AMERICAN NATIONAL STANDARD

ANSI/ASSE A10.23 – 2014
Safety Requirements for the Installation of Drilled Shafts

American National Standard for Construction and Demolition Operations

ANSI/ASSE A10.23 – 2014

AMERICAN SOCIETY OF SAFETY ENGINEERS

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ANSI/ASSE A10.23 – 2014

American National Standard
Construction and Demolition Operations

Safety Requirements for the Installation of Drilled Shafts

Secretariat

American Society of Safety Engineers
1800 East Oakton Street
Des Plaines, Illinois 60018-2187

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Foreword (This Foreword is not a part of American National Standard A10.23-2014.)

This standard is one of a series of safety standards that have been formulated by the Accredited Standards Committee on Safety in Construction and Demolition Operations, A10. It is expected that the standards in the A10 series will find a major application in industry, serving as a guide to contractors, labor, and equipment manufacturers. For the convenience of users, a list of existing and proposed standards in the A10 series for Safety Requirements in Construction and Demolition Operations follows.

A10.1 Pre-Project & Pre-Task Safety & Health Planning
A10.2 Safety, Health and Environmental Training (under development)
A10.3 Powder-Actuated Fastening Systems
A10.4 Personnel Hoists and Employee Elevators
A10.5 Material Hoists
A10.6 Demolition Operations
A10.7 Transportation, Storage, Handling and Use of Commercial Explosives and Blasting Agents
A10.8 Scaffolding
A10.9 Concrete and Masonry Construction
A10.10 Temporary and Portable Space Heating Devices
A10.11 Personnel and Debris Nets
A10.12 Excavation
A10.13 Steel Erection
A10.15 Dredging
A10.16 Tunnels, Shafts and Caissons
A10.17 Safe Operating Practices for Hot Mix Asphalt (HMA) Construction
A10.18 Temporary Roof and Floor Holes, Wall Openings, Stairways and Other Unprotected Edges
A10.19 Pile Installation and Extraction Operations
A10.20 Ceramic Tile, Terrazzo, and Marble Work
A10.21 Safe Construction and Demolition of Wind Generation/Turbine Facilities (under development)
A10.22 Rope-Guided and Non-Guided Workers' Hoists
A10.23 Safety Requirements for the Installation of Drilled Shafts
A10.24 Roofing – Safety Requirements for Low-Sloped Roofs
A10.25 Sanitation in Construction
A10.26 Emergency Procedures for Construction Sites
A10.27 Hot Mix Asphalt Facilities
A10.28 Work Platforms Suspended from Cranes or Derricks
A10.29 Aerial Platforms in Construction (under development)
A10.31 Digger-Derricks
A10.32 Personal Fall Protection Used in Construction and Demolition Operations
A10.33 Safety and Health Program Requirements for Multi-Employer Projects
A10.34 Public Protection
A10.37 Debris Nets
A10.38 Basic Elements of a Program to Provide a Safe and Healthful Work Environment
A10.39 Construction Safety and Health Audit Program
A10.40 Reduction of Musculoskeletal Problems in Construction
A10.41 Equipment Operator and Supervisor Qualifications and Responsibilities (under development)
A10.42 Rigging Qualifications and Responsibilities in the Construction Industry
A10.43 Confined Spaces in Construction (under development)
A10.44 Lockout/Tagout in Construction
A10.46 Hearing Loss Prevention

A10.47 Highway Construction Safety
A10.48 Communication Tower Erection (under development)
A10.49 Control of Health Hazards (under development)

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AMERICAN NATIONAL STANDARD A10.23
SAFETY REQUIREMENTS FOR THE INSTALLATION OF DRILLED SHAFTS

1. SCOPE, PURPOSE, APPLICATION AND EXCEPTIONS

1.1 Scope. This standard establishes safety requirements for the installation of drilled shafts during construction and demolition operations.

1.2 Purpose. This standard is intended for use as a guideline for protecting workers from hazards associated with installation of drilled shafts.

1.3 Application. This standard applies to employment and places of employment where employees are exposed to hazards associated with the construction of drilled shafts for foundations and earth retention elements. This standard does not apply to driven piles covered by ANSI/ASSE A10.19 or caissons covered by ANSI/ASSE A10.16.

