

PILECONNECT

STANDARDS

PCS 101:26

Reclaimed and Surplus Oil Country Tubular Goods as Helical Pile Shaft Material

Classification, Inspection, and Design Provisions

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Recommended Practice (Voluntary Guideline)

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Preface

Steel pipe originally manufactured for oil and gas well construction, commonly described as oil country tubular goods (OCTG), is widely available in North America as surplus or reclaimed material and is increasingly fabricated into helical piles, particularly in Western Canada and the United States oil-producing regions. This material is frequently manufactured to API Specification 5CT in grades whose specified minimum yield strengths meet or exceed those of the structural steels commonly used in purpose-built helical pile shafts.

At the time of publication, no recognized standard addresses the classification, inspection, or structural design treatment of this material when reused as pile shafting. The result is an industry condition in which products of materially different provenance are quoted and supplied interchangeably, without a common vocabulary for describing their differences, and without consistent expectations for documentation, condition verification, or design conservatism.

This recommended practice is intended to fill that gap in a manner compatible with the alternative-solutions frameworks of the NBC and IBC. It does not introduce new structural theory. It defines material categories, minimum documentation and traceability, scalable inspection and testing levels, conservative default design provisions, and an application-class framework that ties the required rigor to the consequence of failure. The approach is modelled on established protocols for the reuse of reclaimed structural steel and on existing owner specifications for steel piling.

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1 Scope

1.1 This recommended practice applies to steel pipe or casing used as a permanent, load-carrying helical pile shaft where the material is not supplied as new product certified to CSA G40.20/G40.21, ASTM A500, or ASTM A252, but is surplus or reclaimed tubular product originally manufactured to a recognized standard, including but not limited to API Specification 5CT, API Specification 5L, and ASTM A53.

1.2 This recommended practice provides a classification system, minimum documentation and traceability requirements, inspection and testing levels, default design provisions, and an application-class acceptance framework intended to support demonstration of equivalence as an alternative solution under Division C of the National Building Code of Canada or under the alternative materials provisions of the International Building Code, at the discretion of the authority having jurisdiction and the engineer of record.

1.3 This recommended practice does not apply to

- (a) pipe of unknown or unverifiable original manufacturing standard;
- (b) driven pile applications, except where adopted by the engineer of record with appropriate modification;
- (c) helix plates, brackets, couplings, or other pile components, which shall conform to the project specification; or
- (d) temporary works.

1.4 In this document, *shall* indicates a requirement necessary to conform to this practice; *should* indicates a recommendation; and *may* indicates an option.

Note: *Pipe of unknown original standard is excluded because the framework of this practice depends on a known specified minimum yield strength as the basis for design. Material that cannot be identified to a recognized standard requires project-specific material testing outside the scope of this document.*

2 Reference Publications

This recommended practice refers to the following publications, and where such reference is made, it shall be to the edition listed below, including all amendments published thereto.

- API Specification 5CT - Casing and Tubing
- API Specification 5L - Line Pipe
- ASTM A252/A252M - Standard Specification for Welded and Seamless Steel Pipe Piles
- ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing
- CSA G40.20/G40.21 - General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel
- CSA S16 - Design of Steel Structures
- CSA W59 - Welded Steel Construction
- CSA W47.1 - Certification of Companies for Fusion Welding of Steel
- National Building Code of Canada, Division B Part 4 and Division C (alternative solutions)
- ICC-ES AC358 - Acceptance Criteria for Helical Pile Systems and Devices
- SCI P427 - Structural Steel Reuse (The Steel Construction Institute, UK)

Note: SCI P427 is cited as the model protocol for assessment and reuse of reclaimed structural steel. Its sampling-based qualification philosophy underlies Clause 6 of this practice.

3 Definitions

The following definitions apply in this recommended practice:

Authority having jurisdiction (AHJ) - the governmental body responsible for enforcement of the applicable building code.

Engineer of record (EOR) - the professional engineer responsible for the foundation design in which the pile shaft material is used.

