Specification for PVC Lined Steel Tubular Goods

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FOREWORD

Purpose Statement

a. The purpose of this Specification is to provide standards for PVC lined steel pipe or tubing, suitable for use in conveying water and/or oil in the Petroleum Industry.

b. American Petroleum Institute (API) Specifications are published as aids to the procurement of standardized equipment and materials, as well as instructions to manufacturers of equipment or materials covered by an API Specification. These Specifications are not intended to obviate the need for sound engineering, nor to inhibit in any way anyone from purchasing or producing products to other specifications.

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f. This Specification for PVC lined steel tubular goods was formulated by the API Production Department Committee on Standardization of Plastic Pipe.

g. This Standard (supplement) shall become effective on the date printed on the cover but may be used voluntarily from the date of distribution.

SUGGESTIONS FOR ORDERING

SUGGESTIONS FOR ORDERING API PVC LINED STEEL LINE PIPE

In placing orders for PVC Lined Steel Line Pipe to be manufactured in accordance with API Specification 15LT, the purchaser should specify the following on the purchase order:

Specifications	API Specification 15LT
Quantity	
Steel Pipe Grade or Class	API Specification 5L, Table 3.1 & 4.1
New Steel Pipe Furnished by Purchaser	
Used Steel Pipe Furnished by Purchaser	
New Steel Pipe Furnished by Manufacturer	
Process of Pipe Manufacture	API Specification 5L, Table 2.1
Size Nominal	
Weight per Foot or Wall Thickness	
Length	
Inspection of Pipe by Purchaser	Section 8
Fittings	Paragraph 7.2
PVC Liner Class	API Specification 15LT, Paragraph 4.1
Size Nominal	Table 5.2
SDR or Wall Thickness	Table 5.1, 5.2
End Protection	Section 6
Rejection of PVC Liner	Paragraph 5.1.g

Delivery Date & Shipping Instructions

Attention is called to the following stipulations which are subject to agreement between the purchaser and the manufacturer:

Hydrostatic Tests and Frequency	Paragraph 3.2.a
End Protection	Section 6
Inspection	Section 8
Marking Requirements	Section 9 & Appendix B
Rejection of Steel Tubular	Paragraph 3.2.h
Acceptance	Appendix E
Testing	Section 5

SPECIAL NOTE:

Nothing in this specification should be interpreted as indicating a preference by the Committee for any material or process or as indicating equality between the various materials or processes. In the selection of materials and processes, the purchaser must be guided by his experience and by the service for which the PVC lined steel pipe is intended.

SUGGESTIONS FOR ORDERING API PVC LINED STEEL TUBING

In placing orders for PVC Lined Steel Tubing to be manufactured in accordance with API Specification 15LT, the purchaser should specify the following on the purchase order:

Specification	API Specification 15LT
Quantity	
Type of Tubing	API Specification 5CT Per Table 2.1
Non-Upset, External-Upset or Integral Joint	
Threaded, Plain-End or Special End	
With or Without Couplings	
Special Bevel Couplings	
Special-Clearance Couplings	
New Steel Tubing Furnished by Purchaser	
Used Steel Tubing Furnished by Purchaser	
New Steel Tubing Furnished by Manufacturer	
Used Steel Tubing Furnished by Manufacturer	
Size (outside diameter)	
Weight per foot or Wall Thickness	
Grade	
Range Length	
Inspection of Tubing by Purchaser	Section 8
PVC Liner Class	API Specification 15LT Paragraph 4.1
Size Nominal	Table 5.3
SDR or Wall Thickness	Table 5.1, 5.3
End Protection	Section 6
Rejection of PVC Liner	Paragraph 5.1.g

Delivery Date & Shipping Instructions

Attention is called to the following stipulations which are subject to agreement between the purchaser and the manufacturer:

Coupling Make-Up (Other than power-tight)	API Specification 5CT
Tubing with Couplings Detached	API Specification 5CT
Hydrostatic Tests and Frequency	Paragraph 3.2.a
End Protection	Section 6
Inspection	Section 8
Marking Requirements	Section 9 & Appendix B
Rejection of Steel Tubular	Paragraph 3.2.h
Acceptance	Appendix E
Testing	Section 5

SPECIAL NOTE:

Nothing in this specification should be interpreted as indicating a preference by the Committee for any material or process or as indicating equality between the various materials or processes. In the selection of materials and processes, the purchaser must be guided by his experience and by the service for which the PVC lined steel tubing is intended.

