Do Not Circulate or Publish Specification for Unbonded Single-Strand Tendons Used for Slab-on-Ground Construction

Public Comment November 2024

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PTI M10.6-24

Specification for Unbonded Single Strand Tendons Used for Slab-on-Ground Construction



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Front matter

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117	Table of Contents
118	1.0—General
119	1.1—Scope
120	1.2—Definitions
121	1.3—References
122	1.3.1—Referenced standards and organizations
123	1.3.2—Cited publications
124	1.4—System description
125	1.5—Submittals
126	1.5.1—Prestressing steel
127	1.5.2—Anchorages and couplers

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128 1.5.3—Sheathing 129 1.5.4—PT coating 130 1.5.5—Fabrication plant 131 1.5.6—Stressing records 132 1.6—Fabrication 133 1.6.1—General 134 1.6.1.1—PTI certified plants 135 1.6.1.2—Non-PTI certified plants 136 1.6.2—Handling, storage, and shipping 137 1.6.2.1—Handling prior to shipping 138 1.6.2.2—Storage prior to shipping	
1301.5.5—Fabrication plant1311.5.6—Stressing records1321.6—Fabrication1331.6.1—General1341.6.1.1—PTI certified plants1351.6.1.2—Non-PTI certified plants1361.6.2—Handling, storage, and shipping1371.6.2.1—Handling prior to shipping	
1311.5.6—Stressing records1321.6—Fabrication1331.6.1—General1341.6.1.1—PTI certified plants1351.6.1.2—Non-PTI certified plants1361.6.2—Handling, storage, and shipping1371.6.2.1—Handling prior to shipping	
1321.6—Fabrication1331.6.1—General1341.6.1.1—PTI certified plants1351.6.1.2—Non-PTI certified plants1361.6.2—Handling, storage, and shipping1371.6.2.1—Handling prior to shipping	
1331.6.1—General1341.6.1.1—PTI certified plants1351.6.1.2—Non-PTI certified plants1361.6.2—Handling, storage, and shipping1371.6.2.1—Handling prior to shipping	
1341.6.1.1—PTI certified plants1351.6.1.2—Non-PTI certified plants1361.6.2—Handling, storage, and shipping1371.6.2.1—Handling prior to shipping	
1351.6.1.2—Non-PTI certified plants1361.6.2—Handling, storage, and shipping1371.6.2.1—Handling prior to shipping	
1361.6.2—Handling, storage, and shipping1371.6.2.1—Handling prior to shipping	
137 1.6.2.1—Handling prior to shipping	
150 1.0.2.2 Storage prior to simpping	
139 1.6.2.3—Shipping	
137 1.0.2.5—Simpping 140 1.7—Delivery, handling, and storage	
140 1.7—Delivery, handling, and storage	
141 1.7.1—Denvery 142 1.7.2—Handling and storage	
142 1.7.2—Handling and storage 143 1.7.2.1—Handling	
144 1.7.2.2—Storage	
145 1.7.2.3—Exposure	
1451.7.2.5Exposure1461.7.2.4—Wedges and anchors	
147 2.0—Products	
147 2.0 Floadets 148 2.1—Prestressing steel	
149 2.1.1—Mechanical properties	
150 2.1.2—Thermomechanical treatment	
151 2.1.3—Traceability	
152 2.1.4—Testing	
153 2.1.5—Strand producer records	
154 2.1.6—Identification	
155 2.1.7—Packaging, marking, storage, and protection	
156 2.1.8—Acceptance criteria for surface condition	
157 2.1.9—Compliance requirements	
158 2.2—Anchorages and couplers	
159 2.2.1—Anchorages	
160 2.2.1.1—Static tests	
161 2.2.1.2—Fatigue tests	
162 2.2.1.3—Bearing stresses	
163 2.2.2—Castings	
164 2.2.3—Wedges used in anchorages	
165 2.2.4—Couplers	
166 2.2.5—Compliance requirements	
167 2.2.5.1—Conformance testing	
168 2.2.5.2—Compliance	
169 2.2.6—Anchorages and couplers in aggressive environments	
170 2.2.6.1—Anchorages	
171 2.2.6.2—Encapsulated tendons	

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172	2.3—Sheathing
172	2.3.1—General properties
173	2.3.2—Minimum thickness and diameter
174	2.3.2—Winimum thickness
175	2.3.2.2—Insider diameter
170	2.3.2.3—Appearance
177	2.3.2—Appearance 2.3.3—Fabrication process
178	2.3.4—Sheathing coverage
179	2.3.4—Sheathing coverage 2.3.5—Encapsulated tendons
180	2.3.5—Encapsulated tendons 2.4—PT coating
181	2.4—11 Coating 2.4.1—General properties
182	2.4.2—Type of PT coating
183	2.4.2—Type of PT coalling 2.4.3—Minimum quantity
184	2.4.4—Performance criteria
185	3.0—Execution
180	3.1—General
187	3.1.1—Qualifications and inspection
189	3.1.2—Recommended procedures
190	3.1.3—Handling
191	3.1.4—Protection
192	3.2—Tendon installation
192	3.2.1—General
193	3.2.1.1—Support intervals
195	3.2.1.2—Support system
196	3.2.1.2 Support system 3.2.1.3—Tendon tolerances
197	3.2.1.4—Lateral deviations
198	3.2.1.5—Protection
199	33.2.1.6—Protection from water
200	3.2.1.7—Encapsulated tendons
201	3.2.2—Stressing anchorages
202	3.2.2.1—Installation
203	3.2.2.2—Attachment requirements
204	3.2.2.3—Cover requirements
205	3.2.2.4—Pocket formers
206	3.2.2.5—Encapsulated tendons
207	3.2.2.6—Strand tail cover
208	3.2.3—Intermediate anchorages
209	3.2.3.1—Installation
210	3.2.3.2—Placement
211	3.2.3.3—Cover requirements
212	3.2.3.4—Pocket formers
213	3.2.3.5—Encapsulated tendons
214	3.2.4—Fixed anchorages
215	3.2.4.1—Installation

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216	3.2.4.2—Wedge seating methods for fixed anchorages
217	3.2.4.3—Placement
218	3.2.4.4—Encapsulated tendons
219	3.2.5—Sheathing inspection
220	3.2.5.1—Sheathing damage
221	3.2.5.2—Repair procedure
222	3.3—Concrete placement
223	3.3.1—General
224	3.3.2—Placement
225	3.3.3—Protection of tendons
226	3.3.4—Sheathing repairs
227	3.4—Tendon stressing
228	3.4.1—General
229	3.4.1.1—Protection from water
230	3.4.1.2—Stressing procedures
231	3.4.1.3—Stressing jacks
232	3.4.2—Jack calibration
233	3.4.3—Elongation measurements
234	3.5—Tendon finishing
235	3.5.1—General
236	3.5.1.1—Cutting of tendon tails
237	3.5.1.2—Cutting methods
238	3.5.2—Encapsulated tendons
239	3.5.3—Stressing pockets
240	3.5.3.1—Preparation
241	3.5.3.2Timing

242	SPECIFICATION	COMMENTARY
243	1.0—General	
244	1.1—Scope	C1.1 — Scope
245	These specifications provide performance criteria	The intent of this
246	for materials and detailed recommendations for the	document is to provide
247	fabrication and installation of unbonded single-strand	detailed specifications for
248	tendons specifically used in any application of slab-	all common uses of
249	on-ground construction using unbonded post-	unbonded PT tendons for
250	tensioned (PT) reinforcement. Specifications are	slab-on-ground
251	presented for both "standard" and "encapsulated"	applications.
252	unbonded single-strand tendon systems.	
253	The more restrictive materials, fabrication, and	There are certain special
254	construction requirements for tendons used in	slab-on-ground foundations
255	aggressive environments referred to as encapsulated	or applications that, either
256	tendons in this specification are essential to the long-	because of their service
257	term durability of the PT system when used in	requirements or structural

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258	foundations that are exposed to or constructed in these	behavior, might impose
259	environments.	additional requirements on
260		the PT system that exceed
261	Where appropriate, a commentary follows most	the minimum requirements
262	major sections of the document.	of this standard
263	5	specification. In such cases,
264		a special specification
265		should be developed.
266		
267		Slab-on-ground
268		foundations exposed to
269		potentially aggressive
270		environments may require
270		additional protection of the
272		PT system, as determined to
272		be appropriate by the
273		licensed design professional
275		(LDP). The LDP should
275		evaluate the conditions for
277		each project to determine if
278		the environment in which
279		the foundation is built is to
280		be considered aggressive.
281		
282		This specification may
283		also be used to apply to
284		nonstructural applications,
285		such as topping slabs or
286		waterproofing slabs on fill.
287		
288		This specification should
289		be considered a minimum
290		standard and, due to
291		experience or project
292		considerations, may be
293		made more restrictive by the
294		LDP.
295	-	The LDP should evaluate
296		the conditions for each
297		project to determine if the
298		environment in which the
299		foundation is built requires
300		additional protection of the
301		PT system.
302		Residential slab-on-
303		ground foundation

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304 305 306 307 308 309 310 311 312 313 314 315 316 317		construction requires that there is a minimum of 8 in. from the top of the finished floor to the top of finished grade and that positive drainage away from the foundation be provided. This will, in most cases, ensure that the stressing pockets of the PT system are not permanently in contact with the soil and will prevent ponding of water against the foundation and
318		immersion of the stressing
319		pockets.
220		
320 321	1.2 — Definitions The following definitions govern in this specification	
321	The following definitions govern in this specification. Refer to "Post-Tensioning Terminology (PTT)" for	
322	additional definitions (https://www.post-	
334	tensioning.org/education/publications/terminology.as	
335	px).	
336	P	
337	Aggressive environment – An environment in which	
338	slab-on-ground foundations are exposed to direct or	
339	indirect applications of deicing chemicals, seawater,	
340	brackish water, or spray from these water sources; and	
341	salt-laden air as occurs in the vicinity of seacoasts and	
342	coastal waterways. Aggressive environments also	
343	include applications where stressing pockets are	
344	subject to hydrostatic head. These environments	
345	typically require encapsulated tendons.	
346 347	Anchor For unbonded single strend tenders	
347	Anchor – For unbonded single-strand tendons, a device that houses the wedges and transfers the	
348	prestressing force to the concrete.	
350	presucessing force to the concrete.	
351	Anchorage – A mechanical device consisting of all	
352	components required to transfer the PT force from the	
353	prestressing steel to the foundation.	
354		
355	<i>Concrete contractor</i> – Contracting entity responsible	
356	for placing, finishing, and curing the PT concrete.	
357		
358		

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359	Coupler – A device used to connect the ends of	
360	tendons, making them structurally continuous.	
361	······································	
362	<i>Elongation</i> – Increase in the length of prestressing	
363	steel due to the stressing force.	
364		
365	<i>Encapsulated tendon</i> – A tendon that is completely	
366	enclosed in a watertight covering from end to end,	
367	including anchorages, sheathing with PT coating, and	
368	an encapsulation cap over the strand tail at each end.	
369	un eneupsulation eup over the strand tait a each end.	
370	<i>Encapsulation cap</i> – Plastic cap filled with PT coating	
370	with a positive watertight connection to the anchor	
372	protecting the wedges and the strand tail.	
373	protecting the wedges and the strand tan.	
374	Jack – A mechanical device (normally hydraulic)	
374	used to apply force to a single strand.	
376	used to apply force to a single strand.	
370	Licensed design professional (LDP) – An engineer or	
378	architect who is licensed to practice as defined by the	
378	statutory requirements of the professional licensing	
380	laws of a state or jurisdiction and who is responsible	
380	for the structural design and the preparation of	
382	Contract Documents for the work.	
383	Contract Documents for the work.	
383 384	Nonaggressive environment – All environments not	
385	specifically defined herein as aggressive.	
385	specifically defined herein as aggressive.	
380 387	Post-tensioning (PT) – Method of prestressing in	
388	which prestressing steel is tensioned after concrete	
389	has hardened.	
390	has hardened.	
390 391	PT installer – Contracting entity or entities	
391 392	<i>PT installer</i> – Contracting entity or entities responsible for unloading and handling the PT	
393	materials, storing and protecting them on the jobsite,	
394	tendon installation, stressing, and tendon finishing in	
395	accordance with the Contract Documents, including	
396	this specification.	
390 397	uns specification.	
398	PT supplier – Contracting entity responsible for	
398 399	furnishing and delivering to the jobsite all	
400	components of the PT system, including PT	
400	installation drawings and stressing equipment.	
401	instantion drawings and successing equipment.	
402	Prestressing steel – High-strength steel used to	
403	prestress concrete, consisting of seven-wire strands.	
404	presuess concrete, consisting of seven-wife suanus.	

