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**United States
Coast Guard**



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INSPECTION GUIDE FOR REINFORCED CONCRETE VESSELS

Volume 1 INSPECTION GUIDE

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Construction Technology Laboratories
A Division of the Portland Cement Association

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16. Abstract This guide provides a check list for use by U.S. Coast Guard Marine Inspectors in the inspection of reinforced concrete vessels. It provides itemized requirements to insure quality of newly constructed vessels and proper maintenance of in-service vessels. Topics covered include materials, batching and mixing, inspection before concreting, inspection during concreting, inspection after concreting, testing hardened concrete, in-service inspection, and repairs. <table border="1" style="float: right;"> <tr> <td colspan="2">Accession For</td> </tr> <tr> <td>NTIS GRA&I</td> <td>☒</td> </tr> <tr> <td>DTIC TAB</td> <td>☐</td> </tr> <tr> <td>Unannounced</td> <td>☐</td> </tr> <tr> <td colspan="2">Justification</td> </tr> <tr> <td colspan="2">By</td> </tr> <tr> <td colspan="2">Distribution/</td> </tr> <tr> <td colspan="2">Availability Codes</td> </tr> <tr> <td>Dist</td> <td>Avail and/or Special</td> </tr> <tr> <td>A</td> <td></td> </tr> </table>				Accession For		NTIS GRA&I	☒	DTIC TAB	☐	Unannounced	☐	Justification		By		Distribution/		Availability Codes		Dist	Avail and/or Special	A	
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U.S. COAST GUARD
INSPECTION GUIDE FOR
REINFORCED CONCRETE VESSELS

1. INTRODUCTION

This Guide provides U.S. Coast Guard Marine Inspectors with a detailed check list of items to be considered for quality assurance of construction of reinforced concrete vessels and for in-service inspection of vessels. It is recognized that, within the regulatory role of the U.S. Coast Guard, the Marine Inspector does not serve to perform quality control tests for the vessel owner or contractor. However, it is necessary for the Inspector to monitor construction operations and to participate in in-service inspections so that he may determine if the condition of the vessel is satisfactory to insure safety of life and property at sea.

It is anticipated that general inspection and monitoring operations for reinforced concrete vessels will be similar to those for steel vessels. However, inspection of concrete vessel construction may require a greater level of effort. This is because concrete is essentially "manufactured" on site.

This guide is supplemented by a separate document entitled "Commentary on Inspection Guide for Reinforced Concrete Vessels," that provides background information for topics covered. It is assumed that Inspectors using the guide have knowledge of the fundamentals of concrete technology and reinforced and prestressed concrete.

Material in the guide is based on current practice for concrete in marine environments. The following publications have served as a basis for much of the material:

- (a) ACI Committee 357, "Guide for the Design and Construction of Fixed Offshore Concrete Structures," American Concrete Institute, 1978.
- (b) ACI Committee 318, "Building Code Requirements for Reinforced Concrete (ACI 318-77)," American Concrete Institute, 1977.
- (c) "Rules for the Design, Construction, and Inspection of Offshore Structures," Det Norske Veritas, 1977.
- (d) "Guidelines for the Design, Construction, and Classification of Floating Concrete Structures," Det Norske Veritas, 1978.
- (e) "Recommendations for the Design and Construction of Concrete Sea Structures," Federation Internationale de la Precontrainte, Third Edition, 1977.
- (f) ACI Committee 301, "Specifications for Structural Concrete for Buildings," American Concrete Institute, 1975.
- (g) "Inspection, Maintenance and Repair of Concrete Offshore Structures," Cement and Concrete Association, London, 1974.

Data in these publications were supplemented with information from references listed in Appendixes to this Guide.

1.1 Format of Guide

The Guide is presented as a detailed checklist. Primary objective of the list is to insure that items critical to quality assurance are monitored by U.S. Coast Guard inspection. Data in the checklist are not intended to supersede construction specifications and drawings. These documents should be closely examined prior to start of construction.

The frequency of U.S. Coast Guard inspection will depend on a number of factors including size and complexity of the project, experience and performance record of the contractor, experience and performance record of the testing laboratory, and experience of the Marine Inspector. The level of inspection effort will vary at different stages of construction. After

verification of test procedures, documentation, and flow of reports, the Coast Guard Marine Inspector may choose to monitor daily test reports, and only spot-check field operations. Although the inspector may not verify all items on the checklist, he should be certain that they have been considered in the construction process.

1.2 Use of the Guide

The Inspector's initials and the date of inspection should be entered after an item on the list has been verified. If the item is not applicable, the letters "NA" should be entered. If no entries appear after an item, it is assumed that the Inspector is not satisfied with the inspection results and that corrective measures are being taken. At the Inspector's option, corrective measures to be taken may be noted in the guide. Reinspection of an item may be indicated by entering initials and the new date in a different color.

Items marked with an asterisk (*) generally require inspection on a regular basis. Frequency of inspection will be based on specific requirements of each project.

Numbers of Sections 4 through 11 correspond to companion sections in the "Commentary on Inspection Guide for Reinforced Concrete Vessels."

2. VESSEL DATA

Vessel Name: _____

Official No.: _____

Type of Vessel: _____

Vessel Owner: _____

Shipyard: _____

Testing Laboratory(ies): _____

3. PRELIMINARY INSPECTION

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
1. Have design and drawings been approved by USCG Merchant Marine Technical Branch?	_____	_____	
2. Have plans and specifications been reviewed by inspector prior to start of construction?	_____	_____	
3. Has a preconstruction conference been held with USCG, Owner, Classification Society, Contractor, Testing Laboratory, and other interested parties to review construction specifications and to coordinate inspection operations?	_____	_____	
4. Have representatives been assigned for coordination of inspection between USCG, Owner, Classification Society, Contractor, Test Laboratory, and other interested parties?	_____	_____	
5. Have provisions been made for flow of records and reports?	_____	_____	
6. Does the Testing Laboratory(ies) meet requirements of ASTM E329?	_____	_____	
7. Has the Testing Laboratory(ies) been inspected by the Materials Reference Laboratory?	_____	_____	

4. MATERIALS

4.1 Cement

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
1. Does portland cement conform to ASTM C150 Type I, II, or III; or ASTM C595 Blended Hydraulic Cements?	_____	_____	
2. Are certified copies of mill test reports for cement included with each shipment as follows:			
(a) Chemical Analysis (ASTM C114)	_____	_____	
(b) Fineness by Turbidimeter (ASTM C115) or Fineness by Air Permeability (ASTM C204)	_____	_____	
(c) Autoclave Expansion (ASTM C151)	_____	_____	
(d) Time of Setting by Vicat Needle (ASTM C191) or Time of Setting by Gillmore Needles (ASTM C266)	_____	_____	
(e) Air Content of Mortar (ASTM C185)	_____	_____	
(f) Compressive Strength (ASTM C109)	_____	_____	
(g) False Set (ASTM C451) - Optional	_____	_____	
(h) Heat of Hydration (ASTM C186) - Optional	_____	_____	
3. Is tricalcium aluminate content (C ₃ A) within limits stated in construction specification?	_____	_____	
4. Is incoming cement sampled and tested to verify supplier's certifications?	_____	_____	
5. In addition, are tests ASTM C109 and ASTM C191 repeated monthly to check quality of cement in storage?	_____	_____	
6. If cement is packaged, is it marked showing type, brand, date of receipt, and manufacturer's name?	_____	_____	

4. MATERIALS

4.1 Cement (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
7. Is packaged cement protected from weather during shipment and storage?	_____	_____	
8. Is packaged cement used in the chronological order that it was delivered?	_____	_____	
9. Is bulk cement stored in weather-tight bins or silos?	_____	_____	
10. Are controls adequate to identify bulk cement?	_____	_____	
11. Are there individuals responsible for receiving, inspecting, storing, and handling cement?	_____	_____	
12. Are records available on all of the above items?	_____	_____	