1.4 Exceptions. In cases of practical difficulties, unnecessary hardships or new developments, the enforcing authority may grant exceptions to literal requirements of this standard. There may be exceptions that would permit the use of other devices or methods, but only when it is clearly indicated that equivalent safety is secured.

2. REFERENCES

2.1 Referenced American National Standards. This standard is intended to be used in conjunction with the latest approved revision of the following American National Standards.

ANSI/ASSE A10.8, *Scaffolding Safety Requirements*

ANSI/ASSE A10.12, *Safety Requirements for Excavation*

ANSI/ASSE A10.16, *Safety Requirements for Tunnels, Shafts and Caissons*

ANSI/ASSE A10.18, *Safety Requirements for Temporary Roof and Floor Holes, Wall Openings, Stairway's, and Other Unprotected Edges*

ANSI/ASSE A10.19, *Safety Requirements for Pile Installation and Extraction Operations*

ANSI/ASSE A10.28, *Safety Requirements for Work Platforms Suspended from Cranes or Derricks*

ANSI/ASSE A10.32, *Personal Fall Protection Used in Construction and Demolition Operations*

ANSI/ASSE A10.33, *Safety & Health Program Requirements for Multi-Employer Projects*

ANSI/ASSE A10.42, *Safety Requirements for Rigging Qualifications and Responsibilities*

ANSI/ASSE A10.44, *Control of Energy Sources (Lockout/Tagout) for Construction and Demolition Operations*

ANSI/ALI A14.3, *Safety Requirements for Fixed Ladders*

ANSI/ASME B30.5, *Mobile and Locomotive Cranes*

ANSI/ASSE Z359.4, *Safety Requirements for Assisted-Rescue and Self-Rescue Systems, Subsystems and Components*

2.2 Additional References.

The International Association of Foundation Drilling (ADSC), *Recommended Procedures*

for the Entry of Drilled Shaft Foundation Excavations

Common Ground Alliance (CGA), *Best Practices*

American Conference of Governmental Industrial Hygienists (ACGIH), *TLVs® and BEIs®*

American Public Works Association (APWA), *Recommended Marking Guidelines for Underground Utilities*

APWA, *Uniform Color Code*

3. DEFINITIONS

3.1 Auger. A cutting tool for boring or perforating soils or rocks, for determining the quality of soils or the nature of the rocks or strata upon which they lie. In drill shaft installation, an auger is attached to a Kelly bar.

3.2 Batter. A gradual backward slope in a wall or similar structure. An incline to vertical.

3.3 Boatswain's (Bosun's) Chair. A rigid seat on which personnel ride when being hoisted into and out of drilled shaft excavations.

3.4 Casing. A steel shell used to construct a drilled shaft. The casing assists in advancing the excavation by supporting the walls of the shaft. A casing may be permanent or temporary. A casing is also referred to as a shell.

3.5 Casing Method. A method of shaft construction in which a cased hole is advanced and cleaned, reinforcing steel is placed and the shaft is concreted. Temporary casing (if any) is extracted during the process.

3.6 Competent Person. One who is capable of identifying existing and predictable hazards in the surroundings or identifying working conditions that are unsanitary, hazardous or dangerous to employees, and who has the authority to take prompt corrective measures to eliminate them.

3.7 Competent (Stable) Rock. Rock that is structurally sound enough to have openings without the need of structural support.

3.8 Drilling Mud. Slurry comprised of bentonite or polymers (see Slurry).

3.9 Drilled Shaft. A shaft constructed by excavating a cylindrical hole, placing reinforcing steel (as required) and filling the hole with concrete or other cementitious material.

3.10 Drilled Shaft Contractor. A person, firm or corporation, as designated in the project documents, who is primarily responsible for specific construction work within their contracted scope of work.

3.11 Dry Construction Method. A method of shaft construction consisting of drilling a shaft, removing water (if any) and material from the excavation, placement of reinforcing steel and concreting the shaft in a relatively dry condition.

3.12 Equivalent. Alternative materials, designs or features that will provide an equal degree of strength and safety.

3.13 Kelly Bar. A hollow bar (square or round), typically comprised of telescoping sections, that transfers torque and crowd force from the rotary drive to the drilling tool during rotary drilling.