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° 1 1 0	
6	
prestressing steel and sheathing.	
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1 0	
· · · · ·	
corrosion protection and contains PT coating.	
and lateral loads to the soil. The foundation may be	
ribbed or uniformly thick and may be reinforced to	
resist the effects of soil movement, shrinkage and	
temperature, and structural loading.	
Strand – High-strength steel wires wound around a	
center wire, typically seven-wire strand, conforming	
to ASTM A416/A416M.	
Strand tail – The protruding length of the strand from	
the face of the anchor casting that remains in place	
after the tendon tail has been cut off.	
Stressing pocket – The recess created by the pocket	
former between the stressing or intermediate	
anchorage and the edge of the concrete to allow the	
nosepiece access for stressing.	
Tendon - A complete assembly of a prestressing	
element consisting of anchorages and couplers,	
prestressing steel, PT coating, and sheathing.	
Tendon profile – The specified path of a tendon from	
end to end in a member.	
Tendon tail - The protruding length of the tendon	
outside the stressing anchorage needed temporarily	
for stressing of the tendon.	
Unbonded tendon – Tendon in which the prestressing	
steel is prevented from bonding to the concrete, and is	
permanently free to move relative to the concrete. The	
prestressing force is transferred to the concrete only	
through the anchorages.	
	 ribbed or uniformly thick and may be reinforced to resist the effects of soil movement, shrinkage and temperature, and structural loading. Strand – High-strength steel wires wound around a center wire, typically seven-wire strand, conforming to ASTM A416/A416M. Strand tail – The protruding length of the strand from the face of the anchor casting that remains in place after the tendon tail has been cut off. Stressing pocket – The recess created by the pocket former between the stressing or intermediate anchorage and the edge of the concrete to allow the nosepiece access for stressing. Tendon – A complete assembly of a prestressing element consisting of anchorages and couplers, prestressing steel, PT coating, and sheathing. Tendon profile – The specified path of a tendon from end to end in a member. Tendon tail – The protruding length of the tendon outside the stressing anchorage needed temporarily for stressing of the tendon. Unbonded tendon – Tendon in which the prestressing steel is prevented from bonding to the concrete. The prestressing force is transferred to the concrete only

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449		
450	Wedges - Pieces of tapered, high-strength, heat-	
451	treated steel with serrations (teeth) that penetrate the	
452	prestressing steel during transfer of prestressing force.	
453	I Contraction of the contraction	
454	Wedge cavity – The tapered opening in the anchor	
455	designed to allow the strand passing through and to	
456	accommodate the seating of the wedges.	
150	decommodule the seating of the wedges.	
457	1.3 — References	
458	1.3.1 — Referenced standards and organizations	
459	The standards and reports listed as follows were the	
460	latest editions at the time this document was prepared.	
461	Because these documents are revised frequently, the	
462	reader is advised to contact the proper sponsoring	
463	group if it is desired to refer to the latest version.	
464	Stoup if it is desired to refer to the fatest version.	
465	ASTM International	
466	ASTM A370, Standard Test Methods and Definitions	
467	for Mechanical Testing of Steel Products	
407	for Meenanical Testing of Steel Floudets	
468	ASTM A416/A416M, Standard Specification for	
469	Low-Relaxation Seven-Wire Steel Strand for	
470	Prestressed Concrete	
471	Testressed concrete	
472	ASTM A1061/A1061M, Standard Test Methods for	
473	Testing Multi-Wire Steel Prestressing Strand	
474	resting Multi-whe Steer restlessing Strand	
475	ASTM B117, Standard Practice for Operating Salt	
476	Spray (Fog) Apparatus	
477	Spray (10g) Apparatus	
478	ASTM D92, Standard Test Method for Flash and Fire	
479	Points by Cleveland Open Cup Tester	
480	Tomis by Cleveland Open Cup Tester	
480 481	ASTM D95, Standard Test Method for Water in	
481	Petroleum Products and Bituminous Materials by	
482 483	Distillation	
	Distillation	
484 485	ASTM DO17 Stondard Tool Mathada for Com	
485	ASTM D217, Standard Test Methods for Cone	
486	Penetration of Lubricating Grease	
487	ACTM D445 Stondard Test Mathed for W	
488	ASTM D445, Standard Test Method for Kinematic	
489	Viscosity of Transparent and Opaque Liquids (and	
490	Calculation of Dynamic Viscosity)	
491		
492		

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 493 ASTM D512, Standard Test Methods for Chloride Ion In Water 494 ASTM D610, Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces 496 497 ASTM D638, Standard Test Method for Tensile Properties of Plastics 498 Properties of Plastics 499 500 ASTM D792, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement 503
 494 ASTM D610, Standard Practice for Evaluating Degree of Rusting on Painted Steel Surfaces 496 497 ASTM D638, Standard Test Method for Tensile Properties of Plastics 499 500 ASTM D792, Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
 495 Degree of Rusting on Painted Steel Surfaces 496 497 ASTM D638, Standard Test Method for Tensile 498 Properties of Plastics 499 500 ASTM D792, Standard Test Methods for Density and 501 Specific Gravity (Relative Density) of Plastics by 502 Displacement 503
 495 Degree of Rusting on Painted Steel Surfaces 496 497 ASTM D638, Standard Test Method for Tensile 498 Properties of Plastics 499 500 ASTM D792, Standard Test Methods for Density and 501 Specific Gravity (Relative Density) of Plastics by 502 Displacement 503
 495 Degree of Rusting on Painted Steel Surfaces 496 497 ASTM D638, Standard Test Method for Tensile 498 Properties of Plastics 499 500 ASTM D792, Standard Test Methods for Density and 501 Specific Gravity (Relative Density) of Plastics by 502 Displacement 503
 495 Degree of Rusting on Painted Steel Surfaces 496 497 ASTM D638, Standard Test Method for Tensile 498 Properties of Plastics 499 500 ASTM D792, Standard Test Methods for Density and 501 Specific Gravity (Relative Density) of Plastics by 502 Displacement 503
 496 497 ASTM D638, Standard Test Method for Tensile 498 Properties of Plastics 499 500 ASTM D792, Standard Test Methods for Density and 501 Specific Gravity (Relative Density) of Plastics by 502 Displacement 503
 497 ASTM D638, Standard Test Method for Tensile 498 Properties of Plastics 499 500 ASTM D792, Standard Test Methods for Density and 501 Specific Gravity (Relative Density) of Plastics by 502 Displacement 503
 498 Properties of Plastics 499 500 ASTM D792, Standard Test Methods for Density and 501 Specific Gravity (Relative Density) of Plastics by 502 Displacement 503
 499 500 ASTM D792, Standard Test Methods for Density and 501 Specific Gravity (Relative Density) of Plastics by 502 Displacement 503
 500 ASTM D792, Standard Test Methods for Density and 501 Specific Gravity (Relative Density) of Plastics by 502 Displacement 503
 501 Specific Gravity (Relative Density) of Plastics by 502 Displacement
502 Displacement 503
503
503
504 ASTM D2265, Standard Test Method for Dropping
505 Point of Lubricating Grease Over Wide Temperature
506 Range
507 Runge
508 ASTM D3867, Standard Test Methods for Nitrite-
509 Nitrate in Water
511 ASTM D4289, Standard Test Method for Elastomer
512 Compatibility of Lubricating Greases and Fluids
514 ASTM D4658, Standard Test Method for Sulfide Ion
515 in Water
516
517 ASTM D6184, Standard Test Method for Oil
518 Separation from Lubricating Grease (Conical Sieve
519 Method)
520
521 International Code Council Evaluation Service (ICC-
522 ES)
523 ICC AC303, Post-tensioning Anchorages and
524 Couplers of Prestressed Concrete
525
526 International Organization for Standardization (ISO)
527 ISO/IEC 17065:2012, Conformity assessment —
528 Requirements for Bodies Certifying Products,
529 Processes and Services
530
531 Post-Tensioning Institute (PTI)
532 PTI-CRT20 G1, Manual for Certification of Plants
533 Producing Unbonded Single Strand Tendons
534

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535	PTI DC10.2, Construction and Maintenance Manual	
536	for Post-Tensioned Slab-on-Ground Foundations	
537		
538	M10.2, Specification for Unbonded Single Strand	
539	Tendons	
540		
541	PTI M50.2, Anchorage Zone Design	
542		
543	Society of Automotive Engineers (SAE)	
544	SAE-J449, Surface Texture Control	
545		
546	These publications may be obtained from the	
547	following organizations:	
548		
549	ASTM International	
550	100 Barr Harbor Drive	
551	West Conshohocken, PA 19428-2959	
552	www.astm.org	
553	, , , , , , , , , , , , , , , , , , ,	
554	International Code Council Evaluation Service (ICC-	
555	ES)	
556	4051 West Flossmoor Road	
557	Country Club Hills, IL 60478	
558	www.icc-es.org	
559		
560	International Organization for Standardization (ISO)	
561	Chemin de Blandonnet 8	
562	CP 401	
563	1214 Vernier (Geneva)	
564	Switzerland	
565	www.iso.org	
567		
568	Post-Tensioning Institute (PTI)	
569	38800 Country Club Drive	
570	Farmington Hills, MI 48331	
571	www.post-tensioning.org	
572	г б. 978	
573	Society of Automotive Engineers (SAE)	
574	400 Commonwealth Drive	
575	Warrendale, PA 15096-0001	
576	www.sae.org	
577		
578	1.3.2 — Cited publications	
579	Chacos, G. P., 2007, "Back-Up Bars for Residential	
580	Slab-on-Ground Foundations," PTI Journal, July, V.	
580	5, No. 1, pp. 17-22.	
501	5, 10.1, pp.17-22.	

This draft is not final and is subject to revision. This draft is for public review and comment. Page 15 of 64

500		
582		
583	Sason, A. S., 1992, "Evaluation of Degree of Rusting	
584	on Prestressed Concrete Strand," PCI Journal,	
585	May/June, V. 37, No. 3, pp. 25-30.	
586	1.4 — System description	C1.4 — System description
587	Unbonded single-strand tendons consist of	Tendons are typically
588	prestressing steel covered with a PT coating and	fabricated in a fabrication
589	encased in a continuous sheathing with anchorages at	plant. Fabrication consists
590	each end and at intermediate locations as required.	of applying PT coating and
590 591	each end and at intermediate locations as required.	
		sheathing to the prestressing
592		steel, cutting the tendon to a
593		specified length, marking it
594		for a specific location in the
595		slab-on-ground foundation,
596		attaching the fixed
597		anchorages, positioning
598		intermediate anchorages (if
599		required by design), and
600		coiling and securing the
601		tendons into bundles.
602		Bundles are then loaded
603		onto trucks for delivery to
604		the jobsite along with the
605		stressing anchors, wedges,
606		and other accessories.
607		
608		At the jobsite, the tendons
609		are installed in accordance
610		with approved installation
611		drawings. The tendon
612		location (profile control
613		points) and the final
614		effective force (or the
615		number of tendons) are
616		specified by the LDP.
617		Stressing of the tendons is
618		done with hydraulic
619		equipment (jacks, pumps,
620		and gauges) after the
620		concrete is placed and
622		reaches a minimum
623		compressive strength
623 624		
		specified by the PT supplier
625		and acceptable to the LDP.

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		[]
626		After stressing, the tendon
627		tails are cut off, and any
628		stressing pockets are filled
629		with a patch material and
630		finished.
631	1.5 — Submittals	C1.5 — Submittals
632	1.5.1 — Prestressing steel	It is recommended that the
633	Certified mill test reports shall be furnished for each	LDP verify the material
634	coil of strand, containing as a minimum the following	properties of the strand on
635	test information:	their project to confirm that
636	Heat number and identification;	they are consistent with the
637	Specified tensile strength;	material properties
638	Yield strength at 1% extension under load;	specified.
639	Elongation at failure;	T. T
640	Modulus of elasticity;	Although ASTM
641	Diameter of strand;	A416/416M does not
642	Net area of strand; and	specify a standard chemical
643	Type of material (normal relaxation or low	analysis for the heat of steel,
644	relaxation).	such analysis is available.
645		such analysis is available.
646		Modulus of elasticity should
647		
648		be based on an average value determined from each
649		heat.
650	1.5.2 — Anchorages and couplers	
651	Static and fatigue test reports of representative	
652	production assemblies shall be furnished for each	
653	•	
055	different assembly to be used on the project.	
654	1.5.3 — Sheathing	
655	A sheathing material report covering the	
656		
050	requirements of Sections 2.3.1 shall be furnished.	
657	1.5.4 — PT coating	
658	Test results on PT coating, tested in accordance with	
659	Table 1, shall be furnished.	
0.59		
660	1.5.5 — Fabrication plant	
661	A copy of the PT Supplier's PTI Unbonded Tendon	
662	Plant Certification covering both extrusion and	
663	fabrication, or equivalent shall be furnished.	
005	numentation, or equivalent shan be furnished.	
664	1.5.6 — Stressing records	
665	1.5.0 Shessing records	
005		

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		·
666	Stressing records shall be completed during the	
667	stressing operation, with the following data recorded	
668	as a minimum:	
669	Name of the project;	
	Date of stressing operation;	
670	Name and signature of stressing operator or third-	
671	party inspector;	
672	Serial or identification number of stressing	
673	equipment (jack and gauge) used at each	
674	stressing location;	
675	Date of approved Contract Document or	
676	installation drawing used for installation and	
677		
678	stressing; Weather conditions including temperature and	
678 679	Weather conditions, including temperature and rainfall;	
679 680	,	
680 681	Building foundation number or other concrete	
	placement area identification;	
682	Tendon identification mark;	
683	Calculated elongation;	
684	Gauge reading to achieve required jacking force	
695	using actual jack calibration certificate;	
686	Actual measured elongation at each stressing	
687	location; and	
688	Actual gauge reading at each stressing location.	
689		
690	Completed stressing records shall be submitted to	
691	the LDP, if required by the Contract Documents.	
692	1.6 — Fabrication	C1.6 — Fabrication
_		
693	1.6.1 - General	C1.6.1 — General
694	Unbonded single-strand tendons used in PT slab-on-	The requirements of this
695	ground foundation construction shall be fabricated in	section apply to tendons
696	a plant meeting the requirements of Sections 1.6.1.1	intended for use in both
697	or 1.6.1.2. The PT supplier shall be responsible for the	nonaggressive and
698	fabrication and packaging of unbonded tendons.	aggressive environments.
699	Individual tendons shall be secured in bundles using a	Padding material may be
700	tying product that does not damage the sheathing. The	used between any banding
701	tendon sheathing shall be protected from damage by	and the tendon to prevent
702	banding material.	damage.
703		
704	Unbonded single-strand tendons shall be fabricated in	Damage as defined in the
705	a plant audited and certified by an external program	context of this specification
706	accredited by a national accreditation body such as the	refers to a rupture or breach
707	American National Standards Institute (ANSI),	in the sheathing, which
708	International Accreditation Service (IAS), or	could allow the possible
,00		could allow the possible

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709 710 711	equivalent. Nonaccredited certification programs shall meet the essential requirements of the ISO/IEC	intrusion of moisture into the tendon.
711 712	17065:2012, Conformity Assessment, including at a minimum the following:	
710	(a) Have a documented structure which safeguards	
713	impartiality, including provisions to ensure the	
714	impartiality of the operations of the certification body;	
715	this structure shall enable the participation of all	
716	parties concerned in the development of policies and	
717 718	principles regarding the content and functioning of the	
	certification program.	
719	(b) Be free of commercial/financial pressures which	
720	might influence results and be independent from the	
721 722	entity they are certifying.	
722	(c) Have personnel who are competent and who	
723	meet defined minimum relevant criteria as defined by	
724	the certifying agency.	
725	the certifying agency.	
720	(d) Have criteria outlined in specified standards.	
727	(e) Have a procedure for making rules and procedures	
729	available to the public.	
730	available to the public.	
730	1.6.1.1 — PTI-certified plants	
732	Plants shall be certified by the Post-Tensioning	
733	Institute (PTI) according to the procedures set forth in	
734	PTI-CRT20 G1.	
751		
735	1.6.1.2 — Non-PTI-certified plants	
736	In non-PTI-certified plants, conclusive test data	
737	certified by an independent testing laboratory	
738	shall substantiate that all characteristics of the	
739	unbonded tendons—including traceability of all	
740	components; corrosion resistive characteristics;	
741	sheathing; and anchorage system, including	
742	encapsulation, if required—are equivalent to or	
743	superior to the characteristics of tendons	
744	fabricated in accordance with this specification	
745	(refer to Section 1.6.1.1). The independent testing	
746	laboratory shall be accredited to ISO/IEC 17025,	
747	General Requirements for the Competence of	
748	Testing and Calibration Laboratories, The	
749	American Association for Laboratory	
750	Accreditation (A2LA), or other equivalent	
751	accrediting organizations.	