Heat - the quantity of steel produced in a single melting operation, as identified on a mill test certificate.

Lot - a quantity of tubular product of a single nominal size, grade, and source, supplied and inspected as a unit.

Mill test certificate - a document issued by the steel producer certifying the chemical composition and mechanical properties of an identified heat of steel.

Nominal wall thickness - the wall thickness specified for the tubular by the original manufacturing standard, before consideration of manufacturing tolerance, wear, or corrosion.

New-surplus tubular - pipe or casing manufactured to a recognized standard that has never been placed in service (never run downhole or placed in a pipeline), with markings or documentation sufficient to establish its original standard and grade.

Oil country tubular goods (OCTG) - casing, tubing, and related pipe manufactured for oil and gas well construction, principally to API Specification 5CT.

Pulled (reclaimed) tubular - pipe or casing that has been placed in service and subsequently retrieved, cleaned, and prepared for reuse.

Service history - the loading, pressure, temperature, and chemical exposure experienced by a tubular during its prior service life, whether documented or undocumented.

Sour service - prior exposure to fluids containing hydrogen sulphide (H₂S) at levels associated with sulphide stress cracking risk.

Specified minimum yield strength (SMYS) - the minimum yield strength specified by the original manufacturing standard for the identified grade.

4 Material Categories

4.1 All pile shaft material supplied to a project applying this practice shall be classified into one of the categories defined in Clauses 4.2 to 4.4, and the category shall be stated on quotations, drawings, and submittals in accordance with Clause 9.

4.2 Category A - New purpose-built pile products

4.2.1 Category A comprises new steel pile shafts conforming to ASTM A252, ASTM A500, CSA G40.20/G40.21, or equivalent, produced under a documented quality system, with helix attachment and other fabrication performed by a fabricator certified to CSA W47.1 (in Canada) or an equivalent welding

quality program. Category A is included in this practice as the reference condition; its use is governed by existing codes, standards, and evaluation reports and is not further addressed herein.

4.3 Category B - New-surplus tubulars

4.3.1 Category B comprises pipe or casing manufactured to API 5CT, API 5L, ASTM A53, or an equivalent recognized standard, that has never been placed in service, with grade identification established by intact markings, mill test certificates, or both.

4.3.2 Category B material shall be treated, for the purposes of shaft material properties, as new structural pipe of the identified grade. Requirements of this practice applicable to Category B address documentation (Clause 5) and the fabrication of the pile assembly (Clause 7.5).

Note: Dual-certified products meeting both an OCTG standard and a piling standard (e.g., ASTM A252) are common in North American supply and may be treated as Category A where the piling certification is documented.

4.4 Category C - Pulled (reclaimed) tubulars

4.4.1 Category C comprises pipe or casing manufactured to a recognized standard that has been placed in service and retrieved for reuse. The identified grade establishes the SMYS; however, the remaining wall thickness, surface condition, residual stress state, and fracture toughness shall be treated as uncertain to the degree that prior service is undocumented.

4.4.2 Category C material shall not be supplied to a project applying this practice unless the inspection level required by Clause 8 for the applicable application class has been completed and documented.

Table 1 - Summary of material categories

Aspect	Category A - New purpose-built pile product	Category B - New-surplus tubular	Category C - Pulled (reclaimed) tubular
Product standard	CSA G40.20/G40.21; ASTM A500; ASTM A252	API 5CT; API 5L; ASTM A53 (unused)	API 5CT; API 5L; ASTM A53 (used)
Typical SMYS	44–60 ksi (300–415 MPa)	55–110+ ksi (379–758+ MPa)	Per original grade; usable fraction per Clause 7
Service history	None	None	Partially known or unknown
Documentation	Mill certificates; quality system; evaluation report where applicable	Mill certificates and/or API markings	Markings or supplier declaration; inspection records per Clause 6
Principal uncertainty	None beyond normal supply	Quality of pile fabrication (helix attachment, couplings)	Remaining section, condition, and toughness after prior service

5 Documentation and Traceability

5.1 For Category B and Category C material, the supplier shall identify the original manufacturing standard and grade (e.g., “API 5CT L80”), established from product markings, mill test certificates, or a

written supplier declaration. Material whose original standard and grade cannot be established shall be classified outside the scope of this practice (see Clause 1.3).

