, verify the drive tip has been removed. If it still refuses, abandon it and drive a new tube in a different location.

3.5 FIELD QUALITY CONTROL

A. Record for each tube the identification, depth, quantity placed, movement observed, and reason injection was stopped.

B. Record the location of each abandoned tube and each tube that could not be extracted.

C. Return to Service: AP Lift 440 reaches 90 percent cure and is traffic ready in 15 minutes.

3.6 CLEANING

A. Injection Tubes:

1. Standard projects: Tubes may remain in the ground.
2. DOT projects: Cut tubes flush, or drive tubes 3 to 4 inches below the surface before patching, as the Contract Documents require.

B. Clean injection holes of debris and patch with concrete patch in concrete, cold patch in asphalt, or epoxy in interior slabs. Match the surrounding finish.

C. Remove excess resin, foam, plastic sheeting, and debris from the site.

D. Clean tools, hoses, and guns in accordance with the proportioner manufacturer's instructions.

3.7 PROTECTION

A. Protect completed work from traffic until the return-to-service interval in Article 3.5 has elapsed.

B. Conduct a final walkthrough to confirm no injection point was missed, holes are patched, surfaces are clean, and all equipment is accounted for.

END OF SECTION 31 32 00.11