SECTION 1
SCOPE

1.1 COVERAGE

a. This specification covers PVC lined steel line pipe and tubing. Dimensions, materials and physical properties are included.

b. Technical content provides requirements for performance, materials, dimensions and weight; test and inspection; marking and storing.

NOTE 1: *PVC lined accessories and fittings are available, but are beyond the scope of this specification. Consult the appropriate manufacturer regarding PVC lined accessories and fittings.*

NOTE 2: *Mortars and/or adhesives may be used in the fabrication of PVC lined steel line pipe and tubing.*

1.2 APPLICATIONS

a. PRODUCTS. These specifications apply to polyvinyl chloride (PVC) lining of steel line pipe and tubing used as a barrier for shielding the steel from corrosion attack in the handling of oilfield fluids. Specific products covered by the specification are listed as follows:

1. Line Pipe

2. Tubing

b. SERVICE LIMITATIONS. The standard service conditions are as follows:

- Service temperature is 150°F maximum.
- Use of products covered by this specification should be limited to published industry data in the absence of tests for specific applications. A recommended chemical resistance table (Appendix A) lists general resistances to many specific chemical compounds at 0 psig for 72°F and 140°F. It is suggested tests be conducted for special pressure/temperature and multi-phase conditions.
- Gases under elevated pressure service conditions are not recommended.
- Special attention should be made toward, but not limited to certain aromatic chemicals, such as benzene, toluene, xylene and ketones.

1.3 GENERAL. This specification includes by reference, either in total or in part, other API, industry, and government standards listed in Appendix C.

a. REQUIREMENTS. Requirements of other standards included by references in this Specification are essential to the safety and of the equipment produced within a given system.

b. EQUIVALENT STANDARDS. Other nationally or internationally recognized standards shall be submitted to and approved by the API Committee on Standardization of Plastic Pipe for inclusion in this Specification prior to use as equivalent standards.

1.4 UNIT CONVERSIONS. U. S. Customary units are in all cases preferential and shall be the standard in this Specification. Nominal sizes will continue to be shown as fractions. For the purposes of this Specification the fractions and their decimal equivalents are equal and interchangeable. Metric conversions are described in Appendix D.

SECTION 2
GLOSSARY (ABBREVIATIONS, DEFINITIONS)

2.1 ABBREVIATIONS

API — American Petroleum Institute

ASTM — American Society of Testing and Materials

2.2 DEFINITIONS

Acceptance Criteria — Defined limits placed on characteristics of material, product or service.

Adaptors — Appurtenance that allows connecting components with different joining features.

Change-over — Interchangeability between liner systems.

Compounder — An entity which houses equipment to add and blend stabilizers, lubricants, pigments and other necessary ingredients with PVC resins to facilitate extrusion. Compounder can be PVC resin manufacturer, pipe extruder or a separate company.

Date of Manufacture — Manufacturers finished product date (month, year).

Extruder — An entity which converts PVC resin (PVC compounds) into pipe.

Fittings — Tees, 90's, 45's, Reducers, Flanges and Adapters, and other accessories.

Manufacturer — An entity that fabricates or assembles the components to provide finished products.

Manufacturer's batch or lot — Quantity as determined by manufacturer for use in establishing traceability.

May — term used to indicate that a provision is optional.

PVC Resin Manufacturer — An entity that converts (polymerizes) vinyl chloride monomer into polyvinyl chloride (PVC) resins.

Records — Retrievable information.

Schedule — a pipe size system (outside diameters and wall thickness) originated by the iron pipe industry.

Shall — term used to indicate that a provision is mandatory.

Should — term used to indicate that a provision is not mandatory, but recommended as good practice.

Standard Dimension Ratio (SDR) — specific ratio of the average specific outside diameter (O.D.) to the minimum specific wall thickness.

Steel Line Pipe — Pipe used for other than down hole application.

Visual Examination — Examination of parts and equipment for visible defects in material and workmanship.

SECTION 3
PROCESS OF MANUFACTURE

3.1 EXTRUSION PROCESS

a. EXTRUSION — THE MACHINES

Single Screw Extrusion — Favorable results of single screw extrusion with rigid PVC powder (dry blend) or PVC pellets rely on several basic but essential operations in the extrusion process. Promoting shear helps assure a competent level of work or energy in the compound which makes certain there is proper fusion, a homogeneous melt, and assures acceptable physical properties have been obtained. The shear is accomplished by running the extruder at high RPM and high compression (back pressure).