5.2 For Category B material, mill test certificates showing yield strength, tensile strength, and chemical composition shall be provided for each heat or lot where available; where certificates are unavailable, intact API markings together with a supplier declaration of unused condition may be accepted by the EOR.

5.3 For Category C material, the supplier shall provide, to the extent known, a written description of prior service, including

- (a) the nature of service (e.g., production casing, surface casing, line pipe);
- (b) whether service was sweet or sour;
- (c) approximate duration of service; and
- (d) the method of retrieval and any reconditioning performed.

5.4 Traceability shall be maintained at the lot level. Each lot shall be uniquely identified, and all inspection and test records required by Clause 6 shall be associated with the lot identification. Stick-by-stick traceability is not required.

5.5 Tubulars of materially different nominal dimensions, grades, or prior service histories shall not be combined into a single lot for qualification. Each distinct population shall be separately identified, inspected, and qualified.

5.6 Where the prior service history of Category C material is entirely unknown, the material shall be assigned the most conservative applicable assumptions of this practice, including the produced-fluids assumption of Clause 7.4.1 and the sour-service screening of Clause 6.3.3, and the EOR shall not waive these assumptions on the basis of supplier representations that are not documented.

Note: Lot-level qualification with sampling parallels the treatment of machine stress-rated lumber and reclaimed structural steel under SCI P427: individual pieces vary, but design values are established at the population level using sampling and conservative statistics.

6 Inspection and Testing

6.1 Three inspection levels are defined. The minimum inspection level for a given application shall be as required by Clause 8. The EOR may specify a higher level, additional activities, or larger sample sizes for any project.

6.2 Level C1 - Basic screening

6.2.1 Every length of Category C material shall be visually inspected over its full accessible surface. Lengths exhibiting any of the following shall be rejected:

- (a) dents, gouges, or local buckling affecting more than 5% of the diameter;
- (b) ovality exceeding 2% of nominal outside diameter;
- (c) heavy or through-wall pitting, or general corrosion visibly reducing the wall;
- (d) cracking in the pipe body or in any existing weld; or
- (e) lamination, arc strikes, or unauthorized field welds in structurally significant regions; or

- (f) evidence of fire damage, major unrepaired buckling, uncontrolled repair welding, or prior service conditions known to produce embrittlement or environmentally assisted cracking incompatible with the intended reuse.

6.2.2 Outside diameter and end wall thickness shall be measured on a sample of not less than 10% of pieces in each lot (minimum 3 pieces). Where any measured wall thickness is less than 90% of nominal, the lot shall either be rejected or advanced to Level C2 inspection.

6.3 Level C2 - Sampling-based non-destructive examination

6.3.1 In addition to Level C1, ultrasonic wall thickness measurements shall be taken at not fewer than four locations distributed along the length and around the circumference of each sampled piece, on a sample of not less than 10% of pieces per lot (minimum 5 pieces). The minimum and characteristic (5th percentile) wall thickness so established shall be reported and shall form the basis of section properties under Clause 7.3.

6.3.2 Where welds exist on the pipe body, a sample shall be examined by magnetic particle or liquid penetrant methods. Crack-like indications shall be cause for rejection of the piece.

6.3.3 Where prior sour service is known or suspected, hardness testing shall be performed on a sample to identify zones of anomalously high hardness consistent with hydrogen-related damage; pieces exhibiting such zones shall be rejected or referred to Level C3 evaluation.

6.4 Level C3 - Mechanical testing and extended examination

6.4.1 In addition to Level C2, representative coupons shall be extracted and tensile tested to confirm yield and tensile strength against the original grade. Where fracture toughness is relevant to the application, including cold-region service and impact or seismic loading, Charpy V-notch testing shall be performed at a temperature specified by the EOR.