3.14 Permanent Casing. A casing that serves as a form and remains in place after construction.

3.15 Project Constructor. A person, firm or corporation, (i.e. the construction manager, general contractor, prime contractor or other entity), as designated in

the project documents, responsible for supervising and controlling all construction work performed on the project.

3.16 Quality Assurance. A test or procedure, that serves to verify the performance acceptance criteria of the work or product. For purposes of this standard, quality assurance procedures include static load testing, Osterberg cell (O-cell) testing, coring, cross hole sonic logging and other non-destructive testing.

3.17 Rock. Specific geological strata identified in boring logs and/or defined at the shaft installation site by a geotechnical engineer or geotechnical testing laboratory.

3.18 Seat. Placement of the entire circumference of the tip of a casing in direct contact with rock.

3.19 Secant Pile Wall. A wall formed by the construction of intersecting steel-reinforced concrete piles or wide flange, steel H sections.

3.20 Shall. The word "shall" is to be understood as denoting a mandatory requirement.

3.21 Should. The word "should" is to be understood as denoting a recommendation.

3.22 Spin-Off. The process of removing excavated material from the auger or other drill tool by rotating the tool when removed from the excavated shaft.

3.23 Slurry. A mixture of water and bentonite, or water and polymers, which provides hydrostatic pressure to support the sides and bottom of a hole, lubricate and cool the drill tools and aid in clean-out.

3.24 Soldier Pile Wall. A wall comprised of H piles and sheeting. Wide flange steel H sections are driven or drilled into place prior to excavation. As excavation proceeds, sheeting or lagging (e.g. horizontal timbers) is inserted behind or attached to the front of the H pile flanges. Such assemblies are also referred to as king piles or Berlin walls.

3.25 Surface Casing. A temporary casing installed to prevent sloughing of the surrounding soil near the surface of a shaft excavation.

3.26 Tangent Pile Wall. A pile wall constructed with no overlapping members.

3.27 Temporary Casing. A casing that serves to keep a shaft open during construction of the drilled shaft. It serves no permanent structural function and is extracted during concreting.

3.28 Top of Socket. The highest location of the rock socket that is capable of resisting axial and lateral design loads. At any given location, the top of socket elevation is usually below the top of rock elevation. This distance depends on the type and quality of rock and the contractor's drilling methods and equipment.

3.29 Tremie. A pipe or tube (conduit) through which concrete is deposited under water, having at its upper end a hopper for filling and a bail by means of which the assembly can be handled by a crane, derrick or hoist.

3.30 Trial Shaft. A hole for a drilled shaft constructed on the project site, but outside the proposed footing limits. It is not to be incorporated into a structure or foundation. A trial shaft is constructed prior to installing production drilled shafts according to the methods detailed in the contractor's submittals. Its function is to verify the proposed excavation methods and permit inspectors to become familiar with the excavation procedure. Upon inspection and acceptance, the trial shaft is backfilled with unreinforced concrete.

3.31 Wet Construction Method. A method of shaft construction using slurry to

maintain the stability of shaft walls during excavation to final depth and placement of reinforcing steel and concrete.

4. SITE-SPECIFIC SAFETY PLAN

4.1 Prior to initiating drilled shaft operations, the drilled shaft contractor shall develop a written site-specific safety plan (plan) and job hazard analyses (JHAs) for unique drilled shaft activities. The plan shall include, but not be limited to procedures for emergency action, the location of utilities (both above and below grade), designated areas for equipment operations and materials storage, assembly and disassembly sequences for drilled shaft equipment, operation of drilled shaft equipment, the handling of materials and equipment, task-specific training, personal protective equipment and project demobilization. The plan shall be reviewed and approved by the project constructor.

4.2 The competent person shall review the plan and JHAs with all workers potentially exposed to hazards posed by the drilled shaft operations. Copies of the plan and JHAs shall be maintained at the project and available for review until the drilled shaft operations are complete.

4.3 As changes in work procedures occur, the plan and/or JHAs shall be modified as necessary. Such changes shall be communicated to all personnel involved in the drilled shaft operations.

5. SITE INVESTIGATION

5.1 A geotechnical investigation shall be performed to identify subsurface conditions and provide geotechnical conclusions and recommendations for design and construction. The investigation shall include a field reconnaissance of the site and vicinity. A written report of the investigation shall be developed and include:

5.1.1 A description of the proposed project and its location.

5.1.2 A site map of the project, scaled to no less than 1":400', identifying geological conditions, topography and the location of proposed structures. Published geological maps should also be provided where available.