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752	1.6.2 — Handling, storage, and shipping	C1.6.2 — Handling,
753		storage, and shipping
754	The PT supplier shall be responsible for the	
755	handling and storage of unbonded tendons prior to	
756	shipping, including:	
757	1.6.2.1 — Handling prior to shipping	
758	(a) Tendons shall not be damaged during handling,	
759	loading, or moving at the supplier's plant.	
760		
761	(b) Smooth forklift booms, padded forks, or nylon	
762	slings shall be used to handle and lift tendons (metal	
763	chokers or chains shall not be used).	
764	(c) Tendons shall be protected during bundling,	
765	handling, loading, and securing to the transport	
766	vehicle.	
767	1.6.2.2 — Storage prior to shipping	C1.6.2.2 — Storage
768	(a) Stored PT materials that are exposed to any	prior to shipping
769	precipitation (snow, rain, and so on) for a period of	Protection is required to
770	time longer than 7 days (staging) shall be protected	prevent water from
771	from this exposure (tenting or tarping with adequate	penetrating tendons.
772	ventilation, or shrink-wrapping with moisture control	penetrating tendons.
773	is appropriate). PT materials shall not be exposed to	
774	any elements known to be deleterious or corrosive.	
775	any elements known to be deletenous of conosive.	
776	(b) Tandong shall be stored on dunnage or neved	
777	(b) Tendons shall be stored on dunnage or paved surface with proper drainage away from tendons.	
778	Protect tendons that are exposed to sunlight	
779	1 0	
	(ultraviolet [UV] degradation). Acceptable protection	
780 781	includes: UV stabilizers added to the sheathing per the	
781	manufacturer's recommendation to achieve at	
782	least 90 days minimum of UV protection.	
783		
	Protect fabricated tendons that are exposed to suplight (UV degradation) longer than 1 month	
785 786	sunlight (UV degradation) longer than 1 month	
786	maximum from this exposure by tenting or tarping	
787	with adequate ventilation unless UV light stabilizers	
788	are added to the sheathing per manufacturer	
789	recommendations.	
790	1.6.2.3 — Shipping	C1.6.2.3 —Shipping
790 791	11 0	11 0
	(a) Nonmetallic tie-downs shall be used to	It is not required that all
792	secure tendon bundles to the bed of the	shipments of encapsulated
793	transport vehicle. Metal strapping or chains	tendons be shrink-wrapped.
794	shall not be used.	

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795		This may be determined by
	(b) When PT materials are transported further than	the LDP for each project.
796	500 miles (805 km) from the point of	
797	fabrication, or during inclement weather,	
798	protection shall be provided between the bed	
799	of the transport vehicle and bundles to protect	
800	sheathing during transportation.	
801		
802	(c) PT materials shipped into areas or used on	
803	projects defined as aggressive environments shall	
804	be protected during transportation by shipping	
805	inside of enclosed trailers, covering by tarps, or by	
805 806	shrink-wrapping the tendon bundles. PT materials	
800 807		
	shall be protected from deicing salts and other	
808	corrosive elements during transportation.	
809		
010		
810	1.7 — Delivery, handling, and storage	C1.7 — Delivery,
811		handling, and storage
812	1.7.1 — Delivery	C1.7.1 — Delivery
813	Tendons, accessories, and equipment shall be	If the LDP intends to assign
814	protected to maintain their integrity.	responsibility for protection
815		of tendons, accessories, and
816		equipment to parties other
817		than the PT supplier during
818		shipping or the PT installer
819		after shipping, this should
820		be stated in the Contract
821		Documents.
822	1.7.2 — Handling and storage	C1.7.2 - Handling and
823		storage
824	1.7.2.1 — Handling	C1.7.2.1 - Handling
825	During the unloading process, care shall be taken	It is recommended that
826	not to damage sheathing or anchorages. Chains or	nylon or other nonmetallic
827	hooks shall not be used.	slings be used during
828	-	unloading and handling of
829		tendons. Slings should
830		never be choked in the
831		handling of tendon coils.
832		Coils should be cradled in
833		the slings by passing the
834		slings through the center of
0.54		• •
835		the coil
835		the coil.

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836	1.7.2.2 — Storage	C1.7.2.2 — Storage
837 838 839 840 841	The unloading process shall be done as close as possible to the designated storage area to avoid excessive handling of tendons.	Multiple storage moves increase the possibility of damage to sheathing and other components of the system.
842	1.7.2.3 — Exposure	C1.7.2.3 — Exposure
843 844 845 846 847 848 849 850 851	Upon delivery, all PT tendons and accessories shall be protected from deicing salts and other corrosive elements. Tenting or tarping is acceptable. Tendons shall not be exposed to water, snow, deicing salts, or other corrosive elements. When long-term storage (more than 1 month) is required, tendons shall be protected from exposure to direct sunlight per Section 1.6.2.2.	When tarps are used for protection of the tendons, they should be constructed in a tent-like fashion to allow the free circulation of air around the tendon bundles to avoid condensation being trapped under the tarps.
852 853	1.7.2.4 — Wedges and anchors	C1.7.2.4 — Wedges and anchors
854 855 856 857 858 859 860	Wedges and anchors shall be identified by individual concrete placement areas. These components shall only be used in their identified concrete placement areas. In the event components intended for one concrete placement area are exchanged into another concrete placement area, the transaction shall be noted for traceability purposes.	After assignment to a project, any moving of anchors and wedges should be done with care to retain the traceability of such materials.
861	2.0 — PRODUCTS	C2.0 — PRODUCTS
862	2.1 — Prestressing steel	C2.1 — Prestressing steel
863 864	2.1.1 — Mechanical properties	C2.1.1 — Mechanical properties
865 866 867	Prestressing steel shall conform to one of the following requirements: ASTM A416/A416M	Provision can be made for new steels, which would include new sizes, improved
868 869 870 871 872 873	Strand not specifically identified in the latest edition of ASTM A416/A416M shall conform to or exceed the minimum requirements of this standard.	characteristics of relaxation, or improved mechanical properties. However, use of prestressing steels not covered by ASTM standards should be permitted only

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0=1		
874		when the supplier provides
875		conclusive test data certified
876		by an independent testing
877		laboratory substantiating
878		that all characteristics of the
879		material are comparable or
880		superior to the properties of
881		steels conforming to the
882		ASTM standards. The
883		independent testing
883		1 0
		5
885		accredited to ISO 17025 by
886		A2LA, or other equivalent
887		accrediting organizations. In
888		particular, the stress
889		corrosion characteristics of
890		steels produced by quench
891		and temper heat treatments
892		and steels with specified
893		tensile strengths over 270
894		ksi (1860 MPa) should be
895		evaluated carefully.
896		Relaxation properties of
897		new steels should be based
898		on a minimum test period of
899		1000 hours.
077		1000 nours.
900	2.1.2 — Thermomechanical treatment	
900	2.1.2 — Thermomeenamear treatment	
901	The process shall be conducted at a constant and	
902	controlled range of temperature, speed, and stress to	
903	ensure proper stress relieving.	
903	ensure proper suess reneving.	
904	2.1.3 — Traceability	
904	2.1.5 - Traceability	
905	The strand manufacturing process shall be	
906	controlled and documented in a manner providing	
907	identification and traceability with regard to coil(s) of	
907 908	strand and wire rod heat number and wire coil(s) used	
909	to produce the strand.	
910	2.1.4 — Testing	
011	Machanical Properties	
911	Mechanical Properties:	
912		
913		

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914	Perform breaking strength, yield strength,	
	elongation, and dimensional testing on each 30 ton	
915	(27 MT) production lot of finished strand(s) to	
916	confirm the requirements of 2.1.1.	
917		
918	Relaxation properties:	
919		
920	Test the finished strand for relaxation at least	
921	annually, and also if there is a change in the type of	
922	raw material or manufacturing process. Perform the	
923	relaxation test according to the requirements of	
924	ASTM A416/A416M and ASTM A1061/A1061M.	
925		
926	Perform the relaxation test as a full 1000-hour test	
927	at initial production and every third year thereafter.	
928	Interim annual 200-hour relaxation tests are	
929	acceptable provided that the results when extrapolated	
930	to 1000 hours compare consistently to previous	
931	satisfactory full 1000-hour test results.	
932		
933	Reporting:	
934		
935	Mechanical, dimensional, and relaxation testing	
936	shall be reported showing appropriate heat/coil	
937	identification, steel area, and test results. Units shall	
938	be in inlb units and language shall be English.	
939		
940 041	Identify testing facility used, whether in-house or	
941 042	otherwise, including physical address and contact	
942	information.	
943	2.1.5 — Strand producer records	
943	2.1.5 — Sirana producer records	
944	The manufacturer shall produce and maintain for a	
945	period of at least 5 years the following records related	
946	to material production:	
947		
948	Purchasing records showing the purchase of	
949	appropriate base materials used in production;	
950	Product traceability through production and	
951	shipping;	
952	Testing results for tests required under Section	
953	2.1.4, conformities (or nonconformities), and	
954	resultant actions;	
955		
956		

057		
957	Calibration records for testing devices indicating	
	calibration to known standards at intervals not	
958	exceeding 1 year;	
959	Records of quality performance evidencing the	
960	occasion, frequency, and percentage of	
961	accepted and rejected final product.	
962	Records shall include internal and external	
963	occurrences, such as on-site lab results and	
964	customer responses;	
965	Suitability and testing of raw materials including	
966	quality reports from wire or rod suppliers; and	
967	Procedure for the quarantine and disposal of	
	noncompliant product and records of same.	
968	2.1.6 — Identification	C2.1.6 — Identification
969	Each coil of strand shall be clearly identified as to	Strand is identified by the
970	grade, coil and heat number, and type of steel (either	producer with tags, coil
971	normal-relaxation or low-relaxation). Identification	markings, and other means,
972	shall be included in the manufacturing process	as well as mill certificates.
973	documentation.	The documentation flow
974		minimizes the possibility of
975		inadvertent substitution of
976		
		strand with material having
977		lower physical properties.
0.50		
978	2.1.7 — Packaging, marking, storage, and	C2.1.7 - Packaging,
979	protection	marking, storage, and
980		protection
981	Each coil of strand shall be packaged in a manner	For additional corrosion
982	that prevents physical damage to the strand during	protection, the coils of
983	transportation and protects the strand from deleterious	strand can be wrapped in
984	corrosion during transit and storage. Packaging shall	special paper impregnated
985	meet the purchaser's requirements, or in the absence	with vapor phase-inhibitor
986	of specific requirements, shall be appropriate for the	powder.
987	environment and conditions that are likely to be	r
988	encountered during shipping. Strand must be stored in	
989	a protected manner to prevent damage. The strand	
	must be protected from corrosion and damage until	
990		
991	the customer takes responsibility of it. This	
992	responsibility transfer occurs at the point of delivery	
993	and acceptance. Controlled access and strand	
994	movement shall be used to minimize the possibility of	
995	mixing the strand types. Procedures shall be	
996	documented. Each coil of strand produced shall have	
990	documented. Each con or strand produced shall have	
990 997	documented. Each con of strand produced shan have	

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998	two (2) weatherproof and durable tags affixed that indicate the following:	
999		
1000	Coil number;	
1001	Strand type (that is, ASTM A416-low	
1002	relaxation);	
1003	Grade;	
1004	Size; and	
	Manufacturer's name or mark.	
1005	2.1.8 — Acceptance criteria for surface condition	C2.1.8 — Acceptance
1006		criteria for surface
1007		condition
1008	Strand used for tendons shall be dry and shall be	For further information,
1009	graded as follows:	refer to Sason (1992). These
1010		criteria are not intended for
1011	Grade A: No visible rust.	use in evaluating tendons
1012	Grade B: Light surface rust that can be removed	that are in service in existing
1013	by vigorous rubbing with a cloth. No pitting	foundations.
1014	noticeable to the unaided eye. Discoloration in	
1015	steel surface in affected area is permitted.	Grades D, E, and F, while
1016	Grade C: Surface rust, removed with a fine steel	not acceptable for new
1017	wool pad, which leaves small pits on the steel	strand used in tendon
1018	surface of not more than 0.002 in. (0.05 mm)	fabrication, are listed as
1019	diameter or length.	follows for informational
1020		purposes only:
1021		
1022		Grade D: Same as Grade
1023		C, except pits
1024		exceed 0.002 in.
1025		(0.05 mm) diameter
1026		or length (can be felt
1027		with the fingernail).
1028		Grade E: Large oxidized
1029		areas, with flakes
1030		developing in the
1031		corrosion-affected
1032		zones, loss of steel
1033		section noticeable to
1034 1035		the unaided eye.
1035		Grade F: Heavy oxidation on most or all of the
1036		
1037		exposed surface areas, with strong flaking and pit
1038		formation.
1039		ioimation.