6.4.2 The EOR shall specify the extent of additional ultrasonic and weld examination, which may extend to 100% of supplied pieces.

Table 2 - Summary of inspection levels

Level	Minimum activities	Acceptance basis
Level C1 - Screening	100% visual inspection; dimensional check (OD, end wall thickness) on sample per Clause 6.2	Rejection criteria of Clause 6.2; measured wall \geq 90% of nominal at checked locations
Level C2 - Sampling NDT	Level C1 plus UT wall thickness survey on \geq 10% of pieces (min. 5 per lot), multiple locations per piece; MT or PT on sample of body welds; hardness checks where sour service is suspected	Characteristic (5th percentile) wall thickness established for the lot; no crack-like indications; hardness within grade-consistent range
Level C3 - Mechanical testing	Level C2 plus tensile coupons from representative pieces; CVN impact testing where toughness governs; extended UT and weld inspection coverage as specified by the EOR	Measured yield and tensile not less than the design values adopted under Clause 7; CVN per project specification

7 Design Provisions

7.1 Design of pile shafts using Category B or Category C material shall be performed by the EOR in accordance with the applicable structural steel design standard (CSA S16 or equivalent), using the design values of this Clause. Geotechnical capacity, torque correlation, and installation requirements are outside the scope of this practice and shall be addressed by the project specification.

7.2 Design yield strength

7.2.1 The design yield strength shall not exceed the values of Table 3. As an alternative to the reductions of Table 3, the EOR may retain the full SMYS and apply a resistance factor reduced by not less than 10% (Level C3) to 20% (Level C1) relative to the value otherwise applicable, or an equivalently increased global factor of safety in allowable stress design.

Note: In a limit states design framework such as CSA S16, the resistance-factor alternative may be implemented by reducing the resistance factor applicable to the pile shaft, ϕ_s , by not less than 0.1 (Level C3) to 0.2 (Level C1) relative to the value otherwise applicable to new steel of similar grade.

Note: The reductions of Table 3 are deliberately conservative defaults intended for use without project-specific reliability analysis. They reflect uncertainty in remaining section, residual stress, and toughness arising from undocumented service, and parallel the reduced design values adopted in European and UK protocols for reclaimed structural steel. Higher values may be justified by more extensive testing under the direction of the EOR.

7.2.2 The design yield strength basis of Clause 7.2.1 applies equally to the axial, flexural, and torsional resistance of the shaft. Torsional resistance shall be evaluated for both installation torque and any torsional service demands, using the section properties of Clause 7.3.

7.3 Section properties

7.3.1 Section properties for Category C material shall be computed using the measured wall thickness basis of Table 3, less the corrosion allowance of Clause 7.4. Nominal wall thickness shall not be used for Category C material.

7.4 Corrosion allowance

7.4.1 A sacrificial thickness allowance appropriate to the soil environment and design life shall be applied to all categories, on the same basis as for new steel piles. For Category C material that may have carried produced fluids, internal corrosion shall be measured, or, where measurement is impracticable, an additional internal allowance shall be applied as specified by the EOR. Where the prior service of Category C material is unknown, the material shall be assumed to have carried produced fluids unless the supplier specifically documents otherwise.

Note: Published data for steel in undisturbed, de-aerated native soil indicate low long-term section loss at depth, with the most aggressive exposure typically in the upper shaft within disturbed fill and zones of fluctuating groundwater. The corrosion environment below grade is substantially independent of the pipe's origin; the distinct Category C consideration is pre-existing internal or external loss, which Clause 6 measurement is intended to capture.

7.5 Fabrication of the pile assembly

7.5.1 Helix attachment, coupling, and bracket welding for piles fabricated from Category B or C material shall be performed by a fabricator certified to CSA W47.1 (or equivalent program acceptable to the AHJ), using welding procedures qualified for the actual material grade and carbon equivalent. Welding

procedures qualified for mild structural steel shall not be applied to higher-strength OCTG grades without qualification.