5.1.3 The geological history, including information on prior excavations and fills.

5.1.4 A discussion of geological and environmental hazards and an explanation of their potentially harmful effects on workers involved in the drilled shaft operations.

5.1.5 Existing and potential groundwater conditions (i.e. effects of natural and artificial seepage).

5.1.6 Engineering data addressing foundation types for proposed structures, retaining systems, grading considerations, stability of cut-slopes and constructed embankments, settlement of the site and adjacent areas due to existing conditions, proposed construction and proposed surface and subsurface drainage facilities.

5.1.7 The signature, certification number and stamp of a registered Professional Engineer, who by training, education and/or experience is qualified in the practice of geotechnical or soils engineering practices.

6. SITE CONDITIONS

6.1 The project constructor shall:

6.1.1 Inform the drilled shaft contractor of the known locations of subsurface hazards (e.g. voids, tanks, utilities, contaminated soils, etc.) where drilled shaft equipment will be used. The locations of such hazards shall be identified in documents such as site plans, as-built drawings and geotechnical reports.

6.1.2 Ensure that drilled shaft equipment not be assembled or used unless the ground conditions on which they are moved or placed are firm, drained (except for marshes/wetlands) and graded to the extent that the equipment manufacturer's specifications for adequate support and degree of level are met.

6.1.3 Organize and conduct a preconstruction meeting with the drilled shaft contractor to review, among other things, the site specific safety plan.

6.2 The drilled shaft contractor shall establish a restricted access zone around the drilling and/or hoisting areas to prevent access by persons not directly involved in such operations. The restricted access zone shall be supervised by a competent person. The restricted access zone shall comply with the following requirements:

6.2.1 The zone shall encompass the drilled shaft equipment, drilling attachments, the shaft being drilled and the materials and area necessary for the specific operation being performed, including spin-off.

6.2.2 The zone shall be moved with the progress of the work and encompass as much area as necessary to maintain a safe drilling operation. The zone shall be marked with tape, cones or similar form of visual identification.

6.2.3 Only personnel engaged in the drilled shaft installation shall be allowed inside the zone. When other contractors' workers enter the restricted access zone without approval, the drilled shaft contractor shall promptly inform the project constructor or site owner of the intrusions. The project constructor or site owner shall take reasonable steps to prevent such intrusions.

6.2.4 Only materials necessary for the operations being performed shall be stored in the restricted access zone.

6.3 The competent person shall insure there is no caving in or undermining of the soil at the surface near the drilled shaft. If such conditions exist, the competent person shall promptly initiate corrective action to ensure the safety of the persons working in the restricted access zone.

7. DRILLING EQUIPMENT SELECTION

7.1 The selection of drilling equipment and tooling should be based on the geotechnical investigation report used to identify subsurface conditions.

8. DELIVERY AND STORAGE OF REINFORCING STEEL AND CASING

8.1 Casing pipe and assembled reinforcing cages stored on the ground shall be adequately secured by blocking or equivalent methods to prevent unplanned movement and damage.

8.2 Areas for the storage and assembly of reinforcing steel should be planned to minimize handling, but sufficiently far enough away from hazards associated with moving equipment.

9. MATERIALS HANDLING TO POINTS OF FINAL USE

9.1 The drilled shaft contractor shall comply with the manufacturer's specifications, limitations and minimum maintenance requirements applicable to the operation of drill rigs, cranes, forklifts, front-end loaders, boom trucks and other mechanized equipment used to handle material.

9.2 Only rigging and equipment of adequate capacity and configuration shall be used to handle material.

9.3 Reinforcing steel cages and their lift point(s) shall be designed by a registered Professional Engineer so as to withstand the forces applied to them when lifted from a horizontal to vertical position. The cage

fabricator shall ensure the cage is assembled in accordance with the cage design.

9.4 Stored equipment and material shall be secured against unintended displacement.

10. POWER EQUIPMENT

10.1 All equipment used for drilled shaft installations shall be inspected daily before use. Such inspections shall be documented. No modifications to equipment shall be made without the manufacturer's approval or, if unavailable, the modifications shall be designed by a registered Professional Engineer with experience in equipment design. Such modifications shall be performed under the supervision of a qualified person.