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2 — Anchorages and
olers
2.2.1 — Anchorages
ese requirements are
nded to provide an
uate strand/wedge
nection. In developing
e requirements,
ideration was given to
previously published
ifications and currently
lable test data on the
ormance of unbonded
ons. Of particular
ortance are the
irements for static
ngth and ductility set
for anchorages and
blers in Sections 2.2.1
2.2.4, respectively.
etermination of
orages meeting these
ria should be based on a
es of three consecutive
with strand from the
e heat. The following
iderations led to these
mum requirements:
requirements.
atic strength: For
ural members, the

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1090	maximum permissible
1090	1
	design strength f_{ps} at
1092	nominal flexural capacity is
1093	approximately 222 ksi
1094	(1530 MPa) for normal-
1095	relaxation strand and 236
1096	ksi (1627 MPa) for low-
1097	relaxation strand. These
1098	values are slightly less than
1099	the specified yield strength
1100	for these materials (0.85 \times
1101	270 = 229.5 ksi [1582 MPa]
1102	and $0.9 \times 270 = 243$ ksi
1103	[1675 MPa], respectively)
1104	and are 82% and 88%,
1105	respectively, of the
1106	specified tensile strength of
1107	270 ksi (1860 MPa). In
1108	nearly all cases, the design
1109	tendon strength will be
1110	substantially less than the
1111	yield strength. Accordingly,
1112	the requirement that
1113	anchorages for unbonded
1114	tendons develop 95% of the
1115	actual breaking strength of
1116	the tendon material provides
1117	a substantial safety margin
1118	between the ultimate tendon
1119	capacity and the tendon
1120	design strength.
1121	
1122	Static ductility: Along
1123	with a strength requirement,
1124	it is important that
1125	specifications for unbonded
1126	tendons include a ductility
1127	requirement. This is usually
1128	expressed as a minimum
1129	percent elongation in the
1130	gauge length under total
1131	load. This requirement
1132	ensures that the anchorage
1133	used does not damage the
1134	prestressing steel and lead to
1135	a failure at an elongation

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		[]
1136		below that specified. The
1137		tendon should elongate
1138		appreciably to avoid the
		possibility of a brittle
1139		failure.
1140		
1141		Because of the sensitivity of
1142		the strain in these high-
1143		stress regions, and to
1144		provide a comfortable
1145		margin of safety, 2.0% is
1146		specified as the required
1147		minimum total elongation
1148		under ultimate load. A
1149		tendon satisfying this
1150		requirement will possess
1151		ductility capacity greater
1152		than the member that
1153		contains it. The gauge
1154		length is defined as the
1155		length of prestressing steel
1156		measured between two
1157		points a fixed distance
1158		inside each anchorage. This
1159		eliminates the need to
1160		account for seating loss. A 3
1161		ft (915 mm) minimum total
1162		gauge length is
1163		recommended.
1164		
1165	2.2.1.1 — Static tests	C2.2.1.1 - Static tests
1100		
1166	The test assembly shall consist of standard	The LDP may not wish to
1167	production quality components and tendons that	require that static and
1168	shall be at least 3.5 ft (1.1 m) long between	fatigue testing be performed
1169	anchorages. The test shall provide determination	because these tests are
1170	of the yield strength, specified tensile strength,	expensive and usually are
1170	and percent elongation of the complete tendon. It	not necessary on every
1172	is not required to use the same specimen for	project. In lieu of testing,
1172	static and fatigue tests.	data from prior tests on
1173		representative tendon
1174		samples could be submitted.
1175		(The provisions of Section
1170		2.2.5 may be satisfactory.)
1177		2.2.5 may be satisfactory.)
11/0		

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1179		The static test is a tensile
1180		test of an assembled
1181		tendon. The test specimen
1182		should be assembled using
1183		standard production quality
1184		components that are
1185		sampled at random.
1105		sampled at random.
1186	2.2.1.2 — Fatigue tests	C2.2.1.2 — Fatigue
1187		tests
1188	Fatigue tests shall be performed on tendon	Fatigue tests are
1189	specimens with standard production quality	conducted to prove that the
1190	components and with a minimum gauge length of	tendon assembly has the
1191	3.5 ft (1.1 m) between anchorages. In the first	capability to resist cyclic
1192	test, the tendon shall withstand 500,000 cycles	loading resulting from the
1193	between 60 and 66% of the specified tensile	flexural and thermal
1194	strength. In the second test, the tendon shall	movements of the
1195	withstand 50 cycles between 40 and 85% of the	foundation concrete and the
1196	specified tensile strength. One complete cycle	dynamic effects of
1197	involves change from the lower stress level to the	earthquakes. Because
1198	upper stress level and back to the lower stress. It	unbonded tendons
1190	is not required to use the same specimen for both	experience changes of stress
1200	fatigue tests.	levels over their entire
1200	langue tests.	
		length, fatigue tests are
1202 1203		required. It is common in
		the PT industry to refer to
1204		these tests as dynamic tests
1205		but they are in fact low-
1206		cycle fatigue tests.
1207		T I T 00,000 I I I I I I I I I I I I I I I I I
1208		The 500,000-cycle test over
1209		a relatively low stress range
1210		is intended to
1211		conservatively simulate the
1212		variation in tendon stress
1213		due to flexural and thermal
1214		movements of the
1215		foundation concrete that
1216		may be expected to occur
1217		over the useful life of the
1218		slab-on-ground foundation.
1219		The 50-cycle test over a
1220		high stress range is
1221		intended to conservatively
1222		simulate the effect of a
1222		simulate the effect of a

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1223		covers conthevalue on the
		severe earthquake on the
1224		tendon.
1225	2.2.1.3 — Bearing stresses	C2.2.1.3 — Bearing
1225	2.2.1.5 Dearing stresses	stresses
1220		511 05505
1227	Average bearing stresses on concrete created by	Permissible concrete
1228	anchorages shall not exceed values computed by the	bearing stresses are included
1229	following equations unless testing by an independent	in this tendon material
1230	testing laboratory indicates anchorage performance	specification because they
1231	equivalent or superior to anchorages satisfying the	directly affect the size of
1232	requirements of this section. The independent testing	tendon anchorages.
1233	laboratory shall be accredited to ISO 17025 by A2LA,	
1234	or other equivalent accrediting organizations.	The constant has been
1235		increased for slab-on-
1236	(a) At transfer load	ground construction from
1237	$f_{cp} = 0.8 f'_{ci} \sqrt{\frac{A'_b}{A_b} - 0.2}$	1.25 to 1.40 at transfer to
1238	$J_{cp} = 0.8 J_{ci} \sqrt{A_b} - 0.2$	allow for stressing of the
1239	but not greater than $1.40f_{ci}$	tendons at a minimum
1240	(b) At service load	concrete compressive
1241		strength of 2000 psi (13.8
1242	$f_{cp} = 0.6 f_c' \sqrt{\frac{A_b'}{A_b}}$	MPa). Experience has
1243		shown that this is an
1244	but not greater than f_c'	acceptable practice
1245		provided that the
1246	where f is permissible concrete compressive	anchorages are cast into a
1247	where f_{cp} is permissible concrete compressive	perimeter rib or thickened
1248	stress; f_c' is specified concrete compressive strength;	section that is at least 11.5
1249	f_{ci} is specified concrete compressive strength at time of initial prestress; A_b is the maximum area of the	in. (290 mm) deep, that the
1250	portion of the concrete anchorage surface that is	anchorage is located and
1251	geometrically similar to and concentric with the area	oriented such that $\sqrt{A_b' / A_b}$ is
1252	of the anchorage; and A_b is the net bearing area of the	greater than 3.2, and that the
1253	anchorage.	nominal slab tendon spacing
1254	unonorugo.	is greater than 24 in. (0.6 m).
1255	f_{cp} is the average bearing stress P/A_b in the concrete,	
1256	computed by dividing the force P of the prestressing	For further information,
1257	steel by the net bearing area A_b between concrete and	refer to Chacos (2007).
1258 1259	bearing plate or other structural element of the	
1259	anchorage that has the function of transferring force	For a rectangular
1260	to the concrete.	anchorage, A_b' can be
1261		determined by extending the
1202 1263	Any special reinforcement required for the	diagonals of the anchorage
1203 1264	anchorage shall be determined by the PT supplier and	rectangle to form
1204 1265	indicated on the installation drawings.	progressively larger
1265	6	rectangles concentric with
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1267 1268 1269 1270 1271 1272 1273 1274 1275		diagonal reaches an edge of the concrete-bearing surface (either vertical or horizontal). The gross bearing area of the resultant larger rectangle is A_b' . For other anchorage shapes, A_b' is determined in a similar manner.
1276 1277 1278 1279 1280 1281 1282 1283 1284		The specified bearing stress limitations address only the high local stresses in the concrete immediately around the anchorage device. PTI provides design guidance for anchorage zones in PTI M50.2.
1285	2.2.2 — Castings	C2.2.2 — Castings
1286 1287 1288 1289 1290 1291 1292 1293 1294 1295 1296 1297 1298 1299 1230	Castings shall be nonporous and free of sand, blowholes, voids, and other defects. Casting dimensions shall be compatible with anchorage system design specifications.	Important considerations in the design of castings are raw material grade, surface roughness, surface hardness, flatness of conical angle, compatible angle geometry, and tolerance in combination with wedge and specified strand (Section 2.2.3). The reference for standard conditions of casting surface conditions is SAE-J449.
1230 1231 1232 1233 1234 1235	Wedges shall be designed to preclude failure of prestressing steel due to notching or pinching effects under test load conditions stipulated in Sections 2.2.1.1 and 2.2.1.2 for both normal- and low-relaxation prestressing steel. Component parts	anchorages Due to the dynamic interrelationship of the component parts during the transferring of force to the anchorages, the casting and
1236 1237 1238	from different manufacturers shall not be used without substantiating complete tendon test data.	the wedges should always be considered as one design unit (ICC AC303).

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	2.2.4 — Couplers
	2.2.4 — Couplers
1241 Couplers shall be used only at locations specifically An e	
1241 Couplets shall be used only at locations specificative And	example of adjusting
	adius proportionally to strand diameter is: for a
1	
1 1 1	5 in. (9.5 mm) diameter
1 1	nd, the radius of
	ature should not be less
	0.375/0.5(20 ft) = 15.0
	.5 m). Refer to Section
	2.1 for additional
	ground on the strength
1251 elongation at rupture below the 2% required for the criter	ria.
1252 tendon in Section 2.2.1.	
1254 Coupler components shall be protected with the	
1255 same PT coating used on the strand, and shall be	
1256 enclosed in sleeving with adequate length to	
1257 accommodate the elongation of the tendon during	
1258 stressing.	
1259 2.2.5 — Compliance requirements	
1260 2.2.5.1 — Conformance testing	
1261 The adequacy of a tendon system shall be confirmed	
1262 by satisfactory static, fatigue and hydrostatic	
1263 conformance (if required) tests in accordance with the	
1264 minimum requirements outlined in Sections 2.2.1.1,	
1265 2.2.1.2, and 2.2.6.1.	
1205 2.2.1.2, and 2.2.0.1.	
1266 2.2.5.2 — Compliance	
1267 Upon request, data shall be submitted to show	
1268 compliance with provisions of Sections 2.2.1.1,	
1269 2.2.1.2, and 2.2.6.1.	
1270 2.2.6 — Anchorages and couplers in aggressive C2	2.2.6 — Anchorages
0 1 00	d couplers in
	gressive environments
1272 ag	
	C2.2.6.1 — Anchorages

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1274	Anchorages used for PT slab-on-ground foundation	The LDP should evaluate
1275	construction shall be protected against corrosion when	the condition for each
1276	the LDP determines the soils or environment in which	project to determine if the
1277	the foundation is built is to be considered aggressive,	environment in which the
1278	as defined in Section 1.2.	foundation is built is to be
1279		considered aggressive.
1280	When anchorages are to be protected against	
1281	corrosion by encapsulation, a watertight	Protection of the
1282	connection of the sheathing to the anchorage and	anchorages of the PT system
1283	a watertight enclosure of the wedge cavity and	may be obtained by various
1284	prestressing steel are required to provide	means, including epoxy
1285	corrosion protection of the anchor, wedges, and	coating, plastic
1286	prestressing steel at all anchorages. Anchorages	encapsulation, or other
1287	shall be designed to attain watertight	acceptable means.
1288	encapsulation of the prestressing steel and all	1
1289	connections shall have demonstrated the ability	The use of epoxy coating
1290	to remain watertight when subject to pressure of	is acceptable; however,
1291	1.25 psi (0.0086 MPa) for a period of 24 hours.	special inspection is
1292		required to identify damage
1293		that can occur to the epoxy
1294		system during
1295		transportation, handling,
1296		and installation. Damaging
1297		the epoxy coating would
1298		breach the encapsulation
1299		and make the system
1230		unacceptable. Encapsulated
1230		tendons that employ the use
1232		of "bare" metallic
1232		anchorages produced from a
1234		material that is subject to
1235		corrosion are unacceptable.
1236		
1233		When testing an
1238		encapsulated assembly for
1230		watertightness, the
1239		specimen should be
1241		arranged in a position to
1242		ensure at least a pressure of
1243		1.25 psi (0.0086 MPa) over
1244		the entire specimen length.
1244		The pressure of 1.25 psi
1245		(0.0086 MPa) approximates
1240		3 ft (1 m) of water pressure.
1247		This pressure is considered
1248		to be a worst-case situation
1247		to be a worst-case situation

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1250	for normal applications. For
1251	applications where water
1252	pressure may exceed 3 ft (1
1253	m) (for example, slabs
1254	below grade), the project
1255	specification should require
1256	a more stringent test
1257	performance.
1258	p • • • • • • • • •
1259	It is recommended that
1260	pressure testing include the
1260	following additional
1201	-
1262	requirements:
	(a) Testing should be
1264	(a) Testing should be
1265	certified by an independent
1266	testing laboratory selected
1267	by the system manufacturer.
1268	The independent testing
1269	laboratory should be
1270	accredited to ISO 17025 by
1271	A2LA, or other equivalent
1272	accrediting organizations.
1273	
1274	(b) Representative
1275	samples from production
1276	runs selected and assembled
1277	by the manufacturer should
1278	be used in testing.
1279	
1280	(c) Stressing,
1281	intermediate, and fixed
1282	anchorage assemblies
1283	should each be tested.
1284	
1285	(d) Three tests are
1286	required for each assembly
1287	with all three passing for the
1288	system to pass.
1289	
120)	(e) Retesting is required
1290	whenever a component of
1291	an assembly changes or the
1292	testing criteria changes.
1293	testing enterna changes.
1294	
1293	

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1206		(f) The menufacturer of
1296		(f) The manufacturer of
1297		the encapsulated tendons
1298		should provide
1299		identification of all
1300		component parts of their
1301		individual system and
1302		provide assembly
1303		instructions that will be sent
1304		to the field for the system
1305		tested.
1306		
1307		Encapsulated tendons
1308		using components from
1309		different manufacturers are
1310		acceptable provided they are
1310		tested in accordance with (a)
1311		through (f) mentioned
1312		previously.
1313		proviously.
1314		The following suggested
1315		method may be used for
1310		detecting the presence of
1317		u 1
1318		moisture:
		(i) Add white nigment to
1320		(i) Add white pigment to
1321		the PT coating.
1322		
1323		(ii) Use a colored dye in
1324		the water that will contrast
1325		with the white color of the
1326		PT coating.
1327		
1328		(iii) The "Pass" criterion is
1329		no colored dye staining,
1330		anywhere on the white PT
1331		coating, inside the
1332		encapsulated tendon.
1333	2.2.6.2 — Encapsulated tendons	
1334	Any component used to connect the sheathing to	
1335	any anchorage or coupler enclosure in encapsulated	
1336	tendons shall conform to the following:	
1337		
1338	1. The connecting components shall:	
1339		