Note: Higher-strength API grades (e.g., L80, P110) may be quenched-and-tempered and can be susceptible to hydrogen-induced cracking and heat-affected-zone softening if welded with procedures developed for 44–60 ksi structural steel. Procedure qualification on the actual material is the controlling quality issue for Category B and C pile fabrication.

7.5.2 Installation torque records shall be kept for all piles regardless of category, and shall identify the material category and lot of each installed pile.

Table 3 - Default design values for shaft material

Category	Inspection level completed	Design yield strength	Section properties
B	Clause 5 documentation	1.00 × SMYS	Nominal, less corrosion allowance
C	Level C1	0.70 × SMYS	Minimum measured wall, less corrosion allowance
C	Level C2	0.80 × SMYS	Characteristic (5th percentile) wall, less corrosion allowance
C	Level C3	0.90 × SMYS (not exceeding measured yield)	Characteristic wall, less corrosion allowance

8 Application Classes and Acceptance

8.1 Each application shall be assigned by the EOR to one of three application classes according to the consequence of foundation failure, with reference to the importance categories of the applicable building code:

- (a) Class 1 - Low consequence: decks, small accessory structures, and light ancillary structures whose failure presents low risk to life safety;
- (b) Class 2 - Normal consequence: dwellings and low-rise commercial or industrial structures of normal importance; and
- (c) Class 3 - High consequence: telecommunication and transmission structures, structures assigned high or post-disaster importance, and any structure so designated by the EOR or AHJ.

8.2 The permitted material categories and minimum inspection levels for each application class shall be as given in Table 4.

Table 4 - Acceptance of material categories by application class

Application class	Category A	Category B	Category C
Class 1 - Low consequence (decks, light ancillary structures)	Permitted	Permitted with Clause 5 documentation	Permitted with Level C1 qualification and Table 3 design values

Class 2 - Normal consequence (houses, low-rise commercial and industrial)	Permitted	Permitted with Clause 5 documentation	Permitted only with Level C2 qualification and Table 3 design values
Class 3 - High consequence (telecommunication and transmission structures, post-disaster and high-importance buildings)	Permitted (preferred)	Permitted with full documentation and EOR acceptance	Not permitted by default; may be permitted only with Level C3 qualification and the explicit written acceptance of the EOR and owner

8.3 Nothing in Table 4 limits the authority of the EOR or the AHJ to impose more restrictive requirements for any project.

9 Disclosure

9.1 Quotations, contracts, shop drawings, and engineering submittals for helical piles supplied under this practice shall state, for the shaft material:

- (a) the material category (A, B, or C);
- (b) the original manufacturing standard and grade (e.g., “Category C - API 5CT L80”);
- (c) nominal outside diameter and the wall thickness basis used in design; and
- (d) for Category C, the inspection level completed and a reference to the lot inspection records.

9.2 Where the purchaser is a consumer (e.g., a residential owner), the disclosure of Clause 9.1 shall be made in plain language on or with the quotation.

9.3 Substitution of material of a different category from that quoted or specified shall not be made without the written acceptance of the EOR and notification to the purchaser.

Note: Clause 9 is the central obligation of this practice. The categories of Clause 4 carry different value propositions, and each is legitimate within the limits of Clause 8; the condition this practice is intended to eliminate is the supply of materially different products as though they were interchangeable.

10 Owner Specification Language

10.1 Owners and specifiers may adopt this practice by reference using language substantially as follows:

“Helical pile shafts shall be identified as Category A, B, or C in accordance with PCS 101:26. Category C shafts shall not be used unless specifically permitted by the Contract Documents. Where permitted, Category C shafts shall be qualified to not less than the level required by PCS 101:26 Table 4 for the applicable application class, and the engineer of record shall state on the design documents the design-strength basis adopted for the material.”

10.2 Owners may, by project specification, prohibit Category C material entirely, require qualification levels above the minimums of Table 4, or require proof testing of completed pile assemblies.