4. MATERIALS

4.2 Aggregates

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
1. Do aggregates conform to ASTM C33 or C3307	_____	_____	
2. Is there more than one (1) location from which aggregate is obtained and are tests made from each?	_____	_____	
3. Have the following tests been performed on the aggregate?	_____	_____	
(a) Grading and Fineness Modulus (ASTM C136 or ASTM C330)	_____	_____	
(b) Amount of Material Finer Than No. 200 Sieve (ASTM C117)	_____	_____	
(c) Organic Impurities (ASTM C40)	_____	_____	
(d) Mortar Strength Test (ASTM C87)	_____	_____	
(e) Soundness (ASTM C88)	_____	_____	
(f) Friable Particles (ASTM C142)	_____	_____	
(g) Coal and Lignite (ASTM C123)	_____	_____	
(h) Abrasion of Coarse Aggregate (ASTM C131 or ASTM C535)	_____	_____	
(i) Specific Gravity and Absorption - Coarse Aggregate (ASTM C127)	_____	_____	
(j) Specific Gravity and Absorption - Fine Aggregate (ASTM C128)	_____	_____	
(k) Bulk Unit Weight (ASTM C29)	_____	_____	
(l) Water Soluble Chlorides (ASTM D1411)	_____	_____	
(m) Flat or Elongated Particles (ASTM C125 and ASTM D3398 or Corps of Engineers Spec. CRD-C119-53)	_____	_____	

4. MATERIALS

4.2 Aggregates (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
(n) Soft Particles (ASTM C235)	_____	_____	
(o) Compressive and Flexural Strength in Concrete (ASTM C39 and ASTM C78).	_____	_____	
(p) Freezing and Thawing Resistance (ASTM C682 or C666)	_____	_____	
(q) Reactive Aggregates (ASTM C227, ASTM C289, ASTM C342, and ASTM C586)	_____	_____	
4. Are incoming aggregates sampled and tested to verify supplier's certification and are tests pro- perly documented?	_____	_____	
5. Do procedures for unloading aggre- gates prevent harmful segregation and breakage?	_____	_____	
6. Do procedures for stockpiling prevent harmful segregation and breakage?	_____	_____	
7. Is aggregate stored in a manner to prevent contamination and inclusion of foreign material in the concrete, and to insure that aggregates are not intermingled?	_____	_____	
8. Is free water in aggregates allowed to drain prior to their use?	_____	_____	
9. Do procedures for prewetting lightweight aggregate provide thorough and uniform distribution of water?	_____	_____	
10. If marine aggregates are used, are they washed with fresh water so that chloride and sulfate contents are within limits of construction specifications?	_____	_____	

4. MATERIALS

4.2 Aggregates (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
11. Does maximum aggregate size conform to construction specifications?	_____	_____	
12. Are records available for all above items?	_____	_____	

4. MATERIALS

4.3 Mixing Water

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
1. Is water supply adequate and supplied at pressures sufficiently uniform to insure accurate measurement?	_____	_____	
2. Is water potable?	_____	_____	
3. Have the following tests been performed on the water (including ice) by the Testing Laboratory?	_____	_____	
(a) Chloride Content (ASTM D512)	_____	_____	
(b) Sulfate Content (ASTM D516)	_____	_____	
4. Are chloride and sulfate contents within limits of construction specifications?	_____	_____	
5. Are records available on all above items?	_____	_____	

4. MATERIALS

4.4 Admixtures

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
1. Is handling and storage system adequate to prevent inadvertent mixing or contamination of admixtures?	_____	_____	
2. Are admixture containers clearly labeled by type, proprietary name, and amount?	_____	_____	
3. Are liquid admixtures protected to prevent freezing?	_____	_____	
4. Is agitation provided for liquid admixtures that are not stable solutions?	_____	_____	
5. Are all admixtures being used as specified in construction specifications or as approved by the design office?	_____	_____	
6. Does air-entraining admixture conform to ASTM C260?	_____	_____	
7. Do water-reducing admixtures, retarding admixtures, accelerating admixtures, water-reducing and retarding admixtures, and water-reducing and accelerating admixtures conform to ASTM C494?	_____	_____	
8. If pozzolans are used, do they conform to ASTM C618 and have they been tested for sulfate resistance and corrosion when used in concrete with the selected type of cement?	_____	_____	
9. If two or more admixtures are used, is their compatibility documented?	_____	_____	
10. Does use of admixtures containing chloride ions result in excess chloride content as established by construction specifications?	_____	_____	
11. Are records available on all above items?	_____	_____	

4. MATERIALS

4.5 Reinforcing and Prestressing Steel

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
1. Is deformed steel being used for all reinforcement except spirals or prestressing tendons?	_____	_____	
2. Do deformed reinforcing bars conform to ASTM A615, A616, A617, or A706?	_____	_____	
3. Are certified test reports of heat number, chemical analysis, and mechanical properties submitted for each heat and size of bar?	_____	_____	
4. Does yield strength of deformed reinforcement conform to that determined by tests on full size bars?	_____	_____	
5. Do bend test requirements for deformed reinforcement conform to ACI 318-77, Section 3.5.3.2?	_____	_____	
6. Is weldable reinforcing steel being used in the splash zone, unless otherwise indicated in the construction specifications?	_____	_____	
7. Do epoxy coated or galvanized reinforcing bars meet requirements of construction specifications?	_____	_____	
8. Do bar and rod mats for concrete reinforcement conform to ASTM A184?	_____	_____	
9. Does smooth wire for spiral reinforcement conform to ASTM A82?	_____	_____	
10. Does deformed wire for concrete reinforcement conform to ASTM A496?	_____	_____	
11. Does welded smooth wire fabric for concrete reinforcement conform to ASTM A195?	_____	_____	
12. Does welded deformed wire fabric for concrete reinforcement conform to ASTM A497?	_____	_____	

4. MATERIALS

4.5 Reinforcing and Prestressing Steel (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
13. For bars, wire, or wire fabric with a specified yield strength exceeding 60,000 psi, is the yield strength defined at a stress corresponding to a strain of 0.35 percent?	_____	_____	
14. Are certified test reports of chemical analysis and mechanical properties submitted for deformed wire, wire fabric, and smooth wire reinforcement?	_____	_____	
15. Are shipments of reinforcing materials identified as to heat number, manufacturer, size, type, and grade?	_____	_____	
16. Are reinforcing materials segregated and stored according to type, grade, and size?	_____	_____	
17. Does the Test Laboratory perform sampling to verify supplier's certifications?	_____	_____	
18. Is rejected reinforcement tagged and separated from acceptable reinforcement?	_____	_____	
19. Do prestressing wires, strands, and bars conform to ASTM A421, ASTM A416, and ASTM A722, respectively?	_____	_____	
20. If low-relaxation wire or strand is specified, are tests in accordance with ASTM E328?	_____	_____	
21. Do anchorage components for prestressing systems conform to dimensions, finish, alignment, and tolerances given in Construction Specifications?	_____	_____	

4. MATERIALS

4.5 Reinforcing and Prestressing Steel (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
22. Are anchorages and couplings capable of developing at least 95% of the minimum specified ultimate tensile strength of the prestressing steel in the unbonded condition without exceeding anticipated set?	_____	_____	
23. Have prestressing tendon assemblies been tested under static and dynamic conditions in accordance with PTI Guide Specifications unless otherwise stated in the construction specifications?	_____	_____	
24. Are certified test reports on prestressing materials and tendon assemblies available?	_____	_____	
25. Are prestressing materials and tendon assemblies shipped and stored in weathertight enclosures to insure protection against corrosion?	_____	_____	
26. Are welding, flame cutting or similar operations carried out far enough away from stored prestressing tendons to insure that temperature of the tendons is not raised and that tendons are not splashed with weld material?	_____	_____	
27. Are prestressing tendons kept clean, and free from grease, insoluble oil, deposits of salt, or any other material likely to affect bond or durability?	_____	_____	
28. Are protective wrappings or coatings for tendons chemically neutral and designed to prevent electro-corrosive attack?	_____	_____	
29. Are records available for all above items?	_____	_____	

4. MATERIALS

4.6 Post-Tensioning Ducts

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
1. Are post-tensioning ducts semi-rigid, mortar-tight, and water-tight with at least 1 mm wall thickness?	_____	_____	
2. Are ducts nonreactive with concrete, tendons, or filler material?	_____	_____	
3. Are ferrous ducts or galvanized metal ducts passivated by chromate wash?	_____	_____	
4. Have plastic ducts been rejected unless specified in construction specifications?	_____	_____	
5. Do ducts for single wire, strand, or bar tendons have an inside diameter at least 1/4 in. larger than the nominal diameter of the tendon?	_____	_____	
6. Do ducts for multiple wire, strand, or bar tendons have an inside cross-sectional area at least twice the nominal net area of the enclosed tendon?	_____	_____	
7. Are bell and spigot joints used with saw-cut ends free of burrs and dents?	_____	_____	
8. Are ducts provided with openings at both ends for grout injection?	_____	_____	
9. Are ducts stored clear of the ground and protected from weather?	_____	_____	