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-		
1340	(a) Be watertight in conformance with Section	
1341	2.2.6.1.	
	(b) Conform to the same requirements as the	
	sheathing for durability during fabrication,	
1342	transportation, handling, storage, and installation.	
1343	transportation, nanoming, storage, and instantation.	
	(a) Here a minimum this have a f 0.050 in (1.25)	
1344	(c) Have a minimum thickness of 0.050 in. (1.25	
1345	mm).	
1346		
1347	(d) Have a watertight, positive mechanical	
1348	connection to the anchorage protection or coupler	
1349	enclosure and a watertight connection	
1350	at the tendon sheathing.	
1351		
1352	(e) Have a minimum 2 in. (50 mm) overlap and	
1353	maintain seal between the end of the extruded	
1353	sheathing covering the prestressing steel and the	
1355	watertight connection at the tendon sheathing.	
1355	watertight connection at the tendon sheathing.	
	(f) Do translycont or have other method of verifying	
1357	(f) Be translucent or have other method of verifying	
1358	compliance with Sections 2.2.6.2, Item 1(a), and	
1359	Section 2.2.6.2, Item 2.	
1360		
1361	Within the connecting component or enclosure,	
1362	prestressing steel shall be either covered by	
1363	sheathing for its full length, or be in full contact	
1364	with PT coating in conformance with Section	
1365	2.4.3 where sheathing is not present.	
1366		
1367		
1507		
1368	2.3 — Sheathing	C2.3 — Sheathing
1500	2.5 — Sheathing	C2.5 — Sheathing
1369	2.3.1 — General properties	C2.3.1 — General
	2.5.1 — General properties	
1370		properties
1071	Tondon shoothing for unborded sinch (1	To develop stor land.
1371	Tendon sheathing for unbonded single-strand	To develop standards for
1372	tendons shall be made of material with the following	determining the
1373	properties:	acceptability for other
1374		sheathing materials to meet
1375	Sufficient strength and durability to withstand	the durability requirements
1376	damage during fabrication, transport,	reflected by the use of
1377	installation, concrete placement, and	sheathing meeting the
1378	stressing;	requirements listed under
-		

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1380	Chemically stable, without embrittlement or	representative sample of the
1381	softening over the anticipated exposure	alternate product should be
1382	temperature range and service life of the slab-	used to determine
1383	on-ground foundation. Free chloride ions shall	comparable values
	not be extractable from the sheathing material;	considering the following
1384	and	characteristics:
1385	Nonreactive with concrete, prestressing steel,	
1386	reinforcing steel, and PT coating.	A. Abrasion resistance;
1380	Tennorenig steer, and TT coating.	B. UV resistance up to 6
1387		months' exposure;
		1 ,
1389		C. Impact resistance;
1390		D. Chemical resistance to
1391		concrete, admixtures, and
1392		PT coating;
1393		E. Chloride permeability;
1394		F. Tear resistance;
1395		G. Cold weather
1396		exposure;
1397		H. Thermal cracking;
1398		I. Tensile strength;
1399		J. Compressive strength;
1400		K. Brittleness;
1401		L. Temperature range of –
1402		20 to 120°F (-30 to 49°C).
1403		
1404		Equivalency can be
1405		determined by testing,
1405		subject to the approval of
1400		the LDP, which
1407		demonstrates that all
1408		
		requirements of Section 2.3
1410		are satisfied by the alternate
1411		material.
1412		
1413	2.3.2 — Minimum thickness and diameter	C2.3.2 — Minimum
1414		thickness and diameter
1415	2.3.2.1 — Minimum thickness	C2.3.2.1 — Minimum
1416		thickness
1110		
1417	Minimum thickness of sheathing shall be 0.040 in.	Due to the fabrication
1417	(1.02 mm) for polyethylene or polypropylene with a	process, slight variations in
1419	minimum density of 0.034 lb/in. ³ (0.941 g/cm ³), or	sheathing thickness may
1419	equivalent if other materials are used.	occur around the perimeter.
	עקעוזימוכות וו טעוכו וומוכוומוג מול עגלע.	
1421		
1422		sheathing thickness of up to

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1423 1424 1425 1426 1427 1428	For encapsulated tendons, the minimum thickness of sheathing using the aforementioned material properties shall be 0.050 in. (1.25 mm).	10% are acceptable provided an average of four equidistant readings along the circumference equals or exceeds the required thickness.
1429	2.3.2.2 — Inside diameter	
1430	Sheathing shall be concentric with the strand	
1431	and shall have an inside diameter at least 0.030 in.	
1432	(0.75 mm) greater than the maximum diameter of the	
1433	strand.	
1434	2.3.2.3 — Appearance	
_		
1435	Sheathing shall provide a smooth circular outside	
1436	surface and shall not visibly reveal lay of the strand.	
1437	2.3.3 — Fabrication process	C2.3.3 — Fabrication
1438	1	process
		1
1439	Tendons shall be fabricated by a process that	The watertight
1440	provides watertight encasement of the PT coating.	encasement is intended to
1441		prevent migration of any
1442		water intruding from the
1443		ends or a break in the
1444		sheathing.
1445		
1446		The sheathing extrusion
1447 1448		process, in which the PT
1448		coating is applied to the strand under pressure and
1449		the plastic sheathing is
1450		extruded onto the strand,
1451		meets the intent and
1453		requirement of this section.
1454		requirement of this section.
1455		Some small bubbles and air
1456		spaces are normal and
1457		unavoidable in the
1458		fabrication process.
1430		
1458	2.3.4 — Sheathing coverage	C2.3.4 — Sheathing

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1462	intrusion of cement paste or loss of the PT coating.	differences and varying
1463		industry practices, the LDP
1464		should specify the length of
1465		the unsheathed, coated
1466		strand permitted to remain
1467		unsheathed in
1468		nonaggressive
1469		environments at the
1470		stressing, intermediate, and
1471		fixed anchorages.
1472		Generally, no more than 1
1473		in. (25 mm) of unsheathed
1474		strand is permitted at the
1475		stressing and intermediate
1476		anchorages and no more
1477		than 12 in. (305 mm) is
1478		permitted at the fixed
1479		anchorages.
1480	2.3.5 — Encapsulated tendons	C2.3.5 — Encapsulated
1481		tendons
1482	The sheathing connection to sleeving at couplers	This requirement ensures
1483	and to all stressing, intermediate, and fixed	complete encapsulation of
1484	anchorages shall be in conformance with Section	the tendon from end to end.
1		
1485	2.2.6.2. Connections shall remain watertight when	A watertight connection
1486	subjected to a pressure of 1.25 psi (0.0086 MPa) for	may be achieved by either
1486 1487	-	may be achieved by either using special connector
1486 1487 1488	subjected to a pressure of 1.25 psi (0.0086 MPa) for	may be achieved by either using special connector pieces that provide a
1486 1487 1488 1489	subjected to a pressure of 1.25 psi (0.0086 MPa) for	may be achieved by either using special connector pieces that provide a watertight connection to the
1486 1487 1488 1489 1490	subjected to a pressure of 1.25 psi (0.0086 MPa) for	may be achieved by either using special connector pieces that provide a watertight connection to the anchor at one end and to the
1486 1487 1488 1489 1490 1491	subjected to a pressure of 1.25 psi (0.0086 MPa) for	may be achieved by either using special connector pieces that provide a watertight connection to the anchor at one end and to the sheathing at the other end,
1486 1487 1488 1489 1490 1491 1492	subjected to a pressure of 1.25 psi (0.0086 MPa) for	may be achieved by either using special connector pieces that provide a watertight connection to the anchor at one end and to the sheathing at the other end, or by other means meeting
1486 1487 1488 1489 1490 1491 1492 1493	subjected to a pressure of 1.25 psi (0.0086 MPa) for	may be achieved by either using special connector pieces that provide a watertight connection to the anchor at one end and to the sheathing at the other end, or by other means meeting the pressure test
1486 1487 1488 1489 1490 1491 1492 1493 1494	subjected to a pressure of 1.25 psi (0.0086 MPa) for	may be achieved by either using special connector pieces that provide a watertight connection to the anchor at one end and to the sheathing at the other end, or by other means meeting the pressure test performance criteria. For
1486 1487 1488 1489 1490 1491 1492 1493 1494 1495	subjected to a pressure of 1.25 psi (0.0086 MPa) for	may be achieved by either using special connector pieces that provide a watertight connection to the anchor at one end and to the sheathing at the other end, or by other means meeting the pressure test performance criteria. For watertightness testing
1486 1487 1488 1489 1490 1491 1492 1493 1494 1495 1496	subjected to a pressure of 1.25 psi (0.0086 MPa) for	may be achieved by either using special connector pieces that provide a watertight connection to the anchor at one end and to the sheathing at the other end, or by other means meeting the pressure test performance criteria. For watertightness testing requirements, refer to
1486 1487 1488 1489 1490 1491 1492 1493 1494 1495	subjected to a pressure of 1.25 psi (0.0086 MPa) for	may be achieved by either using special connector pieces that provide a watertight connection to the anchor at one end and to the sheathing at the other end, or by other means meeting the pressure test performance criteria. For watertightness testing
1486 1487 1488 1489 1490 1491 1492 1493 1494 1495 1496	subjected to a pressure of 1.25 psi (0.0086 MPa) for	may be achieved by either using special connector pieces that provide a watertight connection to the anchor at one end and to the sheathing at the other end, or by other means meeting the pressure test performance criteria. For watertightness testing requirements, refer to
1486 1487 1488 1489 1490 1491 1492 1493 1494 1495 1496 1497	subjected to a pressure of 1.25 psi (0.0086 MPa) for a period of 24 hours.	may be achieved by either using special connector pieces that provide a watertight connection to the anchor at one end and to the sheathing at the other end, or by other means meeting the pressure test performance criteria. For watertightness testing requirements, refer to Section C2.2.6.1.
1486 1487 1488 1489 1490 1491 1492 1493 1494 1495 1496 1497 1498	subjected to a pressure of 1.25 psi (0.0086 MPa) for a period of 24 hours. 2.4 — PT coating	may be achieved by either using special connector pieces that provide a watertight connection to the anchor at one end and to the sheathing at the other end, or by other means meeting the pressure test performance criteria. For watertightness testing requirements, refer to Section C2.2.6.1.

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r		
1502	• Provide corrosion protection to the prestressing	
1503	steel;	
1504	• Provide lubrication between the strand and	
1505	sheathing;	
1506		
	• Resist flow within anticipated temperature range	
1507	of exposure;	
1508	• Provide continuous non-brittle coating at lowest	
1509	anticipated temperature of exposure; and	
1510	• Be chemically stable and nonreactive with	
1511		
1512	prestressing steel, reinforcing steel, sheathing	
1012	material, and concrete.	
1513	2.4.2 - Type of PT coating	
1313	$2.\tau.2 - 1 ype of 11 country$	
1514	The PT coating shall be a compound with	
1515	appropriate moisture displacing and corrosion-	
1516	inhibiting properties, as specified in Section 2.4.4.	
1010		
1517	2.4.3 — Minimum quantity	C2.4.3 — Minimum
1518		quantity
1510		quantity
1519	The minimum weight of the PT coating on the	The quantity of PT coating
1520	strand shall be not less than 2.5 lb (1.14 kg) per 100 ft	specified provides a
1520	(30.5 m) for 0.5 in. (12.7 mm) diameter strand.	minimum coating over the
1521		crests of the strand of 0.015
1523	Minimum quantity of PT coating for other strand	in. (0.40 mm).
1524	sizes can be determined by linear extrapolation.	
1525		
1526	The coating material shall completely fill the	
1527	annular space between the strand and sheathing. The	
1528	coating shall extend over the entire tendon length.	
1020		
1529	2.4.4 — Performance criteria	C2.4.4 — Performance
1530		criteria
1531	Provide PT coating compound that complies with	Table 2.4.4.1: The tests
1532	the tests and associated acceptance criteria specified	for PT coatings presented in
1533	in Table 2.4.4.1. Conduct qualification tests 1 through	Table 2.4.4.1 are considered
1535	10 from Table 2.4.4.1 every 30 months or whenever	to be baseline tests to ensure
1534	•	
	any change is made to their chemical composition.	that minimum corrosion
1536		protection properties are
1537	In addition, conduct and report the results of tests 1,	provided. New
1538	9, and 10 specified in Table 2.4.4.1 for every batch of	developments of coating
1539	PT coating supplied.	materials may not meet
1540		some of these test
1541		requirements and, in such
10 11		requirements und, in such

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1542 1543cases, other and more comprehensive tests may be necessary to ascertain their adequacy.1546 1547 1548Tests 1 and 2: Limiting the dropping point to 300°F (149°C) minimum is intended to ensure product stability under elevated temperatures that are possible during tendon fabrication and installation. Test 1, together with Test 2, ensures that the bleeding of the lighter components from the coating is minimized.1550 1555Test 3: Water content is limited to exclude the presence of free water in the coating material.1560 1566 1566 1566Test 4: This test refers to the old component in the coating material.1570 1570 1571 1571 1576Test 5: This test provides a method to determine the effectiveness of the coating material.1577 1578 1579 1578 1579Test 5: This test provides a method is a standard test used for corrosion- inhibiting coatings such as paints. The acceptance criteria of Grade 7 or better (according to ASTM D610) (after 1000 hours of exposure		
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1571change of consistency of the coating material.157215731573Test 5: This test provides a method to determine the effectiveness of the corrosion-inhibiting properties of the coating.1579The method is a standard test used for corrosion- inhibiting coatings such as paints. The acceptance criteria of Grade 7 or better (according to ASTM D610)	1569	derivatives, which affect the
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1572coating material.1573Test 5: This test provides1574Test 5: This test provides1575a method to determine the1576effectiveness of the1577corrosion-inhibiting1578properties of the coating.1579The method is a standard1580test used for corrosion-1581inhibiting coatings such as1582paints. The acceptance1583criteria of Grade 7 or better1584(according to ASTM D610)	1571	
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1583criteria of Grade 7 or better (according to ASTM D610)		
1584 (according to ASTM D610)		1 1
	1584	(according to ASTM D610)
	1585	
1586 requires that only 0.3% of	1586	-

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1587	the expected area can have
1587	the exposed area can have indications of corrosion.
1589	
	(Refer to Fig. 1, Examples
1590	of Area Percentages, from
1591	ASTM D610.) The test is
1592	conducted on a 3 x 6 in. (75
1593	x 150 mm) steel panel with
1594	a coating thickness of 0.005
1595	in. (125 mm). When
1596	determining the percent of
1597	area corroded, only the area
1598	inside 0.25 in. (6 mm) from
1599	the edges of the panel is
1600	evaluated.
1601	
1602	Test 6: Water-soluble ions
1603	known to cause corrosion
1604	are limited by this
1605	requirement.
1606	
1607	Test 7: The soak test is
1608	designed to determine the
1609	ability of the coating to
1610	provide corrosion protection
1611	after having been exposed to
1612	standing water for a period
1613	of time. Certain coatings
1614	will absorb water to an
1615	extent that they will
1616	emulsify and no longer
1617	provide a barrier against
1618	moisture reaching the steel.
1619	This test will guard against
1620	use of such coatings.
1621	č
1622	Test 8: Certain petroleum
1623	derivatives react with
1624	polyethylene or
1625	polypropylene, changing
1626	their physical properties to
1627	the point where they are no
1628	longer usable as sheathing
1629	materials. This test is
1630	required to preclude the use
1631	of coatings with such
1632	derivatives.