10.2 All power equipment shall be operated in accordance with its manufacturer's specifications for use.

10.3 Fuel-operated power plants shall not be operated in enclosed work areas unless exhaust is adequately ventilated or ducted away.

10.4 A fire extinguisher of appropriate size and type shall be maintained on the equipment.

10.5 Electrical power sources shall be disconnected and locked or tagged out before servicing such equipment.

10.6 Regardless of energy source, the system(s) shall be locked out or tagged out to prevent accidental start up.

11. PRESSURIZED LINES AND HOSES

11.1 All compressed air hose connections including those connected to airlift pipes or jet pipes shall be pinned or wired together and securely tethered with an adequate length of alloy steel chain or wire rope (whip check) having a working load limit of not less than 3,250 pounds (1,474kg).

11.2 Pneumatic systems powering hand tools shall be protected by an air flow reduction valve at the source to prevent uncontrolled movement of lines should a coupling become disconnected or damage occurs elsewhere in a hose length. The valve shall be sized to the supply requirement and shall not be oversized. All such valves shall be inspected for proper operation before using the tool.

11.3 Chains or wire rope used as line restraints shall not be shortened with knots, bolts or other makeshift devices.

11.4 Hydraulic hoses shall be routed to avoid twisting, pulling, kinking, crushing, abrading or flexing to less than their specified minimum bending radii.

11.5 Hydraulic systems shall not be operated above the maximum or below the minimum temperatures or pressures specified by their manufacturers.

11.6 Hoses, fittings and related assemblies shall not be intermixed unless recognized as compatible by their manufacturers. Hoses, fittings and related assemblies shall be marked as to capacity.

11.7 Hoses, fittings and related assemblies should be marked with their manufacturer's rated capacities.

11.8 The working pressure of hoses shall be greater than or equal to the maximum designed system pressure (including potential pressure surges) of the equipment to which they are connected. Concrete hoses shall be abrasion-resistant.

11.9 Pressurized systems (air, steam or hydraulic) shall be bled and all pressure relieved before service is performed on such systems.

11.10 Electrical systems shall be properly grounded during operation. A ground fault circuit interrupter (GFCI) shall be used for additional protection from electrical shock.

12. SPECIFIC DRILLED SHAFT INSTALLATION EQUIPMENT REQUIREMENTS

12.1 The drilled shaft installation equipment manufacturer's recommendations for assembly, disassembly, inspection, maintenance and operation shall be followed. Modifications to such equipment shall be subject to the equipment manufacturer's approval.

12.2 The drilled shaft installation equipment shall be inspected at least once every shift prior to operation. Additional equipment inspection and maintenance cycles may be required due to extreme conditions. If conditions warrant, maintenance and inspection cycles should change to a more frequent basis. The inspections shall be documented.

12.3 Prior to any drilling operations, all overhead and underground utilities must be located. The drilled shaft contractor is responsible for contacting the local One Call Center service to mark public utilities and the project constructor or site owner to mark private utilities.

12.4 The location of underground utility lines should be marked in accordance with the American Public Works Association's (APWA) marking guidelines and color codes. Markers (e.g., flags, stakes) should be suitable for the terrain and site conditions.

12.5 Whenever feasible, engineering controls shall be used to prevent contact with such utilities. The utility owner(s) shall be consulted to determine safe working clearance distances.

12.6 The minimum safe working clearance distance between energized overhead electrical power lines and all parts of construction equipment shall be:

Voltage	Minimum Safe Working Clearance Distance
50,000 volts (50kV) or less	10 feet
50kV TO 200kV	15 feet
200kV to 350kV	20 feet
350kV to 500kV	25 feet
500kV to 750kV	35 feet
750kV to 1000kV	45 feet

If the safe working clearance distance cannot be attained between the drill rig and any overhead power lines, the lines shall be de-energized, moved or otherwise rendered harmless before any work activity can begin.