In the single screw process, generally PVC compounds can be handled for length/diameter (L/D) ratios of at least 24:1, and may differ in some operations. PVC extruders typically use a vacuum vent for extraction of volatiles (air pockets or gas filled voids). Common working pressure at the vent section have a range of 15-22 inches Hg vacuum. PVC single screws incorporate a two-stage screw design; a mixing zone and a decompression zone at the vented area. The screw also is designed with a hollow center for oil temperature control to assist in proper compound mix.

Twin Screw Extrusion — To achieve the best results in twin screw extrusion, low RPM along with low compression are necessary, just the opposite of single screw. This in turn creates very low friction (shear) for a considerable lower running temperature as well as a more consistent melt flow.

In the twin screw process L/D ratio is generally not considered due to the flexibility of compounds used (less heat sensitive). Similar to the single screw process, the twin screw process also uses a vacuum vent for extraction of volatiles. Typical working pressure for the vent section is 15-22 inches Hg vacuum. PVC twin screws differ slightly in design between machines, but basically have a feeding zone, decompression zone (at the vent section) and a mixing zone. The screws are each hollow centered for oil temperature control.

b. BASIC EXTRUSION OPERATION

In both operations, the compound enters the feed section and is carried by the screw(s) through the barrel. The heated PVC material is forced through a small hole or orifice (approximately 3/4"-1" diameter) and flows through a die. The die assists in giving the I.D. and O.D. a smooth glossy appearance. The material moves into the sizing tank, the cooling tank, and is pulled through the cooling tank by the take-off or pull-off which has a two-fold function. The pull-off helps pull the extruded material (soon to be finished product) through the cooling tanks and also controls the thickness of the wall by varying the speed. The finished product passes through a cutoff saw which is triggered by a microswitch for the desired length.

3.2. PRELIMINARY INSPECTIONS.

a. Steel tubular goods shall be adjudged suitable for lining by the manufacturer provided the following minimum requirements have been met:

Unless previously waived in writing by the purchaser, each length to be lined shall be hydrostatic tested with test pressure and duration subject to agreement between purchaser and manufacturer. If no waiver or agreement is addressed between such parties, a minimum five second test duration shall be used.

b. Steel tubular goods should be adjudged suitable for lining by the manufacturer provided the following minimum requirements have been met:

1. The maximum out-of-roundness should not exceed the manufacturer's acceptable limits.
2. The steel tubular goods should have no deviation from straightness exceeding the manufacturer's acceptable limits.
3. Pin and coupling threads on threaded and coupled pipe should be visually inspected for pulled, galled, or otherwise damaged threads. Tubular goods with thread wear exceeding manufacturer's acceptable limits should not be lined without reconditioning to meet these limits.
4. Tubular exteriors should be visually inspected for obvious defects such as crushed, pitted or corrosion damaged body. Missing, damaged, beveled, or special clearance couplings should be noted.
5. Tubular exteriors should be visually inspected for obvious pitting or corrosion damage, paraffin or other buildup, and existing coatings or linings.
6. Preliminary cleaning requirements should be determined. Tubular goods may require steaming, mechanical boring or pressure water blasting to prepare the interior surface for the grit blasting process, refer Table 8.1.
7. Steel tubular goods which have been determined unsuitable for lining should be marked and set aside at the manufacturer's facility. The purchaser should be notified for removal or disposal of the rejected steel tubulars.

3.3 MANUFACTURING PROCESS. PVC linings can be applied to new or used steel pipe and tubing. There are several types of manufacturing processes for inserting PVC liner systems. Currently, lining processes A, B, and C are different and not intended to be interchangeable. Consult the appropriate manufacturer if change-over capability is desired.

Lining processes may involve heating and forming of the PVC liner. Heating and forming procedures should be controlled to avoid degrading the corrosion resistance and mechanical properties of the PVC. The processes do not involve temperatures above 525°F (to prevent metallurgical damage — see API RP5L7) nor internal pressures exceeding specified minimum yield strength of the steel (per API Specs 5CT or 5L).

The most important criteria for the PVC liner is to serve as a continuous corrosion barrier. Once installed, the mechanical properties of the PVC liner do not add significantly to the system strength.

a. FABRICATION PROCESS "A"

A process of manufacturing in which a PVC tube or liner is inserted into a steel tube and bonded to the ID of that tube to create a corrosion barrier.

Steel line pipe or tubing, new or used, can be used in this lining process. The tubing is sandblasted on the ID to remove foreign material and is internally sprayed with a coating of adhesive. This adhesive is allowed to dry or cure; thereby creating a film on the internal surface of the pipe. This adhesive is allowed to flow into the J-section (per API Spec 5B) of the coupling and around the tapered segment of the pin end.