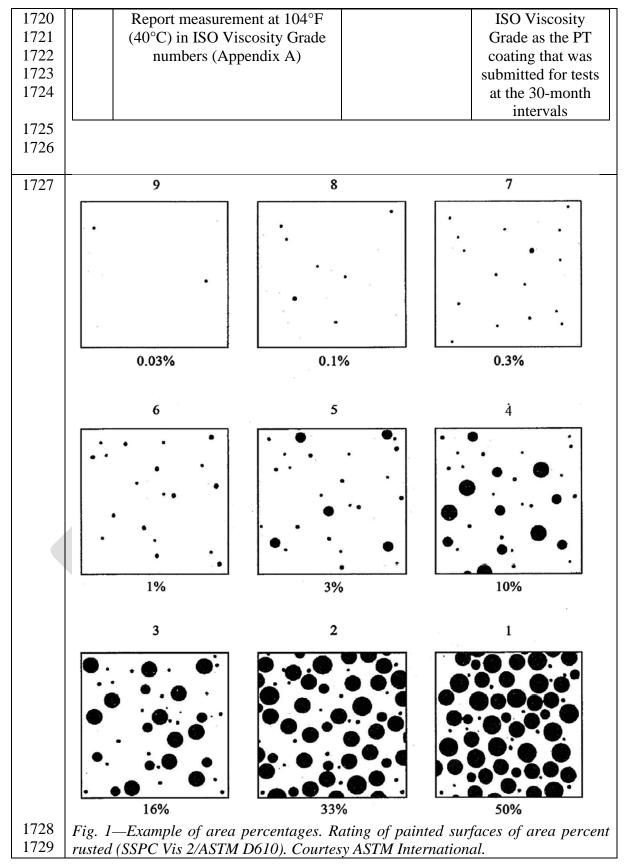
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1633	2.4.5	5 — Shipping and handling		
1634	Transport bulk shipments of PT coating in a manner			
1635		nsures it is not mixed with any PT		
1636		ed according to Section 2.4.4. A	Ũ	
1630		ners/tanks hoses and pumps being u		
1638		ort/transfer of PT coating shall be de		
1639	-	nsport/transfer of PT coating or be of		
1640		com any other contaminates that co		
1640		rious impact on the PT coating. In th		
1642		edicated equipment is used	for the	
1643		ort/transfer of PT coating, veri		
1644	_	ng shall be required.		
1044	cicaiiii	ng shan be required.		
1645	Table	2.4.4.1—Performance specification		
1646	No.	Test description	Test method	Acceptance
1647				criteria
1648	1	Dropping point	ASTM D2265	Minimum 300°F
1649				(149°C)
1650	2	Oil separation at 160°F (71°C)	ASTM D6184	0.5% maximum by
1651		All weight/mass	(modified)	mass
1652		measurements shall be		
1653		recorded to four (4)		
1654		significant digits in		
1655		grams.		
1656		Run three (3) separate		
1657		samples from the same		
1658		batch. The bleed shall be		
1659		calculated for each		
1660		sample and the result		
1661		reported as the		
1662		average/mean of the three		
1663		recorded samples.		
1664		Final result shall be reported		
1665		to the nearest two (2)		
1666		significant digits (0.xx%).		
1667	3	Water content	ASTM D95	0.1% maximum
1668	4	Flash point (refers to oil	ASTM D92	Minimum 300°F
1669		component)		(149°C)
1670	5	Corrosion test (5% salt fog at	ASTM B117	Rust Grade 7 or
1671		100°F [38°C], 0.005 in. [0.127		better after 1000
1672		mm], Q Panel Type S)		hours of exposure
1673				according to
1674				ASTM D610
10/4				AS1M D610

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1675	6	Water-soluble ions	ASTM D512	10 ppm maximum
1676	Ũ	Chlorides	ASTM D3867	for all
1677		Nitrates	ASTM D4658	101 001
1678		Sulfides		
1679				
		Procedure: The inside (bottom		
1680		and sides) of a 1.06 qt (1 L) glass		
1681		beaker (approximate outside		
1682		diameter 4.13 in. [105 mm],		
1683		height 5.71 in. [145 mm]) is		
1684		thoroughly coated with 3.53 \pm		
1685		$0.35 \text{ oz} (100 \pm 10 \text{ g}) \text{ of}$		
1686		corrosion-inhibiting coating		
1687		material. The coated beaker is		
1688		filled with approximately 30 oz		
1689		(900 cc) of distilled water and		
1690		heated in an oven at a controlled		
1691		temperature of 100°F (37.8 \pm		
1692		1.1°C) for 4 hours. The water		
1693		extraction is tested by the noted		
1694		test procedures for the		
1695		appropriate water-soluble ions.		
1696		Results are reported as ppm in		
1697		the extracted water.		
1698	7	Soak test (5% salt fog at 100°F	ASTM B117	No emulsification
1699		[38°C],	(modified)	of the coating after
1700		0.005 in. [0.127 mm] coating, Q		720 hours of
1701		Panel		exposure
1702		Type S. Immerse panels 50% in		
1703		a 5% salt		
1704		solution and expose to salt fog)		
1705	8	Compatibility with sheathing		Permissible
1706		(a) Hardness and volume change	ASTM D4289	change in hardness
1707		of polymer after exposure to	(ASTM D792 for	15%, volume 10%
1708		grease, 40 days at 150°F (66°C)	density)	
1709		(b) Tensile strength change of		Permissible
1710		polymer 40 days	ASTM D638	change in tensile
1711 1712		after exposure to grease, 40 days		strength 30%
1712		at $150^{\circ}\mathrm{E}(66^{\circ}\mathrm{C})$		
1713		150°F (66°C)		265 to 205 (NIL CI
1714	9	Cone penetration	ASTM D217	265 to 295 (NLGI
1715				2) worked
1710	10	Kinomatia visagaity of base cil	ASTM D445	penetration The base oil for
1718	10	Kinematic viscosity of base oil	ASTM D443	each batch shall be
1719				within the same
1/1/				within the same

This draft is not final and is subject to revision. This draft is for public review and comment. Page 45 of 64



This draft is not final and is subject to revision. This draft is for public review and comment. Page 46 of 64

1730	2.5 — Alternative materials	
1731	A PT system is comprised of a tensile	
1732	element that has an anchorage mechanism	
1733	permanently connected at each end that	
1734	transfers the force connecting the anchorage	
1735	mechanisms from the tensile element into a	
1736	structural element. During the application of	
1737	the force, the tensile element is free to move	
1738	relative to the structural element.	
1739	In an unbonded PT system, the tensile	
1740	element is permanently isolated from the	
1741	structural element and both the tensile	
1742	element and anchorage mechanism are	
1743	permanently protected from any source that	
1744	could cause corrosion or deterioration of the	
1745	materials used in these elements.	
1746	In current unbonded systems, the tensile	
1747	element is a steel strand, and the anchorage	
1748	mechanism is a steel element with a conical	
1749	void that uses steel wedges with gripping	
1750	teeth that form a mechanical connection to	
1751	the strand to transfer the force into the	
1752	anchorage mechanism when the wedges are	
1753	pulled into the conical hole.	
1754	The materials, systems, and components	
1755	described herein reflect current technology.	
1756	Nothing herein shall be construed to prevent	
1757	other materials or components from being	
1758	introduced or used, provided alternate	
1759	components manufactured from different	
1760	material and associated dimensional	
1761	differences shall be tested to confirm	
1762	performance equivalency, including the	
1763	requirements of PTI M10.6, Specification for	
1764	Unbonded Single-Strand Tendons Used for	
1765	Slab-on-Ground Construction. The use of	
1766	any components after successful testing is	
1767	subject to the approval of the LDP.	
1768	Proposed components comprised of	
1769	alternate materials shall be presented and	
1770	balloted in by PTI Committee M-10,	
1771	Unbonded Tendon, for possible equivalency	
1772	to PTI M10.2, Specification for Unbonded	

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1770		
1773	Single Strand Tendons Used for Slab-on-	
1774	Ground Construction. Conformance shall be	
1775	established through testing by an	
1776	independent testing laboratory accredited to	
1777	ISO 17025 by A2LA, or other equivalent	
1778	accrediting organizations, and approval by	
1779	an independent task group appointed by PTI	
1780	Committee M10 and approved by the	
1781	Technical Advisory Board (TAB). It shall	
1782	be comprised of a minimum five-person	
1783	task group that has relevant experience in	
1784	the product for which the alternate material	
1785	is used, while not having any direct	
1786	financial or monetary interest in the	
1780	proposed alternative material. The	
1787	independent task group shall review the new	
1789	component/product, taking into account the	
1789	results of the independent testing	
1791	laboratories, manufacturing tolerances, and	
1791	other acceptance qualifications necessary to	
1792	ensure that the proposed alternate	
1793		
	component/product of this specification	
1795	meet or exceed the qualifications and	
1706	nonformance of the automatic manification	
1796	performance of the current specification.	
1796 1797	performance of the current specification. 3.0 — EXECUTION	C3.0 — EXECUTION
		C3.0 — EXECUTION C3.1 — General
1797	3.0 — EXECUTION	
1797	3.0 — EXECUTION	
1797	3.0 — EXECUTION	
1797 1798	3.0 — EXECUTION 3.1 — General	C3.1 — General
1797 1798 1799	3.0 — EXECUTION 3.1 — General	C3.1 — General C3.1.1 — Qualifications and
1797 1798 1799	3.0 — EXECUTION 3.1 — General	C3.1 — General C3.1.1 — Qualifications and
1797 1798 1799 1800	3.0 — EXECUTION 3.1 — General 3.1.1 — Qualifications and inspection	C3.1 — General C3.1.1 — Qualifications and inspection
1797 1798 1799 1800 1801	3.0 — EXECUTION 3.1 — General <i>3.1.1 — Qualifications and inspection</i> 3.1.1 — Installation and stressing shall	C3.1 — General C3.1.1 — Qualifications and inspection When required, it is recommended
1797 1798 1799 1800 1801 1802	3.0 — EXECUTION 3.1 — General <i>3.1.1 — Qualifications and inspection</i> 3.1.1 — Installation and stressing shall be performed under the supervision of	C3.1 — General C3.1.1 — Qualifications and inspection When required, it is recommended that the inspection be conducted by
1797 1798 1799 1800 1801 1802 1803	3.0 — EXECUTION 3.1 — General 3.1.1 — Qualifications and inspection 3.1.1 — Installation and stressing shall be performed under the supervision of individuals holding a current certification	C3.1 — General C3.1.1 — Qualifications and inspection When required, it is recommended that the inspection be conducted by an individual holding a certification
1797 1798 1799 1800 1801 1802 1803 1804	3.0 — EXECUTION 3.1 — General 3.1.1 — Qualifications and inspection 3.1.1 — Installation and stressing shall be performed under the supervision of individuals holding a current certification from the PTI Slab-on-Ground	C3.1 — General C3.1.1 — Qualifications and inspection When required, it is recommended that the inspection be conducted by an individual holding a certification from the PTI Level 2 Unbonded PT
1797 1798 1799 1800 1801 1802 1803 1804 1805	3.0 — EXECUTION 3.1 — General 3.1.1 — General 3.1.1 — Qualifications and inspection 3.1.1 — Installation and stressing shall be performed under the supervision of individuals holding a current certification from the PTI Slab-on-Ground Installer/Stressor Field Certification Program or equivalent, unless otherwise	C3.1 — General C3.1.1 — Qualifications and inspection When required, it is recommended that the inspection be conducted by an individual holding a certification from the PTI Level 2 Unbonded PT
1797 1798 1799 1800 1801 1802 1803 1804 1805 1806	3.0 — EXECUTION 3.1 — General <i>3.1.1 — Qualifications and inspection</i> 3.1.1 — Installation and stressing shall be performed under the supervision of individuals holding a current certification from the PTI Slab-on-Ground Installer/Stressor Field Certification	C3.1 — General C3.1.1 — Qualifications and inspection When required, it is recommended that the inspection be conducted by an individual holding a certification from the PTI Level 2 Unbonded PT
1797 1798 1799 1800 1801 1802 1803 1804 1805 1806 1807 1808	3.0 — EXECUTION 3.1 — General 3.1.1 — Qualifications and inspection 3.1.1 — Installation and stressing shall be performed under the supervision of individuals holding a current certification from the PTI Slab-on-Ground Installer/Stressor Field Certification Program or equivalent, unless otherwise specified in the Contract Documents.	C3.1 — General C3.1.1 — Qualifications and inspection When required, it is recommended that the inspection be conducted by an individual holding a certification from the PTI Level 2 Unbonded PT
1797 1798 1799 1800 1801 1802 1803 1804 1805 1806 1807 1808 1809	 3.0 – EXECUTION 3.1 – General 3.1.1 – Qualifications and inspection 3.1.1 – Installation and stressing shall be performed under the supervision of individuals holding a current certification from the PTI Slab-on-Ground Installer/Stressor Field Certification Program or equivalent, unless otherwise specified in the Contract Documents. 3.1.1.2 – If required by Contract 	C3.1 — General C3.1.1 — Qualifications and inspection When required, it is recommended that the inspection be conducted by an individual holding a certification from the PTI Level 2 Unbonded PT
1797 1798 1799 1800 1801 1802 1803 1804 1805 1806 1807 1808 1809 1810	 3.0 — EXECUTION 3.1 — General 3.1.1 — General 3.1.1 — Installation and stressing shall be performed under the supervision of individuals holding a current certification from the PTI Slab-on-Ground Installer/Stressor Field Certification Program or equivalent, unless otherwise specified in the Contract Documents. 3.1.1.2 — If required by Contract Documents, an inspection shall be conducted 	C3.1 — General C3.1.1 — Qualifications and inspection When required, it is recommended that the inspection be conducted by an individual holding a certification from the PTI Level 2 Unbonded PT
1797 1798 1799 1800 1801 1802 1803 1804 1805 1806 1807 1808 1809	 3.0 – EXECUTION 3.1 – General 3.1.1 – Qualifications and inspection 3.1.1 – Installation and stressing shall be performed under the supervision of individuals holding a current certification from the PTI Slab-on-Ground Installer/Stressor Field Certification Program or equivalent, unless otherwise specified in the Contract Documents. 3.1.1.2 – If required by Contract 	C3.1 — General C3.1.1 — Qualifications and inspection When required, it is recommended that the inspection be conducted by an individual holding a certification from the PTI Level 2 Unbonded PT