4. MATERIALS

4.7 Grout for Bonded Tendons

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
1. Does cement for grout conform to ASTM C150 Type I, II, or III?	_____	_____	
2. Does cement satisfy limits for tricalcium aluminate content specified in construction specifications?	_____	_____	
3. Does mixing water satisfy limits on chloride and sulfate content specified in construction specifications?	_____	_____	
4. Is mixing water potable?	_____	_____	
5. Does sand, if used, conform to ASTM C144 (with exception of gradation which may be modified as necessary for workability)?	_____	_____	
6. Have admixtures for grout been tested for possible injurious effects on grout, steel, or concrete (chlorides, for example)?	_____	_____	
7. Have admixtures been screened to insure that calcium chloride is not used?	_____	_____	
8. Have mix proportions for grout been established by test results on fresh and hardened material or, alternatively, on the basis of prior documented experience?	_____	_____	
9. Are total chlorides in grout limited to those stated in construction specifications?	_____	_____	
10. Does water-cement ratio of the grout exceed 0.45 by weight?	_____	_____	
11. Is free volumetric expansion of grout limited to 10%?	_____	_____	

4. MATERIALS

4.7 Grout for Bonded Tendons (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
12. Is bleeding of grout, tested in accordance with PTI Guide Specifications, limited to 2% by volume three hours after mixing, and is the separated water reabsorbed after 24 hours?	_____	_____	

4. MATERIALS

4.8 Inserts and Embedments

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
1. Is use of aluminum inserts and embedments prohibited?			
2. Are reinforcing bars used for anchorage of embedment plates made of weldable steel?	_____	_____	
3. Are reinforcing bars attached to anchorage plates by full penetration welds made in accordance with AWS D12.1?	_____	_____	

4. MATERIALS

4.9 Concrete

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
*1. Does the maximum water-cement ratio of the mix conform to the construction specifications?	_____	_____	
*2. Does the minimum cement content conform to the construction specifications?	_____	_____	
*3. Does the minimum design compressive strength conform to the construction specifications?	_____	_____	
*4. Has the minimum design compressive strength been increased, and are aggregates sufficiently hard, in areas where severe abrasion is anticipated?	_____	_____	
*5. Does amount of air entrainment conform to the construction specifications?	_____	_____	
*6. Does total chloride content of concrete conform to the construction specifications?	_____	_____	
7. Have measures been established to minimize cracking in thin sections and to prevent excessive thermal stresses in mass concrete where high cement contents (in excess of approximately 700 lbs per cubic yard of concrete) are used?	_____	_____	

5. BATCHING AND MIXING CONCRETE

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
1. Does the ready mix concrete production facility meet certification requirements established by NRMCA?	_____	_____	
2. Does the accuracy of weighing scales conform to ASTM C94 unless otherwise stated in the construction specifications?	_____	_____	
3. Are scales arranged so that the plant operator can observe all dials or indicators during the operation?	_____	_____	
4. Are cement, aggregate, and water weight recorders functioning properly?	_____	_____	
5. Is equipment for automatic measuring of moisture content of aggregate functioning properly?	_____	_____	
6. Is bulk cement weighed on a separate scale in a separate weigh batcher?	_____	_____	
7. Are batching controls inter-locked to prevent starting of a new batching cycle before all batchers are completely empty?	_____	_____	
8. Is batching equipment capable of meeting accuracy limits stated in ASTM C94?	_____	_____	
9. Is there leakage when valves are closed in the delivery water system?	_____	_____	
10. Are filling and discharge valves interlocked to prevent discharging before completion of filling operation?	_____	_____	
11. Are scale calibration records available?	_____	_____	
12. Are scale calibrations repeated at least quarterly unless otherwise stated in construction specifications?	_____	_____	

5. BATCHING AND MIXING CONCRETE (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
13. If separate dispensers are not used for liquid admixtures, are provisions made for cleaning dispensers when admixtures are changed?	_____	_____	
14. Is admixture dispenser system free of leaks and properly valved to prevent backflow or siphoning?	_____	_____	
15. Do mixer and agitator trucks carry TMCB rating plate?	_____	_____	
16. Do concrete delivery trucks conform to ASTM C94?	_____	_____	
17. Are all trucks equipped with accurate revolution counters?	_____	_____	
18. Are mixers operated at manufacturer's designated drum speed?	_____	_____	
19. When truck mixing, do number of revolutions conform to ASTM C94 or the construction specifications?	_____	_____	
20. Are mixer drums free of hardened concrete?	_____	_____	
21. When a mixer produces unsatisfactory results, is its use discontinued?	_____	_____	
22. When ice is used to cool mixing water, is it finely crushed, shaved or chipped?	_____	_____	
23. Is ice completely melted at end of mixing?	_____	_____	
24. In cold weather, are provisions made for heating water and/or aggregates to insure specified temperature at placement of concrete?	_____	_____	

5. BATCHING AND MIXING CONCRETE (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
25. In cold weather, are procedures established to insure that cement is not mixed with water, or with mixtures of water and aggregates, having a temperature greater than 100F?	_____	_____	
26. In cold weather, are there adequate provisions to prevent materials containing frozen clumps, ice or snow from entering batching equipment?	_____	_____	
27. Are precautions taken to insure that deleterious salts or chemicals are not used to lower the freezing point of water?	_____	_____	
28. Are batching and mixing procedures for lightweight aggregate concrete in accordance with the construction specifications?	_____	_____	
*29. Do delivery tickets contain following information:			
(a) Name of ready-mixed concrete company?	_____	_____	
(b) Plant designation where batched?	_____	_____	
(c) Ticket serial number?	_____	_____	
(d) Truck number or designation?	_____	_____	
(e) Name of contractor or purchaser?	_____	_____	
(f) Job designation?	_____	_____	
(g) Concrete designation?	_____	_____	
(h) Amount of concrete (cubic yards)?	_____	_____	
(i) Date?	_____	_____	
(j) Time batch was loaded?	_____	_____	

5. BATCHING AND MIXING CONCRETE (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
(k) Extra water added at request of receiver and his signature?	_____	_____	
(l) Type and name of admixtures and amount batched?	_____	_____	
*30. Are delivery tickets properly filled in and signed?	_____	_____	
*31. Do delivery tickets accompany each load of concrete?	_____	_____	
*32. Are delivery tickets completed and filed at point of receipt?	_____	_____	

6. INSPECTION BEFORE CONCRETING

6.1 Reinforcement

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
*1. At time of concrete placement, is reinforcement free of mud, loose rust, grease, oil, deposits of salts, ice, snow, or other materials that may adversely affect bond or durability?	_____	_____	
*2. Do reinforcing bars with mill-scale or rust meet minimum dimensions specified in ASTM A615, A616, A617, or A706 as applicable (based on hand wire brushed test specimen)?	_____	_____	
*3. Where standard hooks for reinforcing bars are specified, do they conform to ACI 318?	_____	_____	
*4. Do bend diameters of reinforcement conform to ACI 318, unless otherwise stated in the construction specifications?	_____	_____	
5. Is reinforcement fabricated prior to placement cold bent?	_____	_____	
6. Are provisions made to insure that field bending of reinforcement partially embedded in concrete is only done after approval by the project engineer, unless such bends are shown on construction drawings?	_____	_____	
7. Do welds of reinforcing bars conform to AWS D12.1?	_____	_____	
8. Are welders qualified in accordance with AWS D12.1?	_____	_____	
*9. Are records of welding procedures and weld qualifications maintained?	_____	_____	
*10. Are procedures established to insure that tack welds are not used on reinforcement unless authorized by the project engineer?	_____	_____	

6. INSPECTION BEFORE CONCRETING

6.1 Reinforcement (Continued)

	<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
11.	Do welding procedures prohibit grounding to reinforcement?	_____	_____	
12.	Is reinforcement protected against weld splatter and arcs due to strikes or current drainage?	_____	_____	
*13.	Are completed welds visually inspected for cracks and size?	_____	_____	
*14.	Are defective welds repaired or replaced?	_____	_____	
*15.	Are reinforcing bar splices located in accordance with the construction specifications?	_____	_____	
*16.	Is length of lap splices of reinforcing bars and welded wire fabric in accordance with the construction specifications?	_____	_____	
*17.	Are anchorage lengths of embedded reinforcement in accordance with the construction specifications?	_____	_____	
*18.	Do mechanical splices of reinforcement conform to the construction specifications?	_____	_____	
19.	Have tensile tests conforming to ASTM A370 been conducted on samples of bars mechanically spliced to insure that strength of the bar can be developed and that elongation across the splice does not exceed specified limits?	_____	_____	
*20.	Is reinforcement located and securely supported to insure that specified concrete cover will be obtained?	_____	_____	
*21.	Is reinforcement placed within tolerances specified in ACI 318 unless otherwise stated in the construction specifications?	_____	_____	