12.7 No one should be in contact with the drill rig and the ground during drilling.

12.8 Appropriate warnings about power line contacts shall be posted at the operator's station.

12.9 Mobile cranes operated with crane-mounted drill attachments shall comply with current ANSI/ASME B30.5 requirements.

12.10 Where a boom, counterweight or other structural component of a mobile crane has been modified for attachment of drilled shaft installation equipment, the owner of the crane shall apply accepted engineering principles in demonstrating such modifications will not interfere with the safe operation of the crane. Written permission shall be obtained from the crane manufacturer for such modifications. If the manufacturer is no longer in business, then a registered Professional Engineer who is a

qualified person with respect to the equipment involved shall design the modifications.

12.11 The use of an auxiliary winch on dedicated, self-contained, hydraulic and/or friction clutch/friction brake drilled shaft installation equipment shall be within the limits established by the equipment manufacturer.

12.12 The use of a multi-part load block to increase the capacity of an auxiliary winch line on a dedicated, self-contained, hydraulic and/or friction clutch/friction brake drill rig is prohibited without written authorization from the equipment manufacturer.

12.13 Determination of safe lifting capacities of auxiliary hoists on mobile cranes used for drilled shaft installations shall include the suspended weight of all drill equipment attachments.

12.14 Drilling equipment shall be suitable for the intended battered configuration.

12.15 A qualified signal person shall be positioned in full view of the equipment operator before any drilled shaft equipment is relocated at the work site. Standard hand or voice signals shall be used. The operator shall accept signals only from the designated signalperson except for an emergency stop signal, which may be given by any worker.

12.16 No worker shall be positioned under any portion of a suspended load or the auger during a drilled shaft installation.

12.17 Tag lines shall be used where necessary to control suspended loads.

12.18 The swing radius of the drilling equipment shall be fully barricaded.

12.19 Drilled shaft equipment operators shall be qualified and authorized by their employers to operate such equipment.

12.20 Operators of crane-mounted drill attachments shall possess a certification administered by an accredited testing organization or qualification by an audited employer program, by the U.S. military or licensed by a government entity to operate a crane.

12.21 Operators of crane-mounted drill rigs shall meet all operator physical requirements set forth in ANSI/ASME B30.5.

13. FALL PROTECTION

13.1 Fall protection in the form of standard guardrails, covers or personal fall protection equipment shall be used to protect workers exposed to a hazard of falling 6 feet (1.8m) or more to a lower level.

13.2 Guardrails and hole covers shall be constructed to the requirements of ANSI/ASSE *A10.18, Temporary Roof and Floor Holes, Wall Openings, Stairway's, and Other Unprotected Edges.*

13.3 Employees working in the restricted access zone during shaft construction shall be protected from falls into shafts 6 feet (1.8m) or more in depth by standard guardrails or personal fall protection systems meeting the requirements of ANSI/ASSE A10.32, *Personal Fall Protection Used in Construction and Demolition Operations.*

13.4 All completed shafts shall be guarded by standard guardrails, covers or backfill material such as sand or gravel.

13.5 All completed shafts shall be guarded by standard guardrails, covers or backfill material such as sand or gravel.

13.6 Where casings do not extend to grade, guardrails or hole covers shall be installed so as to prevent falls into shafts from cave-ins.

13.7 Shafts into which personnel can inadvertently trip or step shall be covered.

13.8 Employees shall not be allowed to climb or stand on drilled shaft installation equipment until the equipment operator has applied all brakes and safety switches to prevent any unintended movement of the equipment. The applicable requirements of ANSI/ASSE A10.44, *Control of Energy Sources (Lockout/Tagout) for Construction and Demolitions Operations*, shall apply.

13.9 Rebar protection shall be installed to prevent impalement hazards.

14. CASING EXTRACTION

14.1 When casings are extracted with a vibratory hammer suspended from a crane:

14.1.1 The crane and rigging shall have a minimum rated lifting capacity of not less than 110% of the weight of the hammer and casing for the full working radius of the extraction operation.

14.1.2 The rated capacity of the vibratory hammer's suspension system shall not be exceeded. The hammer manufacturer's recommendations for extraction shall be observed at all times.

14.2 When casings are extracted by impact:

14.2.1 The connection between the hammer and the casing shall be rigged and secured as to prevent unintended disconnection and inspected frequently during the extraction process.

14.2.2 The rated capacity of the impact hammer's suspension system shall not be exceeded. The manufacturer's recommendations for extraction shall be observed at all times.

14.2.3 The crane and rigging shall have a minimum rated lifting capacity of not less than 110% of the weight of the hammer and the casing.