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1813	met. Inspection shall include, but are not	
1814	limited to:	
1815		
1816	• Material cleanliness;	
1817	• Location and quantity of	
1818	materials;	
	• Corresponding material and	
1819	stressing equipment	
1820	certifications; and	
1821	 Stressing of prestressing tendons. 	
1822	• Suessing of presuessing tendons.	
1823	The DT supplier shall be notified of any	
1824	The PT supplier shall be notified of any	
1825	observed damages.	
1020		
1826	3.1.2 — Recommended procedures	
1020		
1827	The PT installer shall conform to the	
1828	requirements shown on the LDP's design	
1829	drawings and/or the installation drawings	
1830	provided by the PT supplier and shall	
1831	conform to the procedures stated in PTI	
1832	DC10.2 unless otherwise specified in the	
1833	Contract Documents. Should conflicts exist	
1834	between the documents cited previously, the	
1835	requirements of the Contract Documents	
1836	shall govern first, followed by the	
1837	requirements of the PT supplier's installation	
1838	drawings.	
1000		
1839	3.1.3 - Handling	
1840	Nonmetallic slings shall be used to lift	
1841	tendons. Metal chokers or chains shall not be	
1842	used. Tendons shall not be dragged on any	
1843	surface where tendon sheathing damage can	
1844	occur.	
1845	3.1.4 — Protection	
1846	Tendon bundles and accessory items shall	
1847	not be stored where they will be subjected	
1848	to rain, snow, or standing that they are not	
1849	damaged during or after unloading.	
	contraget during of alter anotaning.	
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1850	3.2 — Tendon installation	C3.2 — Tendon installation
1851	3.2.1 — General	C3.2.1 — General
1852	Installation of tendons used in PT slab-on-	
1853	ground foundations shall conform to the	
1854	requirements of PTI DC10.2.	
1855	3.2.1.1 — Support intervals	C3.2.1.1 — Support intervals
1856	PT tendons shall be firmly supported at	Limitations on tendon support
1857	intervals not exceeding 54 in. (1.37 m).	intervals are required to prevent
1858	Placing tolerances shall be in accordance	displacement during concrete
1859	with Section 3.2.1.3, or the Contract	placement.
1860	Documents, whichever is the most	
1861	restrictive.	
1862	3.2.1.2 — Support system	C3.2.1.2 — Support system
1863	Tendons shall be attached to support	Due to the large spacing of tendons
1864	chairs or reinforcement in a manner that	and minimal conventional
1865	does not cause damage to the sheathing	reinforcement present in PT slab-on-
1866	and that will prevent displacement	ground foundations, it is
1867	during concrete placing operations.	recommended that the tendons be
1868		securely tied at all tendon
1869		intersections and to the support
1870		system unless an acceptable
1871		alternate means is approved by the
1872		LDP.
1873	3.2.1.3 — Tendon tolerances	
1874	Maximum permissible deviations from	
1875	tendon design locations shall be as follows:	
1876		
1877	1. Ribbed foundations	
1878	Slab tendons/Vertical: Center of gravity	
1879	of strands (CGS) in the middle one-third of	
1880	the actual slab thickness for $t > 4.75$ in. (120)	
1881	mm) and in the middle one-half of the actual	
1882	slab thickness for $t \le 4.75$ in. (120 mm).	
1883		
1884	Slab tendons/Horizontal: Variance from	
1885	plan location ± 12 in. (± 305 mm) with smooth	
1886	transition around obstructions with a	
1887	minimum deviation of 1:6.	

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1888		
1889	Rib tendons/Vertical:	
1890	Kib tendons/ vertical.	
1890	Anchor location: ± 1 in. (± 25 mm)	
1891	Low point: -1 in. $(25 \text{ mm})/+3$ in. (75 mm)	
1892	Low point1 m. (25 mm)/+3 m. (75 mm)	
1893	Dib tandong/Horizontal: 12 in (150 mm)	
1894	Rib tendons/Horizontal: ± 2 in. (± 50 mm) from rib center line.	
1895	from fib center fine.	
1890	2. Uniform thickness foundations	
1897	Tendons/Vertical: CGS in the middle	
1899	one-third of the actual foundation thickness,	
1900	but not to exceed ± 1 in. (± 25 mm).	
1901	Tendens/Herizentel, Marianes from	
1902	Tendons/Horizontal: Variance from	
1903	plan location ± 12 in. (± 305 mm) with smooth	
1904	transition around obstructions with a	
1905	minimum deviation of 1:6.	
1906		
1907	Tolerances shall not reduce clear cover	
1908	to tendons.	
1909	3.2.1.4 - Lateral deviations	C3.2.1.4 - Lateral deviations
1909	5.2.1.4 — Ealeral deviations	$C_{3,2,1,4} = Lateral deviations$
1910	Lateral deviations in tendon location shall	Slab behavior is relatively
1911	be	insensitive to lateral deviations in the
1912	permitted if necessary to avoid	location of tendons (perpendicular to
1912	plumbing blockouts and risers, hold-	the vertical plane of the tendon
1913	down devices, and other inserts (refer to	design location).
1915	Section 3.2.1.3). Such deviations shall	
1916	have a radius of curvature of not less	An example of adjusting the radius
1917	than 20 ft (6.5 m) for 0.5 in. (12.7 mm)	proportionally to the strand diameter
1918	diameter strands. Minimum radius of	is: for a 0.375 in. (9.5 mm) diameter
1919	curvature shall be adjusted	strand, the radius of curvature
1920	proportionally for other diameters.	should not be less than 0.375/0.5(20
1920	Proportionally for other diamotoris.	ft) = 15.0 ft (4.5 m).
1922	3.2.1.5 — Protection	
1923		
1/45	Tendons shall not be exposed to welding	
1923	Tendons shall not be exposed to welding sparks, electric ground currents, or excessive	
	· · · ·	
1924	sparks, electric ground currents, or excessive	
1924 1925	sparks, electric ground currents, or excessive temperatures that deleteriously affect the	
1924 1925 1926	sparks, electric ground currents, or excessive temperatures that deleteriously affect the prestressing steel, anchorages, PT coating, or	

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1929	3.2.1.6 — Protection from water	C3.2.1.6 — Protection from water
1930 1931 1932 1933 1934 1935	Water shall be prevented from entering the tendons during installation.	Possible collectors of water are the coupler and surrounding sheathing, transition components between the sheathing and anchorage, damaged sheathing, and sheathing replacement areas.
1936 1937	3.2.1.7 — Encapsulated tendons	C3.2.1.7 — Encapsulated tendons
1938 1939 1940	All exposed metal tendon components shall be protected within 24 hours after their exposure during installation.	The protection method should be suitable to the environment in which the tendons are located.
1941	3.2.2 — Stressing anchorages	C3.2.2 — Stressing anchorages
1942	3.2.2.1 — Installation	C3.2.2.1 — Installation
1943 1944 1945 1946 1947	Stressing anchorages shall be installed perpendicular to the tendon axis. Any transition curvature in tendon alignment shall not start closer than 12 in. (305 mm) from the stressing anchorage.	Tendon curvatures at the anchorage may cause excessive local friction and adversely affect the tendon efficiency and elongation.
1948	3.2.2.2 — Attachment requirements	
1949 1950 1951 1952	Stressing anchorages shall be securely attached to bulkhead forms. Connections shall be sufficiently rigid to avoid accidental loosening.	
1953	3.2.2.3 — Cover requirements	C3.2.2.3 — Cover requirements
1954 1955 1956 1957 1958 1959 1960 1961	Minimum concrete cover from the top surface to the anchorage shall not be less than 1 in. (25 mm) and the minimum corner concrete cover not less than 3 in. (75 mm). Minimum concrete cover from exterior face of concrete to the face of the stressing-end and fixed-end anchor casting shall be 1.5 in.	At angled slab edges, minimum concrete covers should be maintained at all edges of the anchorages.

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1962	(40 mm) for nonaggressive environments and 2 in. (50 mm) for encapsulated tendons.	
1963	3.2.2.4 — Pocket formers	
1964	Pocket formers used to provide a void at	
1965	the stressing anchorages shall prevent	
1966	intrusion of cement paste into the wedge	
1967	cavity.	
1968	3.2.2.5 — Encapsulated tendons	
1969	Stressing anchorages for encapsulated	
1970	tendons shall have the strand tail and the	
1971	gripping part of the anchorage capped at the	
1972	wedge cavity to completely seal the area	
1973	against moisture. Refer to Sections 2.2.6,	
1974 1975	2.3.5, and 3.5.2. Encapsulation caps shall be installed as soon as possible but within 8	
1975	hours after the cutting of the tendon tails.	
1770	nours after the cutting of the tendon tans.	
1977	3.2.2.6 — Strand tail cover	C3.2.2.6 — Strand tail cover
1978	Minimum concrete cover for the strand tail	In nonaggressive environments in
1979	from the exterior edge of the concrete shall	certain regions, the prevailing
1980	be 0.75 in. (20 mm) for nonaggressive	construction practice is to use an
1981	environments unless a protective tendon	abrasive wheel cutoff saw to cut the
1982	cover cap is used and 1 in. (25 mm) to the	tendon tail, resulting in less than the
1983 1984	encapsulating device for encapsulated tendons.	0.75 in. (20 mm) of cover. This is an acceptable practice provided that a
1984	tendons.	protective tendon cover cap or other
1985		acceptable method is used that
1987		covers at least 1 in. (25 mm) of the
1988		strand tail that is nearest the exterior
1989		edge of the concrete.
1990		-
1991	3.2.3 - Intermediate anchorages	
1992	3.2.3.1 — Installation	

1993	Intermediate anchorages shall be installed	
1994	perpendicular to the tendon axis. Any	
1995	transition curvature in the tendon profile or	
1996	alignment shall not start closer than 12 in.	
	•	
1997	(305 mm) from the intermediate anchorage.	
1998	3.2.3.2 — Placement	
1999	Intermediate anchorages shall be	
2000	embedded in the first concrete placed at a	
	1	
2001	construction joint.	
2002	3.2.3.3 - Cover requirements	
2003	Minimum cover requirements of Section	
2004	3.2.2.3 shall apply to intermediate	
2005	anchorages.	
2005	anchorages.	
2006	2224 D.1.46	
2006	3.2.3.4 — Pocket formers	
2007	Pocket formers used to provide a void at	
2008	the intermediate anchorage shall prevent	
2009	intrusion of cement paste into the wedge	
2010	cavity.	
2010	curry.	
2011	3.2.3.5 — Encapsulated tendons	
2011	5.2.5.5 — Encapsulated tendons	
2012	Encapsulation caps and sleeves for	
2013	encapsulated tendons shall be installed	
2014	as soon as possible but within 8 hours	
2015	after the approval of the stressing	
2016	operation by the LDP.	
2010	operation by the EDT.	
2017		C224 Einsteinstein
2017	3.2.4 — Fixed anchorages	C3.2.4 - Fixed anchorages
2018	3.2.4.1 — Installation	
2019	Fixed anchorages shall be installed on the	
2020	tendon:	
2021	· · · ·	
2021	(a) At the febrication plant prior to	
	(a) At the fabrication plant prior to	
2023	shipment to the jobsite.	
2024		
2025	(b) At the jobsite, provided the PT supplier	
2026	furnishes appropriate equipment and	
2027	instructions satisfactory to the LDP.	
2021	monactions substactory to the LDI.	

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2028	3.2.4.2 — Wedge seating methods for	C3.2.4.2 - Wedge seating
2028	fixed anchorages	methods for fixed anchorages
2027	Jixeu unchoruges	memous jor jixeu unchorages
2030	Fixed anchorages that use wedges for	Three methods of connecting fixed
2031	gripping the strand shall be attached to the	anchorages are currently in use. One
2032	prestressing steel by any method that	grips the prestressing steel extending
2033	permanently fastens the anchor onto the	opposite the wedge cavity side of the
2034	strand. These methods may include pulling	anchor and pulls the wedges into the
2035	the wedges into the wedge cavity, pushing	wedge cavity. This is referred to as
2036 2037	the prestressing steel, which in turn pulls the wedges into the wedge cavity, pushing the	the "pull method." One pushes the prestressing steel, which in turn pulls
2037	wedges into the wedge cavity, pushing the wedges into the wedge cavity without	the wedges into the wedge cavity.
2038	applying force on the strand, or any other	This is referred to as the "strand push
2037	method that will prevent release of the	method." One pushes directly on the
2040	prestressing steel and satisfies the	wedges, which pushes the wedges
2042	requirements of Section 2.2.1.	into the wedge cavity. This is referred
2043	Temporary force applied to seat wedges	to as the "wedges push method."
2044	shall	6 F
2045	be limited to a percentage of the specified	With any method, a temporary force
2046	tensile strength of the prestressing steel as	is applied to seat the wedges.
2047	follows:	
2048	• Pull method = 80 to 85%	Experience has shown that the key
2049	• Strand push method = 85 to 90%	element to properly connecting a
2050	• Wedges push method = 85 to	fixed anchorage to a strand is
2051	120%	limiting the distance that the wedges
2052		will travel from the fully seated
2053	Any method used to connect a fixed	position to the ultimate anchorage
2054	anchorage to a tendon shall limit the amount	load of 95% of the specified tensile
2055	of wedge travel to no more than 0.050 in.	strength of the prestressing steel.
2056 2057	(1.25 mm), between the fully seated position	
2057	resulting from any of the three	
2058	aforementioned methods, and the position when a former of 0.5% of the apprecised tensile	
2057	when a force of 95% of the specified tensile	
2000	strength is applied to the tendon. The fixed end wedge seating method	
2061	that is chosen shall result in the wedge	
2063	halves being seated with a maximum	
2064	offset between wedge halve of 1/4 in.	
L		

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2065	(6.44 mm). The strand tail extending	
2066	past the wedge after completion of the	
2000	seating method shall be no greater than	
2068	the maximum length specified by the	
2069	encapsulation system manufacturer to	
2070	insure proper seating of the	
2071	encapsulation cap.	
	I I I I I I I I I I I I I I I I I I I	
2072	3.2.4.3 — Placement	
2072	5.2.4.5 — 1 lucement	
2072		
2073	Fixed anchorages shall be placed in	
2074	formwork at locations shown on the	
2075	installation drawings provided by the	
2076	LDP or the PT supplier, and securely	
2077	positioned. Concrete cover requirements	
2077	1 1	
	of Section 3.2.2.3 apply to fixed	
2079	anchorages.	
2030	3.2.4.4 — Encapsulated tendons	
2031	Fixed anchorages intended for use in an	
2032	encapsulated tendon shall be covered at	
2032	the wedge cavity side with an	
2034	encapsulation cap. The encapsulation	
2035	cap shall be installed at the fabrication	
2036	plant after coating the strand tail and	
2037	wedge area with the same PT coating	
2038	meeting the requirements of Sections	
2039	2.4.1 and 2.4.4.	
2037	2. T .1 and 2. T .T.	
20.40		
2040	3.2.5 — Sheathing inspection	C3.2.5 — Sheathing inspection
2041	3.2.5.1 — Sheathing damage	C3.2.5.1 — Sheathing damage
2042	After installing the tendons in the forms	For tendons used in nonaggressive
2043	and prior to the concrete placement, the	environments, small damaged areas
2044	sheathing shall be inspected for damage.	in the tendon sheathing of up to 3 in.
		e i
2045	Damaged areas shall be repaired by	(75 mm) in length may be permitted
2046	restoring the PT coating in the damaged	without repair if the damaged areas
2047	area and repairing the sheathing.	are spaced a minimum of 8 ft (2.6 m)
2048	Sheathing repairs shall be watertight and	apart and the total damaged length is
2049	acceptable to the LDP.	less than 2% of the total tendon
2050		length, with the acceptance of the
		•
2051		LDP. All gaps in the sheathing
2052		should be repaired.