6. INSPECTION BEFORE CONCRETING

6.1 Reinforcement (Continued)

	<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
*22.	Does spacing of reinforcement conform to ACI 318 unless otherwise stated in the construction specifications?	_____	_____	
*23.	Does use of bundled reinforcement conform to requirements of ACI 318 unless otherwise stated in construction specifications?	_____	_____	

6. INSPECTION BEFORE CONCRETING

6.2 Prestressing Tendons

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
*1. Is all steel for prestressing tendons free of mud, rust, grease, insoluble oil, deposits of salt, or any other material that may adversely affect bond or durability?	_____	_____	
2. Are welding operations conducted to insure that temperature of prestressing steel is not raised and that tendons are not splashed with weld material?	_____	_____	
3. Do welding procedures prohibit grounding to prestressing tendons?	_____	_____	
*4. Are ducts for prestressing tendons located in accordance with construction drawings?	_____	_____	
*5. Are tolerances in placement of ducts for prestressing tendons in accordance with ACI 318 unless otherwise stated in the construction specifications?	_____	_____	
*6. Are ducts securely fastened to prevent movement during concreting?	_____	_____	
*7. Are ducts watertight with splices taped to prevent intrusion of water, grout, or concrete?	_____	_____	
*8. Are ends of ducts sealed during construction to prevent entry of water?	_____	_____	
9. If ducts are coated to protect against excessive rust, is a chemically neutral protective agent, such as a vapor phase inhibitor powder, employed?	_____	_____	
*10. Are air vents provided at peaks in the duct profile?	_____	_____	

6. INSPECTION BEFORE CONCRETING

6.2 Prestressing Tendons (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
*11. Are drains provided at valleys of duct profile?	_____	_____	
*12. Are couplers used only in locations specified on construction drawings?	_____	_____	
*13. Are coupler housings long enough to permit necessary movements?	_____	_____	
*14. If flexible metal ducts are specified in special areas, are they supported by curved bearing plates to prevent local crushing?	_____	_____	
*15. Are ducts inspected for damage after placement of ducts, reinforcement, embedments, and forming is complete?	_____	_____	
*16. Are holes or openings repaired prior to concrete placement?	_____	_____	
*17. Are anchorages (bearing plates) located, aligned, and secured to insure that tolerances in the construction specifications will be met?			

6. INSPECTION BEFORE CONCRETING

6.3 Formwork and Embedments

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
*1. Is formwork located to insure that the final structure will conform to shape, lines, dimensions, and tolerances stated in construction specifications and drawings?	_____	_____	
*2. Is formwork constructed, supported, and braced in accordance with the construction specifications?	_____	_____	
3. Is formwork constructed so as not to damage previously placed concrete?	_____	_____	
*4. Is formwork sufficiently tight to prevent leakage of mortar?	_____	_____	
*5. Are water and foreign matter being removed from interior of forms prior to concrete placement?	_____	_____	
*6. Is formwork cleaned before reuse?	_____	_____	
*7. Has specified release agent been applied to formwork?	_____	_____	
*8. If precast concrete segments are used as forms, are placement tolerances in conformance with the construction specifications?	_____	_____	
*9. If precast concrete segments are used as forms, have surfaces been prepared in accordance with construction specifications?	_____	_____	
*10. Are precast concrete segments supported to prevent movement during concreting?	_____	_____	
*11. Are ties and connectors between precast concrete form segments in accordance with construction specifications?	_____	_____	
*12. Are construction loads monitored to insure that formwork is not accidentally overloaded?			

6. INSPECTION BEFORE CONCRETING

6.3 Formwork and Embedments (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
*13. Are embedded items secured in position, inspected and approved prior to concrete placement?	_____	_____	
*14. Are metallic embedded items and anchors electrically isolated from primary steel reinforcement in accordance with construction specifications?	_____	_____	
*15. Are embedded items free of oil, grease, dirt, paint, rust, deposits of salt, or any other material that may adversely affect bond or durability?	_____	_____	
*16. Are premolded waterstops, if specified, installed to minimize the number of joints?	_____	_____	
*17. Are voids in sleeves, inserts, and anchor slots protected against intrusion of concrete?	_____	_____	

6. INSPECTION BEFORE CONCRETING

6.4 Construction Joints

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
*1. Are construction joints located as indicated in construction specifications and drawings?	_____	_____	
*2. Are construction joints cleaned in accordance with construction specifications to remove laitance and unsound material, and to uniformly expose coarse aggregate?	_____	_____	
*3. After cleaning, is maximum size aggregate exposed to approximately 25% of its nominal diameter?	_____	_____	
*4. If specified, is epoxy-resin or other bonding compound applied in accordance with manufacturer's recommendations?	_____	_____	
*5. If specified, is cement content being increased at start of the next placement?	_____	_____	
*6. Are construction joints inspected after forms are placed to insure that form release agents or other foreign materials have not come into contact with the hardened concrete surface against which fresh concrete is to be placed?	_____	_____	

7. INSPECTION DURING CONCRETING

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
*1. Are material proportions and admixtures in accordance with approved mix design?	_____	_____	
*2. Is concrete transported from mixers to place of final deposit by methods that prevent segregation or loss of materials?	_____	_____	
3. Is transporting equipment adequate to insure continuous supply of concrete without delays in excess of limits given in the construction specifications?	_____	_____	
4. If concrete is pumped, have trials been made to insure compatibility of mix with equipment being used?	_____	_____	
5. If concrete is pumped, is use of aluminum or aluminum alloy pipe prohibited?	_____	_____	
*6. Is equipment for transporting and placement clean and free of foreign material?	_____	_____	
*7. Are delivery tickets being completed at point of receipt of concrete?	_____	_____	
*8. Are batches rejected if they do not meet slump requirements of the construction specifications?	_____	_____	
9. Is there adequate control to prevent use of concrete that has contained its mixing water for a period longer than stated in the construction specifications?	_____	_____	
10. Is there adequate control to prevent use of concrete that has attained initial set?	_____	_____	

7. INSPECTION DURING CONCRETING (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
11. Is addition of water and remixing of concrete, if required, done under careful supervision and in accordance with the construction specifications?	_____	_____	
*12. If ice or foreign materials are present in concrete, is the batch rejected?	_____	_____	
*13. Are rejected batches noted on delivery ticket?	_____	_____	
*14. Are required number of control test specimens being made in accordance with the construction specifications?	_____	_____	
*15. Are placement temperatures of concrete within limits stated in the construction specifications?	_____	_____	
16. Do the construction specifications permit concrete placement during rain, sleet, or snow?	_____	_____	
17. Are procedures established to prevent rainwater from increasing mixing water or damaging the concrete surfaces?	_____	_____	
*18. Is concrete deposited as near as possible to its final location?	_____	_____	
*19. Is concrete deposited so as to avoid segregation or loss of materials?	_____	_____	
*20. Is concrete thoroughly consolidated by vibration immediately after placement?	_____	_____	
*21. Is placement of internal vibrators and spacing of external vibrators adequate to insure complete consolidation?	_____	_____	

7. INSPECTION DURING CONCRETING (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
*22. Is concrete thoroughly worked around reinforcement and embedded fixtures, and into corners of forms?	_____	_____	
*23. Is there any evidence of excess free water, indicating excessive bleeding, at top of lifts after concrete is consolidated?	_____	_____	
*24. Are the following records being maintained:			
(a) Delivery batch tickets?	_____	_____	
(b) Daily summary report of batch plant activities?	_____	_____	
(c) Daily summary report of concrete field operations?	_____	_____	
(d) Records of disposition of rejected batches?	_____	_____	
(e) Test results?	_____	_____	
(f) Copies of batch plant recorder tapes for each batch?	_____	_____	
*25. Are slump tests being performed in accordance with ASTM C143?	_____	_____	
*26. Are tests for air content being performed in accordance with ASTM C231 or ASTM C173 or ASTM C138?	_____	_____	
*27. Is unit weight, of normal weight concrete being measured in accordance with ASTM C138?	_____	_____	
28. For lightweight concrete that must meet specified limits on air-dry unit weight, has fresh unit weight been correlated with air-dry unit weight (tested in accordance with ASTM C567) to permit use of fresh unit weight as basis for acceptance?	_____	_____	