14.3 When casings are extracted without the use of a vibratory hammer:

14.3.1 The operator shall be prohibited from bouncing, shock loading or free-falling of loads.

14.3.2 The operator should secure any hoisting lines that are not for the extraction.

14.4 In no case shall a crane's lifting capacity or the working loads of associated rigging be exceeded during extraction of a casing.

15. DRILLED SHAFT ENTRY

15.1 The practice of entering drilled shafts for activities such as hand cleaning, visual inspection and/or equipment retrieval should be undertaken only after a determination by a qualified person that there are no less-hazardous alternative methods to accomplish the work.

15.1.1 A written, site-specific entry and rescue plan must be created for each project where shaft entry will take place. The rescue plan shall be reviewed with all employees involved in shaft entry. The controlling entity(s) on site (owner and/or project constructor) shall be notified before each shaft entry.

15.1.2 All employees assigned duties associated with a shaft entry shall receive training in the recognition of the hazards associated with shaft entries, the duties and responsibilities of personnel entering the shaft, those attending to personnel in the shaft and those supervising the shaft entry. The content of the training shall be documented.

15.1.3 A competent person shall be continuously present at the topside of any drilled shaft during entry.

15.2 Only shafts with casings or liners having an inside diameter of at least 30 inches (76.2cm) may be entered.

15.2.1 If a drilled shaft is excavated without the use of a casing, then a temporary steel safety casing shall be inserted into the shaft prior to entry as described in 15.2.2.

15.2.2 Safety casings shall be installed from the top of the shaft to the bottom of the shaft. Where a qualified person has determined that deeper portions of shaft walls comprise competent rock, the casing may extend from the top of the shaft down and into at least 12 inches (30.5cm) of the competent rock.

15.2.3 The diameter of the safety casing in relationship with the diameter of the shaft shall not exceed 6 inches (15.2cm).

15.2.4 Where material or objects can fall into a shaft, protective linings or equivalent protection shall be used.

15.2.5 Hoses, lines and cordage suspended in shafts shall be equipped with whip socks or equivalent means to prevent overhead falling-object hazards.

15.2.6 No heavy equipment shall be operated within 20 feet (6m) of a drilled shaft where an entry operation is being performed.

15.3 Prior to entry, drilled shafts shall be dewatered unless constructed under water or with liquid-based slurry mixtures. Dewatering shall continue as necessary during shaft entry. If the shaft cannot be dewatered adequately, no person shall enter the shaft.

15.4 Access to the insides of drilled shafts shall be by portable ladders, fixed ladders attached to casings, frame/boom-supported hoisting equipment, boatswain's chairs or cranes/derricks.

15.4.1 Portable ladders used for shaft access shall comply with their manufacturer's requirements for use.

15.4.2 Fixed ladders attached to the insides of casings shall comply with ANSI/ALI A14.3, *Safety Requirements for Fixed Ladders*.

15.4.3 A frame or boom assembly used for the support of manual- or power-operated hoisting devices shall be designed and constructed in accordance with accepted engineering principles and be capable of supporting, without failure, at least five times the maximum intended load.

15.4.3.1 Frame or boom assemblies used to support hoisting devices should be marked with their maximum rated load capacity.

15.4.4 The structural and mechanical components of frame or boom-supported hoisting assemblies shall be inspected prior to the start of each work shift. The inspection shall be documented.

15.4.5 The legs of frames or booms shall be held in a fixed position using an adequate means of support.

15.4.6 Manual-operated hoisting devices used for personnel access in drilled shafts shall comply with ANSI/ASSE A10.8, *Scaffolding Safety Requirements*.

15.4.7 Power-operated hoisting devices used for personnel access in drilled shafts shall comply with ANSI/ASSE, A10.8 *Scaffolding Safety Requirements*.

15.4.8 Boatswains chairs used for shaft access shall comply with ANSI/ASSE A10.8, *Scaffolding Safety Requirements*.

15.4.9 Where manufacturers allow use of their equipment for such applications, the contractor shall comply with the requirements of ANSI/ASSE A10.28, *Work Platforms Suspended from Cranes or Derricks*.

15.4.10 At no time shall a mobile crane or dedicated drill rig be used to lower or hoist employees into or out of a drilled shaft if the equipment manufacturer prohibits it.