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2053	3.2.5.2 — Repair procedure	C3.2.5.2 — Repair procedure
2054	Tape repair procedures shall conform to	Tape used should:
2055	PTI DC10.2 and acceptable to the LDP.	
2056		• Be self-adhesive and
2057		moisture-proof;
2058		• Be nonreactive with
2059		sheathing, coating, or
2060		prestressing steel;
2061		• Have elastic properties;
2062		• Have a minimum width of
2063		2 in. (50 mm); and
2064		Have a contrasting color to the
2065		tendon sheathing.
2066	3.3 — Concrete placement	
2067	3.3.1 — General	
2068	Water and cement paste shall be prevented	
2069	from entering tendons during concrete	
2070	placing and curing.	-
2071	3.3.2 — Placement	
2072	The position of PT tendons, the tendon	
2073	support system, and nonprestressed	
2074	reinforcement shall remain within tolerance	
2075	during concrete placement. If tendons are	
2076	moved out of their designated positions	
2077 2078	during concreting, they shall be adjusted to their correct position	
2078	their correct position.	
2079	3.3.3 — Protection of tendons	
2080	Pump lines, chutes, and other concrete	
2081	placing equipment shall be supported above	
2082	tendons.	
2083	3.3.4 — Sheathing repairs	
_000	sieuning repuirs	

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2084	Damage to sheathing that occurs during	
2085	concrete placing shall be repaired in	
2086	accordance with the requirements of Section	
2087	3.2.5.	
2007	5.2.5.	
2088	3.4 — Tendon stressing	C3.4 — Tendon stressing
2089	3.4.1 — General	
2090	Stressing of tendons shall conform to PTI	
2091	DC10.2.	
2071	2010.2.	
2092	3.4.1.1 — Protection from water	
2072	5.1.1.1 Trotection from water	
2093	Water shall be prevented from entering the	
2094	tendons prior to completion of the tendon	
2095	finishing operation.	
2075	miniming operation.	
2096	3.4.1.2 — Stressing procedures	
2070	5.1.1.2 Sitessing procedures	
2097	The tendon stressing procedures shall	
2098	conform to the requirements of the PT	
2099	supplier.	
2077	supplier.	
2100	3.4.1.3 — Stressing jacks	
2100	Stressing jucks	-
2101	Hydraulic jacks used to stress unbonded	
2102	single strand tendons shall be equipped with	
2103	jack grippers that will not notch the strand	
2103	more severely than normal anchoring	
2104	wedges.	
2105	wedges.	
2106	3.4.2 — Jack calibration	C3.4.2 — Jack calibration
2107	Stressing jacks and gauges shall be	It is preferable to calibrate jacks
2107	individually identified and calibrated to	and gauges together as a unit.
2100	known standards at intervals not exceeding 6	However, gauges may be calibrated
2109		
	months or at the beginning of each new	to a master gauge of known accuracy,
2111	project. For equipment that is moved	provided the jacks are calibrated to
2112	between jobsites, the interval shall not	the same master gauge.
2113	exceed 3 months. Calibration certificates for	
2114	each jack and gauge used shall	Because of the small size of many
2115	be provided. The calibrated jack-gauge	slab-on-ground foundation projects,
2116	system shall be capable of measuring the	it is common practice for stressing
2117	jacking force within an accuracy of 2%.	equipment to be transported between
2118		jobsites on a daily basis. Because of
2110		jousius on a daily basis. Decause of

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2119 2120 2121 2122 2123 2124 2125 2126 2127 2128	The jack calibration shall be performed by an independent testing agency or by the PT supplier furnishing the stressing equipment. If the PT supplier performs the jack calibration, the jack calibration shall reference the certificate from an independent testing agency specifying the latest calibration date of the test instrument. Provide the test instrument certificate if requested.	this, it is required that the calibration interval be reduced to 3 months.
2129 2130	3.4.3 — Elongation measurements	C3.4.3 — Elongation measurements
2131	Elongation measurements shall be taken	Elongation measurements assist in
2132	at each stressing location immediately	the verification that the tendon force
2133	after stressing. Measured elongations shall	has been properly achieved.
2134	agree with calculated elongations by the	Correlation of calculated and
2135	larger of $\pm 10\%$ or ± 0.25 in. (± 6 mm).	measured elongations within a $\pm 10\%$
2136	Discrepancies exceeding these values	tolerance requires that the elongation calculations be based on the correct
2137 2138	shall be resolved by all parties involved in the PT process to the satisfaction of the	
2138	LDP.	modulus of elasticity and area of steel of the tendon or tendons under
2139 2140		consideration. Further, the friction
2140		and wobble coefficients used are
2142		average values and may vary slightly
2143		from project to project. Variations in
2144		calculated and measured elongation
2145		values in excess of 10%
2146		should be evaluated from the
2147		standpoint of the number of tendons
2148		involved and the structural
2149		significance of the variation. Excess
2150		elongation resulting from a friction
2151		coefficient smaller than that assumed
2152		in calculations is usually not a
2153 2154		structural problem. Repeated
2154 2155		restressing of tendons should be avoided because multiple wedge
2155 2156		bites at the stressing could affect the
2150		long-term performance of the strand.
2157		iong term performance of the strand.
2150		In many slab-on-ground
2160		applications, especially single-
2161		family residential foundations,

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2162 2163 2164 2165 2166 2167 2168 2169		tendons are less than 30 ft (9 m) in length, resulting in small calculated elongations. In these cases, the $\pm 10\%$ tolerance may be too stringent due to inaccuracies in the marking and measuring process. In these cases, the ± 0.25 in. (± 6 mm) tolerance may be used.
2170	3.5 — Tendon finishing	C3.5 — Tendon finishing
2171 2172	Finishing of tendons shall conform to PTI DC10.2.	
2173	3.5.1 — General	C3.5.1 — General
2174 2175	3.5.1.1 — Cutting of tendon tails	C3.5.1.1 — Cutting of tendon tails
2176 2177 2178 2179 2180 2181 2182 2183 2184 2185 2186 2187 2188 2189 2190 2191 2192	Tendon tails shall not be cut until approval has been given by the LDP or if approval is not required by the Contract Documents, within 7 days after stressing. The strand tail after cutting of the tendon tail shall not be less than 0.5 in. (12.7 mm). Minimum concrete cover to the strand tail from the exterior face of the concrete shall be 0.75 in. (20 mm) for nonaggressive environments unless a protective tendon cover cap is used and 1 in. (25 mm) from the exterior face of concrete to the encapsulating device for encapsulated tendons.	For encapsulated tendons, it is recommended that the cutting of the tendon tails be performed within 1 day after approval by the LDP. The elongation report should be submitted on the same day as the stressing operation is completed and the approval or rejection is given by the LDP within 96 hours after stressing. Encapsulation caps should be installed within 8 hours after cutting off tendon tails. The length of strand tails should be compatible with the requirements of the encapsulation manufacturer to ensure a watertight connection of the encapsulation cap.
2193	3.5.1.2 — Cutting methods	
2194 2195 2196 2197 2198 2199 2200	The tendon tail shall be removed by oxyacetylene cutting, abrasive wheel, hydraulic- or electric-powered cold shear, gas plasma cutting, or other method acceptable to the LDP that will not damage the strand, anchorages, or encapsulation. If oxyacetylene cutter is	

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2201	and flammer that had be dimension	
2201	used, flames shall not be directed	
2202	toward the wedges.	
2202		
2203	3.5.2 — Encapsulated tendons	C3.5.2 — Encapsulated tendons
2204	At anchorages intended for use in	The design of the encapsulation caps
2205	encapsulated tendons, encapsulation caps	should provide for a method of
2206	filled with PT coating shall be installed	visual inspection to verify that the
2207	within 8 hours after cutting the tendon	encapsulation cap is filled with PT
2208	tails and before filling the stressing	coating and has been properly
2209	pockets. (Refer to Sections 2.2.6, 2.3.5,	installed.
2210	and 3.2.2.5.)	
2211	3.5.3 — Stressing pockets	C3.5.3 - Stressing pockets
	01	01
2212	3.5.3.1 – Preparation	C3.5.3.1 - Preparation
	1	
2213	Prior to installing stressing pocket patch	The stressing pocket should be
2214	material, the inside concrete surfaces of	prepared according to the procedures
2215	the pocket shall be cleaned to remove	outlined in PTI FAQ #11, "Proper
2216	any laitance or PT coating. The patch	Filling of Single-Strand Tendon
2210	material shall be placed to assure	Stressing Pockets"
2217	complete bonding and filling of the	(https://www.post-
2218	stressing pocket.	tensioning.org/Portals/13/Files/PDFs
2219	stressing pocket.	<u>/Education/FAQ11.pdf</u>).
2220		<u>/Education/FAQ11.pdf</u>).
		Compliant of the filled and last one
2222		Sounding of the filled pocket can
2223		detect poor bond or filling of a
2224		stressing pocket. If poor bond or
2225		voids are found, the patch material
2226		should be removed and replaced.
2227		
2227	3.5.3.2 — Timing	C3.5.3.2 — Timing
2228	Stressing pockets shall be filled with	The filling of the stressing pocket
2228	nonmetallic, non-shrink cementitious	• • • •
		provides the primary protection of
2230	patch material within 4 days after	the stressing anchorage in
2231	tendon tail cutting. The patch material	nonaggressive applications.
2232	used for pocket filling shall not contain	Therefore, earlier filling of stressing
2233	chlorides or other chemicals known to	pockets is desirable. If stressing
2234	be deleterious to prestressing steel, and	pockets are unable to be filled within
2235	shall be nonreactive with prestressing	4 calendar days of tendon tail cutting,
2236	steel, anchorage materials, and concrete.	

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2237	Brick mortar shall not be used for filling	then additional protection should be
2238	stressing pockets.	provided.
2239		
2240		The quality of the patch material as
2241		well as the mixing and installation
2242		are essential in providing protection
2243		of the stressing anchorages. It is
2244		recommended that packaged patch
2245		material containing premixed
2246		portions of cement, sand, and
2247		additives be used in lieu of on-site
2248		mixtures to ensure that the quality of
2249		the patch material achieves the
		required result.

APPENDIX A - ISO VISCOSITY GRADES FOR INDUSTRIAL OILS

		VISCOSITI GRA		
2250	ISO Viscosity	Kinematic	Kinematic	Kinematic
2251	Grade	Viscosity at 104°F	Viscosity at 104°F	Viscosity at 104°F
2252		(40°C),	(40°C),	(40°C),
2253		Min cSt	Mid cSt	Max cSt
2254	2	1.98	2.2	2.42
2255	3	2.88	3.2	3.52
2256	5	4.14	4.6	5.06
2257	7	6.12	6.8	7.48
2258	10	9	10	11
2259	15	13.5	15	16.5
2260	22	19.8	22	24.2
2261	32	28.8	32	35.2
2262	46	41.4	46	50.6
2263	68	61.2	68	74.8
2264	100	90	100	110
2265	150	135	150	165
2266	220	198	220	242
2267 2268	320	288	320	352
2268	460	414	460	506
2209	680	612	680	748
2270	1000	900	1000	1100
2271	1500	1350	1500	1650
2272	2200	1980	2200	2420
2273	3200	2880	3200	3520

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2275	The Post-Tensioning Institute provides the following activities in		
2276 2277	support of its members and the industry:		
2277			
2279	 Technical and certification committees that provide consensus 		
2280	guides, reports, manuals, specifications, standards, and		
2281	certification manuals		
2282	 Spring PTI Convention and Fall PTI Committee Days to 		
2283	facilitate the work of its committees		
2284			
2285	 Technical sessions at the Spring PTI Convention to provide 		
2286	a forum for technical information exchange		
2287	 Educational seminars and webinars to disseminate 		
2288	information on post-tensioned concrete		
2289	 Programs for certification of personnel working with 		
2290	post-tensioned concrete, for certification of plants producing		
2291 2292	unbonded single-strand tendons, and for certification of		
2292	multistrand and bar post-tensioning systems		
2293			
2295	 Research projects and student scholarships 		
2296	 Coordination and cooperation with other related societies 		
2297	The PTI JOURNAL		
2298			
2299	The Post-Tensioning Institute		
2300	Established in 1976, the Post-Tensioning Institute is recognized as the worldwide		
2301	authority on post-tensioning. PTI is dedicated to expanding post-tensioning applications		
2302	through marketing, education, research, teamwork, and code development while		
2303	advancing the quality, safety, efficiency, profitability, and use of post-tensioning		
2304	systems.		
2305			
2306	One of PTI's principal functions is to provide technical guidance on the design,		
2307	construction, maintenance, and repair & rehabilitation of post-tensioned structures. PTI		
2308	has published many informative manuals and technical guides covering most aspects of		
2309 2310	post-tensioning. In addition, PTI publishes the PTI JOURNAL, Newsletters, Technical		
2310	Notes, Frequently Asked Questions, and Technical Updates that give in-depth discussion and/or analysis of issues pertinent to designers in the post-tensioning field. Members are		
2311	also kept up-to-date on industry-related events and information on the PTI Web site at		
2312	www.post-tensioning.org.		
-010	1		

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2314 2315 2316 2317 2318 2319 2320	PTI technical committees, as well as PTI as a whole, operate under a consensus process that ensures that all participants have their views considered. Members of the Institute include major post-tensioning materials fabricators; manufacturers of prestressing materials; companies supplying materials, services, and equipment used in post- tensioned construction; and professional engineers, architects, and contractors. Individuals interested in the activities of PTI are encouraged to become a member.
2321	POST-TENSIONING INSTITUTE Strength in Concrete