7. INSPECTION DURING CONCRETING (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
*29. Are control test specimens being made and cured in accordance with ASTM C31?	_____	_____	
30. If concrete is pumped, has a correlation been established for differences in concrete properties sampled at point of delivery to pump and at point of discharge from line?	_____	_____	

8. INSPECTION AFTER CONCRETING

8.1 Finishing, Curing, and Formwork Removal

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
*1. For decks or other flatwork, after concrete has been placed, consolidated, and screeded; are floating and troweling delayed until the surface water sheen has disappeared?	_____	_____	
*2. Is freshly placed concrete maintained in a moist condition for the period stated in the construction specification?	_____	_____	
*3. Do the construction specifications permit use of a heavy-duty membrane curing compound or a curing mat cover to prevent loss of moisture in lieu of continuous moist curing?	_____	_____	
*4. Unless specifically permitted by the construction specifications, is seawater prohibited for curing concrete?	_____	_____	
*5. In cold weather, is minimum temperature of concrete kept above the limit stated in the construction specification?	_____	_____	
6. In cold weather, are precautions taken to insure that freshly placed concrete is not exposed to carbon dioxide from exhaust gases of heaters?	_____	_____	
*7. In hot weather, are procedures established to keep surfaces from cracking due to rapid drying?	_____	_____	
*8. Is concrete damaged by freezing rejected and replaced?	_____	_____	
*9. Is concrete damaged by accelerated evaporation rejected and replaced?	_____	_____	

8. INSPECTION AFTER CONCRETING

8.1 Finishing, Curing, and Formwork Removal (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
10. If accelerated curing is used for precast segments, is the curing process documented to insure strength and durability equivalent to standard moist curing?	_____	_____	
11. Are forms and shores removed only after test strengths of concrete are sufficient to insure that the structure can support its own weight plus any construction loads?	_____	_____	
*12. Are procedures for formwork removal such that they do not impair safety or serviceability of the structure?	_____	_____	
*13. After removal of formwork, are formed surfaces finished in accordance with the construction specifications?	_____	_____	
*14. After removal of formwork, are holes left from form ties filled in accordance with the construction specifications?	_____	_____	
*15. If defects such as honeycombing occur, is their significance with regard to future performance evaluated prior to undertaking repair?	_____	_____	
*16. If defects such as honeycombing are to be repaired, are repair procedures used in accordance with the construction specifications?	_____	_____	

8. INSPECTION AFTER CONCRETING

8.2 Control Tests of Hardened Concrete

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
1. Are control test specimens being cured in accordance with ASTM C31?	_____	_____	
2. Are test cylinders being tested for compressive strength in accordance with ASTM C39?	_____	_____	
3. Are required numbers of control specimens being tested in accordance with construction specification?	_____	_____	
4. Are test specimens being weighed?	_____	_____	
5. Does structural lightweight concrete meet specified limit on air-dry unit weight as tested in accordance with ASTM C567?	_____	_____	
6. Are results of control tests properly documented?	_____	_____	
7. If splitting tensile tests are required by the construction specification, are tests being conducted in accordance with ASTM C496?	_____	_____	
8. Is evaluation of strength test results in accordance with the construction specification?	_____	_____	

8. INSPECTION AFTER CONCRETING

8.3 Post-Tensioning and Grouting

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
1. Are post-tensioning operations under direction of an experienced supervisor and carried out by trained operators?	_____	_____	
*2. Are tendons being stressed in sequence stated in construction specification?	_____	_____	
*3. Has concrete reached specified strength prior to start of post-tensioning?	_____	_____	
*4. Are components of tensioning equipment accurately set, aligned, and securely supported prior to start of tensioning?	_____	_____	
*5. Are post-tensioning forces determined by measurement of tendon elongation <u>and</u> by measurement of jacking force?	_____	_____	
*6. Is the cause for any difference of more than 5% between the two methods of measurement of post-tensioning forces determined and corrected?	_____	_____	
*7. Is the total loss of prestress resulting from unreplaced broken tendon elements less than 2% of the total prestress?	_____	_____	
8. Are hydraulic pressure gages for measuring jacking force calibrated against known standards (the gage and jack should be calibrated as a unit)?	_____	_____	
9. If load cells are used for measuring jacking force, are they calibrated against known standards?	_____	_____	
*10. Are maximum stressing force levels in conformance with the construction specification?	_____	_____	

8. INSPECTION AFTER CONCRETING

8.3 Post-Tensioning and Grouting (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
*11. Are records kept for all stressing operations?	_____	_____	
*12. If precast segmental construction is used, are procedures for treatment of surfaces between segments in accordance with the construction specifications?	_____	_____	
13. Is grout for permanent protection of post-tensioning tendons mixed in equipment capable of continuous mechanical mixing and agitation that will produce uniform distribution of materials?	_____	_____	
14. Are procedures established to insure that water is not added to increase grout flowability that has been decreased by delayed use of grout?	_____	_____	
15. Is the grout screened prior to its introduction into the pump?	_____	_____	
16. Is the grout pumped continuously to prevent air from being drawn into the post-tensioning duct?	_____	_____	
*17. Are grout temperatures limited to less than 90F during mixing and pumping?	_____	_____	
*18. Has all oil or similar material used for internal protection of the duct been removed prior to grouting (water-soluble oil may be left in ducts or on tendons)?	_____	_____	
19. Are procedures for opening and closing air vents and drains established prior to start of grouting?	_____	_____	
20. Is pumping pressure at tendon inlet limited to maximum specified?	_____	_____	

8. INSPECTION AFTER CONCRETING

8.3 Post-Tensioning and Grouting (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
21. Do procedures for grouting long vertical tendons insure that no water is trapped at the upper end because of bleeding or other causes?	_____	_____	
22. Have procedures been established, or are thixotropic admixtures being used, to prevent pockets caused by bleeding when grouting vertical or steeply inclined tendons?	_____	_____	
*23. In cold weather, is grout protected from freezing?	_____	_____	
*24. Are prestressing anchorages protected from exposure to seawater in accordance with the construction specification?	_____	_____	

9. IN-SERVICE INSPECTION

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
1. Has vessel been surveyed within required inspection period?	_____	_____	
2. Have records from previous in-service inspection surveys been reviewed?	_____	_____	
3. Has a reference system been established to permit clear identification of inspected areas and to permit accurate designation of location of problem areas?	_____	_____	
4. Are data sheets and forms available for recording results of in-service condition inspection?	_____	_____	
5. Has marine growth or other debris been removed as required to permit inspections?	_____	_____	
6. With regard to damage, have exterior and interior of vessel been visually inspected for signs of:			
(a) Impact damage?	_____	_____	
(b) Excessive distortions?	_____	_____	
(c) Flexural cracking (hogging or sagging)?	_____	_____	
(d) Torsional cracking?	_____	_____	
(e) Shear cracking?	_____	_____	
(f) Concrete crushing?	_____	_____	
7. With regard to durability, have exterior and interior of vessel been visually inspected for signs of:			
(a) Cracking?	_____	_____	
(b) Spalling?	_____	_____	
(c) Scaling?	_____	_____	
(d) Disintegration?	_____	_____	

9. IN-SERVICE INSPECTION (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
(e) Popouts?	_____	_____	
(f) Erosion?	_____	_____	
(g) Corrosion?	_____	_____	
(h) Water Leakage?	_____	_____	
8. Have areas around prestressing tendons anchorages been inspected for signs of corrosion or deterioration?	_____	_____	
9. Have cathodic protection systems, if used, been inspected and serviced?	_____	_____	
10. Have exposed metal components and embedments been inspected for corrosion or other signs of deterioration?	_____	_____	
11. Have areas previously repaired been closely inspected to evaluate condition of repair?	_____	_____	
12. Has condition of protective coatings, if used, been inspected?	_____	_____	
13. Have following parts of the vessel been given special attention:			
(a) Areas subjected to alternate wetting and drying?	_____	_____	
(b) Areas subjected to freezing and thawing?	_____	_____	
(c) Areas of stress concentrations?	_____	_____	
(d) Areas of critical load transfer?	_____	_____	
(e) Areas containing construction joints?	_____	_____	
(f) Areas previously repaired?	_____	_____	