Annex A (Informative) Submittal Checklist

The following checklist may be reproduced and attached to quotations and submittals.

- Material category stated (A / B / C)
- Original standard and grade identified (e.g., API 5CT L80); markings or certificates referenced
- Lot identification assigned and stated
- Prior service description provided (Category C): service type, sweet/sour, duration, retrieval method
- Qualification level completed and records attached (Category C): C1 / C2 / C3
- Minimum or characteristic measured wall thickness reported (Category C)
- Design yield strength and wall thickness basis stated on drawings
- Corrosion allowance stated, internal and external
- Fabricator welding certification and procedure qualification for the actual grade confirmed
- Torque records to be kept and to identify material category and lot
- Application class assigned by the EOR and stated (Class 1 / 2 / 3)
- For Class 3 use of Category C material: explicit written acceptance of the EOR and owner attached
- Substitution commitment acknowledged: no change of material category without written EOR acceptance and purchaser notification
- Plain-language disclosure provided to consumer purchaser, where applicable

Annex B (Informative) Commentary

B.1 Why a category system

The dominant failure of current practice is linguistic: “recycled casing” is used indiscriminately for unused surplus pipe of documented high grade and for pulled pipe of undocumented condition. These are different products with different uncertainties. Category B material is, mechanically, high-strength structural pipe whose principal open question is the quality of pile fabrication; Category C material carries an additional uncertainty about remaining condition that is real but quantifiable and manageable. Separating them allows each to be used where it is appropriate, priced for what it is, and inspected in proportion to what is unknown.

B.2 Basis of the design value reductions

The reductions of Table 3 are not derived from a probabilistic calibration; they are conservative defaults in the tradition of engineering treatment of materials with elevated variability, and are consistent in spirit with reclaimed-steel protocols developed in the United Kingdom and Europe, which adopt reduced design values or increased partial factors in proportion to the extent of testing. Because OCTG grades commonly exceed purpose-built pile shaft steels in SMYS by a substantial margin, the reduced design values of Table 3 frequently remain at or above the full design values of conventional shaft material, which is one reason this material can be used responsibly at attractive cost. As a concrete illustration: pulled L80 casing qualified to Level C1 carries a design yield of $0.70 \times 80 \text{ ksi} = 56 \text{ ksi}$, which still exceeds the full specified yield of ASTM A500 Grade C round tubing at 46 ksi; the conservatism is real, yet the material remains competitive.

B.3 Relationship to building codes

This practice is structured to support an alternative-solution demonstration: the categories establish what the material is, the inspection levels establish what is known about it, and the design provisions establish how the residual uncertainty is absorbed. An AHJ presented with a submittal conforming to Clauses 5 through 9 receives substantially more information than is customarily provided for conventional pile materials.

B.4 Items identified for future committee development

The following matters are identified as requiring development through committee work, calibration, or trial use before formal standardization, and their identification here is intended to invite that work rather than to signal immaturity of the concept: recommended minimum sampling rates for ultrasonic thickness surveys; quantified default rejection thresholds for dents, ovality, and pitting; pre-qualified welding procedures for common API-grade-to-structural-steel combinations; reliability-based calibration of the design value reductions of Table 3; and whether particular API grades or prior service histories warrant exclusion from routine building applications.

B.5 Roadmap for a future formal standard

A future owner specification, CSA technical specification, or ASTM guide developed from this practice could usefully add annexes addressing lot formation and sample sizing; illustrated visual rejection criteria; an ultrasonic thickness measurement procedure; worked design examples in compression, tension, and torsion; a corrosion annex summarizing published rates by soil environment with default sacrificial thicknesses for common soil classes; welding compatibility notes for common API grades; a template qualification report and disclosure form; and an owner decision matrix by application class.

B.6 What this practice does not do

This practice does not certify suppliers, does not establish a marking or registration scheme, and does not qualify any product. It is a vocabulary and a floor. Industry adoption, refinement through use, and eventual incorporation into an owner specification or a consensus standard are the intended path.