15.4.11 Drill rigs used for shaft entry must have a positive forward and reverse hydraulic winch.

15.4.12 Regardless of the method used for shaft entry, all entrants shall be protected by a personal fall protection system that complies with ANSI/ASSE A10.32, *Personal Fall Protection Used in Construction and Demolition Operations* and ANSI/ASSE Z359.4, *Safety Requirements for Assisted-Rescue and Self-Rescue Systems, Sub-systems and Components*.

15.5 Tests of the atmosphere in the shaft shall be performed before any entry into the shaft and continuously monitored while personnel are in the shaft.

15.6 During each shaft entry, the quality and quantity of air in the shaft shall be maintained in accordance with 15.6.2.1-15.6.2.3.

15.6.1 Oxygen levels shall be maintained between 19.5% and 23.5%.

15.6.2 Flammable, combustible or explosive mixtures of air shall be maintained below 5% of the Lower Flammable Limit (LFL).

15.6.3 Where measurements of toxic gases at or above 50% of the ACGIH TLVs® are detected, additional monitoring and abatement measures shall be undertaken. Whenever short-term exposure limits (STEL) are detected, work shall cease and all workers shall be removed from the shaft.

15.7 Prior to any work creating a source of ignition either inside a shaft or at its surface opening, the air quality shall be checked and, if necessary, the shaft shall be ventilated with mechanically-induced primary ventilation in the form of a fan and duct system until safe air quality is achieved Where necessary, the ventilation equipment shall be approved for hazardous (classified) locations.

15.8 Compressed air shall not be used for ventilation. The equipment delivering compressed air to shafts during entry shall be monitored for high temperatures and carbon monoxide.

15.9 Compressed gas cylinders shall not be taken into a drilled shaft.

15.10 Where other specific drilled shaft entry procedures are required, the more stringent shall apply.

16. WORKING OVER OR NEAR WATER

16.1 In every crew, there shall be designated signal persons to direct the operation of the deck engines, winches, tow/push boat, crane and/or drill rig. The operator shall receive signals from no other person except in an emergency.

16.2 Land-based cranes or drill rigs working from floating barges or pontoons shall operate at less than their rated capacities on land. An engineering survey shall be performed by a qualified person to determine allowable working loads and radii for equipment operated on floating vessels and structures.

16.2.1 The manufacturer's recommended load rating and allowable list and trim values for such equipment working from the water shall not be exceeded.

16.2.2 All deck surfaces of the crane pontoon or barge shall be above the water and the entire bottom of the pontoon or barge shall be submerged.

16.3 Employees working over or near water, where the danger of drowning exists, shall be provided with U.S. Coast Guard-approved life jackets or buoyant work vests.

When conventional fall protection is used (without exception) to prevent employees from falling into the water and the employer has effectively eliminated the drowning hazard, life jackets or buoyant work vests are not required.

16.4 When conventional fall protection is used, the following shall apply:

16.4.1 Where work over or near water is to be performed from a barge, float stage, temporary or permanent structure, template or cofferdam, walkways at least 20 inches (50.8cm) in width shall be provided across piles or other open work. Walkways shall be kept clear of trip hazards. Each employee on a walking/working surface (horizontal and vertical surface) with an unprotected side or edge which is 6 feet (1.8m) or more above any part of a temporary or permanent structure, template or cofferdam shall be protected from falling by fall protection in the form of standard guardrails, covers, nets or personal fall protection.

16.4.2 Guardrails shall be constructed to the requirements of ANSI/ASSE A10.18, *Safety Requirements for Temporary Roof and Floor Holes, Wall Openings, Stairway's, and Other Unprotected Edges.*

16.4.3 Ring buoys 30 inch (76.2cm) diameter with 90 feet (27.4m) of line attached shall be provided and located where readily available at intervals not exceeding 200 feet (61.0m) on all structures under construction over or near water. Where employees are concentrated in groups, there shall be additional ring buoys consisting of not less than one additional buoy for each 25 employees in the group's work area. Portable standards or equivalent means to hold the ring buoys in plain view shall be provided. All floating platforms in use for drilling operations, with the exception of small work rafts or pontoons, shall be equipped with at least two ring buoys.

16.5 At least one rescue skiff, adequately sized and equipped, shall be immediately available for use at all times during work activities.

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