9. IN-SERVICE INSPECTION (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
14. Are divers selected for underwater inspection qualified, experienced, trained for examination of concrete hulls, and adequately briefed on the project?	_____	_____	
15. Are areas that require detailed examination and nondestructive testing clearly marked?	_____	_____	
16. If areas of deterioration are suspected of affecting structural integrity of the vessel, are procedures for engineering review prior to repairs being undertaken?	_____	_____	

10. IN SITU TESTING OF HARDENED CONCRETE

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
1. Have specifications for test methods and sampling plan been appraised by USCG?	_____	_____	
2. Is hardened concrete being examined and sampled following practices recommended in ASTM C823?	_____	_____	
3. For evaluation of hardened concrete under water, have accuracy and reliability of test method selected been documented?	_____	_____	
4. If drilled cores and sawed beams are specified for evaluating hardened concrete, are they obtained and tested in accordance with ASTM C42?	_____	_____	
5. Are numbers and locations of cores and beams obtained in accordance with specifications?	_____	_____	
6. Are test data on cores and beams available to correlate results for differences in moisture content between samples as tested and in situ concrete?	_____	_____	
7. Are holes left from drilled cores and sawed beams filled in accordance with specified repair procedures?	_____	_____	
8. Are records available for core and beam test results?	_____	_____	
9. If a rebound hammer is being used to evaluate hardened concrete, are rebound numbers obtained in accordance with ASTM C805?	_____	_____	
10. If specified, has rebound hammer been calibrated using concrete cylinders made from same concrete as in the vessel?	_____	_____	
11. If specified, are data available to correlate rebound numbers with core tests?	_____	_____	

10 IN SITU TESTING OF HARDENED CONCRETE (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
12. If rebound numbers are correlated with core tests, are differences in moisture conditions considered?	_____	_____	
13. Are numbers and locations of rebound readings in accordance with specifications?	_____	_____	
14. Are records available for rebound hammer test results?	_____	_____	
15. If a penetration device is being used to evaluate hardened concrete, is penetration resistance obtained in accordance with ASTM C803?	_____	_____	
16. Are numbers and locations of penetration readings in accordance with specifications?	_____	_____	
17. If specified, has penetration device been calibrated using concrete made with same materials?	_____	_____	
18. Are holes left from penetration tests filled in accordance with specified repair procedures?	_____	_____	
19. Are records available for penetration test results?	_____	_____	
20. If pullout tests are specified for evaluating hardened concrete, are pullout strengths obtained in accordance with ASTM C900?	_____	_____	
21. Are numbers and locations of pullout inserts in accordance with specifications (Note: Some pullout test methods must be planned prior to construction because inserts must be embedded in fresh concrete.)?	_____	_____	
22. Has pullout strength been correlated with compressive strength?	_____	_____	
23. Are holes left from pullout tests filled in accordance with specified repair procedures?	_____	_____	

10. IN SITU TESTING OF HARDENED CONCRETE (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
24. Are records available for pullout test results?	_____	_____	
25. If ultrasonic pulse velocity methods are specified for evaluating hardened concrete, are pulse velocities obtained in accordance with ASTM C597?	_____	_____	
26. Are numbers and locations of pulse velocity measurements in accordance with specifications?	_____	_____	
27. Are records available for pulse velocity test results?	_____	_____	
28. If specified for evaluating corrosion activity of reinforcing steel in concrete, are tests of half cell potentials conducted in accordance with ASTM C876?	_____	_____	
29. Are numbers and locations of half cell potential measurements in accordance with specifications?	_____	_____	
30. Are records available for half cell potential test results?	_____	_____	
31. If specified for evaluating deteriorated concrete, are petrographic examinations of hardened concrete in accordance with practices recommended in ASTM C856?	_____	_____	
32. Where applicable, are physical and chemical tests made to support petrographic examinations conducted in accordance with relevant ASTM Standards?	_____	_____	
33. Are records available for results of petrographic examinations and supplementary physical and chemical tests?	_____	_____	
34. If nonstandard tests are required, are they made in accordance with procedures that have been approved by the USCG?	_____	_____	

10. IN SITU TESTING OF HARDENED CONCRETE (Continued)

CHECK LIST

INITIALS DATE NOTES

35. If load tests are considered necessary to confirm safety of the vessel, are they conducted in accordance with procedures approved by the USCG?

11. REPAIRS

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
1. Has cause of defect been determined and have remedial measures been established to prevent recurrence?	_____	_____	
2. Have plans and specifications for structural repairs been approved by the USCG?	_____	_____	
3. Has a conference been held with USCG, Owner, ABS, Contractor, Testing Laboratory, and other interested parties to review structural repair specifications prior to start of operations?	_____	_____	
4. Have plans and specifications for repairs been reviewed by inspector prior to start of repair operations?	_____	_____	
5. Have provisions been made for documentation of repair operations?	_____	_____	
6. Has consideration been given to insuring that the repair method selected will not adversely affect future durability of the vessel?	_____	_____	
7. Have repair procedures selected been proved and documented by prior use or by tests under conditions similar to those in the vessel to be repaired?	_____	_____	
8. Unless otherwise specified, do cement, water, aggregates, and admixtures used for repair meet materials specifications required for new construction?	_____	_____	
9. Unless otherwise specified, do reinforcing materials used for repair meet materials specifications required for new construction?	_____	_____	
10. Do procedures for welding reinforcement during repairs conform to AWS D12.1?	_____	_____	

11. REPAIRS (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
11. If repairs are made using lap or mechanical splices of reinforcement, are splices located and made in accordance with repair specifications?	_____	_____	
12. Do mortar, concrete, or other repair materials have strengths, deformation characteristics, and thermal expansion characteristics that are compatible with the original concrete?	_____	_____	
13. As required by the particular repair condition, are organic resins or latex repair materials effective in damp, wet, and cold environments?	_____	_____	
14. Are organic resins or latex repair materials suitable for application to damp concrete under environmental conditions dictated by job requirements?	_____	_____	
15. Are manufacturer's instructions for application of repair materials strictly followed unless otherwise specified?	_____	_____	
16. Prior to application of repair materials, is all unsound, loose and foreign material removed?	_____	_____	
17. Prior to application of repair materials, is defective or deteriorated concrete completely removed to expose sound uncontaminated concrete?	_____	_____	
18. Is special consideration given to insure removal of all concrete that shows evidence of active or potential corrosion?	_____	_____	
19. Prior to application of repair materials, is exposed reinforcement thoroughly cleaned?	_____	_____	

11. REPAIRS (Continued)

<u>CHECK LIST</u>	<u>INITIALS</u>	<u>DATE</u>	<u>NOTES</u>
20. Are surfaces against which repair materials are to be applied free of grease, oil, or other contaminants that may affect bond?	_____	_____	
21. Are cracks to be repaired free of dust, oil, disintegrated material, and any debris that could affect intrusion and bond of the repair material?	_____	_____	
22. If cracks are repaired by epoxy injection, are procedures being used in accordance with repair specifications?	_____	_____	
23. For repairs using portland cement concrete, mortar, grout, or shotcrete, are curing procedures in accordance with repair specifications?	_____	_____	
24. Are procedures established for inspection and quality control of underwater repairs?	_____	_____	
25. Are procedures established to insure safe storage and handling of volatile, flammable, or potentially toxic repair materials?	_____	_____	
26. Are all repair operations documented and recorded?	_____	_____	

APPENDIX A - APPLICABLE ASTM STANDARDS⁽¹⁾
Annual Book of ASTM Standards - Part 4⁽²⁾

<u>ASTM DESIGNATION</u>	<u>TITLE</u>
A82	Standard Specification for Cold-Drawn Steel Wire for Concrete Reinforcement
A184	Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
A185	Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement
A370	Standard Methods and Definitions for Mechanical Testing of Steel Products
A416	Standard Specification for Uncoated Seven-Wire Stress-Relieved Strand for Prestressed Concrete
A421	Standard Specification for Uncoated Stress-Relieved Wire for Prestressed Concrete
A496	Standard Specification for Deformed Steel Wire for Concrete Reinforcement
A497	Standard Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement
A615	Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
A616	Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement
A617	Standard Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
A704	Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement
A706	Standard Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement

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(2) Use latest edition

APPENDIX A - APPLICABLE ASTM STANDARDS
Annual Book of ASTM Standards - Part 4 (continued)

<u>ASTM DESIGNATION</u>	<u>TITLE</u>
A722	Standard Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete
A767	Standard Specification for Zinc-Coated (Galvanized) Bars for Concrete Reinforcement

APPENDIX A - APPLICABLE ASTM STANDARDS (1)
Annual Book of ASTM Standards - Part 10 (2)

ASTM
DESIGNATION

TITLE

E328

Recommended Practice for Stress-Relaxation Tests for Materials
and Structures

(1) American Society for Testing and Materials (ASTM), 1916 Race Street,
Philadelphia, PA 19103

(2) Use latest edition

APPENDIX A - APPLICABLE ASTM STANDARDS (1)
Annual Book of ASTM Standards - Part 13 (2)

ASTM DESIGNATION	TITLE
C109	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens)
C114	Standard Methods for Chemical Analysis of Hydraulic Cement
C115	Standard Test Method for Fineness of Portland Cement by the Turbidimeter
C150	Standard Specification for Portland Cement
C151	Standard Test Method for Autoclave Expansion of Portland Cement
C157	Standard Test Method for Length Change of Hardened Cement Mortar and Concrete
C183	Standard Methods of Sampling Hydraulic Cement
C185	Standard Test Method for Air Content of Hydraulic Cement Mortar
C186	Standard Test Method for Heat of Hydration of Hydraulic Cement
C187	Standard Test Method for Normal Consistency of Hydraulic Cement
C188	Standard Test Method for Density of Hydraulic Cement
C190	Standard Test Method for Tensile Strength of Hydraulic Cement Mortars
C191	Standard Test Method for Time of Setting of Hydraulic Cement by Vicat Needle
C204	Standard Test Method for Fineness of Portland Cement by Air Permeability Apparatus
C219	Standard Definitions of Terms Relating to Hydraulic Cement
C265	Standard Test Method for Calcium Sulfate in Hydrated Portland Cement Mortar

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APPENDIX A - APPLICABLE ASTM STANDARDS
Annual Book of ASTM Standards - Part 13 (continued)

<u>ASTM DESIGNATION</u>	<u>TITLE</u>
C266	Standard Test Method for Time of Setting of Hydraulic Cement by Gillmore Needles
C305	Standard Method for Mechanical Mixing of Hydraulic Cement Pastes and Mortars of Plastic Consistency
C348	Standard Test Method for Flexural Strength of Hydraulic Cement Mortars
C349	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using Portions of Prisms Broken in Flexure)
C451	Standard Test Method for Early Stiffening of Portland Cement (Paste Method)
C452	Standard Test Method for Potential Expansion of Portland Cement Mortars Exposed to Sulfate
C490	Standard Specification for Apparatus for Use in Measurement of Length Change of Hardened Cement Paste, Mortar, and Concrete
C511	Standard Specification for Moist Cabinets, Moist Rooms, and Water Storage Tanks Used in the Testing of Hydraulic Cements and Concretes
C595	Standard Specification for Blended Hydraulic Cements
C596	Standard Method of Measuring the Drying Shrinkage of Mortar Containing Portland Cement

(1)
(2)

APPENDIX A - APPLICABLE ASTM STANDARDS
Annual Book of ASTM Standards - Part 14

<u>ASTM DESIGNATION</u>	<u>TITLE</u>
C29	Standard Test Method for Unit Weight and Voids in Aggregate
C31	Standard Method of Making and Curing Concrete Test Specimens in the Field
C33	Standard Specification for Concrete Aggregates
C39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
C40	Standard Test Method for Organic Impurities in Sands for Concrete
C42	Standard Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
C70	Standard Test Method for Surface Moisture in Fine Aggregate
C78	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
C87	Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
C88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
C94	Standard Specification for Ready-Mixed Concrete
C116	Standard Test Method for Compressive Strength of Concrete Using Portions of Beams Broken in Flexure
C117	Standard Test Method for Materials Finer than No. 200 (75- μ m) Sieve in Mineral Aggregates by Washing
C123	Standard Test Method for Lightweight Pieces in Aggregate
C125	Standard Definitions of Terms Relating to Concrete and Concrete Aggregates
C127	Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate
C128	Standard Test Method for Specific Gravity and Absorption of Fine Aggregate

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APPENDIX A - APPLICABLE ASTM STANDARDS
Annual Book of ASTM Standards - Part 14 (continued)

<u>ASTM DESIGNATION</u>	<u>TITLE</u>
C131	Standard Test Method for Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine
C136	Standard Test Method for Sieve or Screen Analysis of Fine and Coarse Aggregates
C138	Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
C142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
C143	Standard Test Method for Slump of Portland Cement Concrete
C144	Standard Specifications for Aggregate for Masonry Mortar
C156	Standard Test Method for Water Retention by Concrete Curing Materials
C171	Standard Specification for Sheet Materials for Curing Concrete
C172	Standard Method of Sampling Fresh Concrete
C173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
C174	Standard Method of Measuring Length of Drilled Concrete Cores
C192	Standard Method of Making and Curing Concrete Test Specimens in the Laboratory
C215	Standard Test Method for Fundamental Transverse, Longitudinal, and Torsional Frequencies of Concrete Specimens
C227	Standard Test Method for Potential Alkali Reactivity of Cement - Aggregate Combinations (Mortar-Bar Method)
C230	Standard Specification for Flow Table for Use in Tests of Hydraulic Cement
C231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
C232	Standard Test Method for Bleeding of Concrete
C233	Standard Method of Testing Air-Entraining Admixtures for Concrete

APPENDIX A - APPLICABLE ASTM STANDARDS
Annual Book of ASTM Standards - Part 14 (continued)

<u>ASTM DESIGNATION</u>	<u>TITLE</u>
C235	Standard Test Method for Scratch Hardness of Coarse Aggregate Particles
C260	Standard Specification for Air-Entraining Admixtures for Concrete
C289	Standard Test Method for Potential Reactivity of Aggregates (Chemical Method)
C293	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
C294	Standard Descriptive Nomenclature of Constituents of Natural Mineral Aggregates
C295	Standard Recommended Practice for Petrographic Examination of Aggregates for Concrete
C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
C311	Standard Methods of Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete
C330	Standard Specification for Lightweight Aggregates for Structural Concrete
C341	Standard Test Method for Length Change of Drilled or Sawed Specimens of Cement Mortar and Concrete
C342	Standard Test Method for Potential Volume Change of Cement-Aggregate Combinations
C387	Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete
C403	Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
C418	Standard Test Method for Abrasion Resistance of Concrete by Sandblasting
C441	Standard Test Method for Effectiveness of Mineral Admixtures in Preventing Excessive Expansion of Concrete Due to the Alkali-Aggregate Reaction

APPENDIX A - APPLICABLE ASTM STANDARDS
Annual Book of ASTM Standards - Part 14 (continued)

<u>ASTM DESIGNATION</u>	<u>TITLE</u>
C457	Standard Recommended Practice for Microscopical Determination of Air-Void Content and Parameters of the Air-Void System in Hardened Concrete
C469	Standard Test Method for Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression
C470	Standard Specification for Molds for Forming Concrete Test Cylinders Vertically
C494	Standard Specification for Chemical Admixtures for Concrete
C496	Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
C512	Standard Test Method for Creep of Concrete in Compression
C535	Standard Test Method for Resistance to Abrasion of Large Size Coarse Aggregate by Use of the Los Angeles Machine
C566	Standard Test Method for Total Moisture Content of Aggregate by Drying
C567	Standard Test Method for Unit Weight of Structural Lightweight Concrete
C586	Standard Test Method for Potential Alkali Reactivity of Carbonate Rocks for Concrete Aggregates (Rock Cylinder Method)
C597	Standard Test Method for Pulse Velocity Through Concrete
C617	Standard Method of Capping Cylindrical Concrete Specimens
C618	Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
C642	Standard Test Method for Specific Gravity, Absorption, and Voids in Hardened Concrete
C666	Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing
C671	Standard Test Method for Critical Dilation of Concrete Specimens Subjected to Freezing
C672	Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals

APPENDIX A - APPLICABLE ASTM STANDARDS

Annual Book of ASTM Standards - Part 14 (continued)

<u>ASTM DESIGNATION</u>	<u>TITLE</u>
C682	Standard Recommended Practice for Evaluation of Frost Resistance of Coarse Aggregates in Air-Entrained Concrete by Critical Dilation Procedures
C683	Standard Test Method for Compressive and Flexural Strength of Concrete Under Field Conditions
C684	Standard Method of Making, Accelerated Curing, and Testing of Concrete Compression Test Specimens
C685	Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing
C702	Standard Methods for Reducing Field Samples of Aggregate to Testing Size
C803	Tentative Test Method for Penetration Resistance of Hardened Concrete
C805	Standard Test Method for Rebound Number of Hardened Concrete
C823	Standard Recommended Practice for Examination and Sampling of Hardened Concrete in Constructions
C827	Standard Test Method for Early Volume Change of Cementitious Mixtures
C851	Standard Recommended Practice for Estimating Scratch Hardness of Coarse Aggregate Particles
C856	Standard Recommended Practice for Petrographic Examination of Hardened Concrete
C873	Tentative Test Method for Compressive Strength of Concrete Cylinders Cast in Place in Cylindrical Molds
C876	Standard Test Method for Half Cell Potentials of Reinforcing Steel in Concrete
C881	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
C882	Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete
C883	Standard Test Method for Effective Shrinkage of Epoxy-Resin Systems Used With Concrete

APPENDIX A - APPLICABLE ASTM STANDARDS

Annual Book of ASTM Standards - Part 14 (continued)

<u>ASTM DESIGNATION</u>	<u>TITLE</u>
C884	Standard Test Method for Thermal Compatibility Between Concrete and An Epoxy-Resin Overlay
C900	Tentative Test Method for Pullout Strength of Hardened Concrete
D75	Standard Methods of Sampling Aggregates
D1411	Standard Test Methods for Water-Soluble Chlorides Present as Admixes in Graded Aggregate Road Mixes
E4	Standard Methods of Load Verification of Testing Machines
E11	Standard Specification for Wire-Cloth Sieves for Testing Purposes
E12	Standard Definitions of Terms Relating to Density and Specific Gravity of Solids, Liquids, and Gases
E329	Standard Recommended Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction
-	Manual of Aggregate and Concrete Testing

APPENDIX A - APPLICABLE ASTM STANDARDS (1)
Annual Book of ASTM Standards - Part 15 (2)

ASTM
DESIGNATION

TITLE

D3398

Standard Test Method for Index of Aggregate Particle
Shape and Texture

(1) American Society for Testing and Materials (ASTM), 1916 Race Street,
Philadelphia, PA 19103

(2) Use latest edition

APPENDIX A - APPLICABLE ASTM STANDARDS (1)
Annual Book of ASTM Standards - Part 31 (2)

<u>ASTM DESIGNATION</u>	<u>TITLE</u>
D152	Standard Test Methods for Chloride Ion in Water and Waste Water
D516	Standard Test Methods for Sulfate Ion in Water and Waste Water
D1888	Standard Test Method for Particulate and Dissolved Matter, Solids, or Residue in Water

(1) American Society for Testing and Materials (ASTM), 1916 Race Street,
Philadelphia, PA 19103

(2) Use latest edition

APPENDIX B - STANDARDS, GUIDES, AND RECOMMENDED PRACTICES
OF THE AMERICAN CONCRETE INSTITUTE⁽¹⁾

<u>ACI COMMITTEE</u> ⁽²⁾	<u>TITLE</u>
116	- Cement and Concrete Terminology
201	- Guide to Durable Concrete
201	- Guide for Making a Condition Survey of Concrete in Service
211	- Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete
211	- Recommended Practice for Selecting Proportions for Structural Lightweight Concrete
212	- Guide for Use of Admixtures in Concrete
212	- Admixtures for Concrete
213	- Guide for Structural Lightweight Aggregate Concrete
214	- Recommended Practice for Evaluation of Strength Test Results of Concrete
221	- Selection and Use of Aggregates for Concrete
301	- Specifications for Structural Concrete for Buildings
304	- Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete
304	- Preplaced Aggregate Concrete for Structural and Mass Concrete
304	- Placing Concrete by Pumping Methods
304	- Placing Concrete With Belt Conveyors
305	- Hot Weather Concreting
306	- Cold Weather Concreting
308	- Recommended Practice for Curing Concrete
309	- Recommended Practice for Consolidation of Concrete

(1) American Concrete Institute, P.O. Box 19150, Redford Station, Detroit, Michigan 48219.

(2) See latest edition of ACI Manual of Concrete Practice.

APPENDIX B - STANDARDS, GUIDES, AND RECOMMENDED PRACTICES

OF THE AMERICAN CONCRETE INSTITUTE (Continued)

<u>ACI COMMITTEE</u>	<u>TITLE</u>
311	- Recommended Practice for Concrete Inspection
311	- ACI Manual of Concrete Inspection
315	- Manual of Standard Practice for Detailing Reinforced Concrete Structures
318	- Building Code Requirements for Reinforced Concrete
318	- Commentary on Building Code Requirements for Reinforced Concrete
347	- Recommended Practice for Concrete Formwork
347	- Precast Concrete Units Used as Forms for Cast-in-Place Concrete
357	- Guide for the Design and Construction of Fixed Offshore Concrete Structures
503	- Use of Epoxy Compounds With Concrete
503	- Standard Specification for Bonding Hardened Concrete, Steel, Wood, Brick, and Other Materials to Hardened Concrete With a Multi-Component Epoxy Adhesive
503	- Standard Specification for Bonding Plastic Concrete to Hardened Concrete With a Multi-Component Epoxy Adhesive
503	- Standard Specification for Repairing Concrete With Epoxy Mortars
504	- Guide to Joint Sealants for Concrete Structures
506	- Recommended Practice for Shotcreting
506	- Specification for Materials, Proportioning, and Application of Shotcrete
515	- Guide for the Protection of Concrete Against Chemical Attack by Means of Coatings and Other Corrosion-Resistant Materials
517	- Recommended Practice for Atmospheric Pressure Steam Curing of Concrete

APPENDIX B - STANDARDS, GUIDES, AND RECOMMENDED PRACTICES
OF THE AMERICAN CONCRETE INSTITUTE (Continued)

ACI COMMITTEE

TITLE

- | | |
|-----|---|
| 533 | - Selection and Use of Materials for Precast Concrete Wall Panels |
| 534 | - Fabrication, Handling, and Erection of Precast Concrete Wall Panels |
| 546 | - Guide for Repair of Concrete Bridge Superstructures |

APPENDIX C - OTHER APPLICABLE STANDARDS, GUIDES AND RECOMMENDED PRACTICES

1. "Rules for the Design, Construction, and Inspection of Offshore Structures," Det Norske Veritas, Oslo, 1977.
2. "Guidelines for the Design, Construction, and Classification of Floating Concrete Structures," Det Norske Veritas, Oslo, 1978.
3. "Recommendations for the Design and Construction of Concrete Sea Structures," Federation Internationale de la Precontrainte, Wexham Springs, 1977.
4. Allen, R.T.L. and Gregory-Cullen, J., "Inspection, Maintenance, and Repair of Concrete Offshore Structures," RR SMT-7401, Cement and Concrete Association, London, 1974.
5. "Design and Control of Concrete Mixtures," 12th Edition, Portland Cement Association, Skokie, Illinois, 1979, 133 pp.
6. "Certification of Ready Mixed Concrete Production Facilities," National Ready Mixed Concrete Association, Silver Spring, Maryland, 1976.
7. "Truck Mixer and Agitator Standards of the Truck Mixer Manufacturers Bureau," Truck Mixer Manufacturers Bureau, Silver Spring, Maryland, 1971.
8. "Manual of Standard Practice," Concrete Reinforcing Steel Institute, Chicago, 1976.
9. "Manual of Standard Practice - Welded Wire Fabric," Wire Reinforcement Institute, Inc., McLean, Virginia, 1979.
10. "Reinforcing Steel Welding Code," American Welding Society, AWS D12.1-75, Miami, Florida, 1975.
11. "PTI Post-Tensioning Manual," Post-Tensioning Institute, Phoenix, Arizona, 1981.

APPENDIX D - ABBREVIATIONS

ABS	=	American Bureau of Shipping
ACI	=	American Concrete Institute
ASTM	=	American Society for Testing and Materials
AWS	=	American Welding Society
DNV	=	Det Norske Veritas
FIP	=	Federation Internationale de la Precontrainte
NRMCA	=	National Ready Mixed Concrete Association
PCA	=	Portland Cement Association
PTI	=	Post-Tensioning Institute
TMMB	=	Truck Mixer Manufacturers Bureau