The PVC liner to be installed into the steel tubular is coated with a layer of adhesive that is compatible with the adhesive which was sprayed into the steel tubular. This adhesive is allowed to dry or cure. The liner to be installed in threaded and coupled pipe requires a seal ring to be chemically bonded to the PVC liner. The cured seal ring will function as a seat in the J-section of the threaded and coupled pipe.

When both adhesives are cured the liner is inserted into the steel tubular to proceed through the bonding and finishing process.

Special tools are placed on the ends of the pipe and used to pack off the liner. A combination of heat and pressure is applied to the steel and liner assembly so as to expand the liner to conform to the ID of the steel tubing and to reactivate the adhesives. The unit is cooled, allowing the reset of the adhesives. The PVC liner is now in position against the wall of the steel.

The coupling and pin ends of the lined tubular are hand dressed to create the seating surfaces of the PVC liner at a pre-determined depth. A mark is placed on the pin end to designate the desired depth of make-up to seat the PVC liner in the J-section of the lined steel tubular.

The lined pipe, coupling and pin areas are checked and dope is applied to the connection. Pin end protectors are placed on the pipe.

b. FABRICATION PROCESS "B"

INSTALLATION OF THE LINER — The entire inside diameter of each tubular is sandblasted to remove any remaining scale or other foreign matter. The extruded PVC liner is then sleeved inside the steel joint. The liner is pulled past the coupling, inserted into a special device for heating the PVC liner and a precision designed mandrel is exposed to the heated liner end and causes the end to flare slightly. The liner is drawn back into the coupling flush with the end of the tubular.

A special machined connection is threaded onto the pin-end of the joint and the coupling end is elevated and aligned with a splash plate. A hose is inserted into the special pin-end connection and a portland cement slurry is pumped, at controlled pressures, between the outside diameter of the liner and the inside diameter of the steel tubular. Elevating the pipe while injecting the cement slurry assures that it is uniformily applied to minimize voids between the PVC liner and the steel goods. The cement slurry is then allowed to cure for a specified length of time.

A machined spacer is used to gauge the amount of PVC liner protruding past the exposed pin-end of the tubular. The liner is inserted into a specially designed heating device and flared with a precision mandrel around the pin-end of the pipe.

The threads of the coupling and the pin-end (having already been cleaned) are dressed with a special light protective compound. A small amount of teflon based pipe dope is applied to the threads of the coupling only. A plastic thread protector is threaded onto the pin-end and the pipe receives a layer of corrosion resistant aluminum tank coating on the full outside diameter of the pipe. Finally, there is a special identification number (lot number) assigned to the tubular and permanently applied to the steel tubular surface.

c. FABRICATION PROCESS "C"

1. The interior surface of the steel line pipe or tubing is cleaned by abrasive blasting.
2. The lining is formed by inserting a rigid PVC liner with a modified exterior surface texture, into the conditioned steel tubular. The annular space between the PVC liner and steel tubular is filled with a portland cement mortar.
3. After the liner is placed, mortar is pumped at a controlled rate through a lining cap on one end of the tubular into the annulus between the steel tubular and PVC liner. After returns at the opposite end of the tubular are evident, the pressure is raised to just below the collapse pressure of the tube to effect a squeeze and cause partial dehydration of the mortar.
4. The mortar is locked in the annular space under pressure and the mortar is allowed to set before removing the cap.
5. The end cap is removed and the ends of the liner are flared over the ends of the steel tubular. If the tubular being lined is threaded and coupled, the flare on the coupling end is prepared and placed in proper position before the annulus is filled with mortar.
6. A reference band is stenciled on the pin end.
7. The lined tubular is thoroughly cleaned and inspected. Threads are brushed clean and a protective coating applied. Once the tubular has passed visual inspection, thread protectors are placed on the pin end and plugs inserted in the coupling.

3.4 REPAIRS. Defects in new lined systems are typically not repaired — the manufacturer will replace any defective liners found during the manufacturing process. Repair kits are available for field end repair. Note that these repairs result in a liner system which is no longer one continuous piece.

Repair methods may be field applied, shop repaired, or re-lined depending on the type of damage. Distinct differences in the lined products require contacting the appropriate lining manufacturer to determine the repair requirements for damaged PVC lined steel tubular goods.

SECTION 4
MATERIAL COMPOSITION

4.1 CHEMICAL. The poly (vinyl chloride) (PVC) extrusion compound shall meet the requirements for PVC class 12454B; or class 12454C; as set forth in ASTM D 1784.

4.2 POLYMER CONTENT. The homopolymer portion of the PVC compound shall contain a minimum of 88% vinyl chloride.

4.3 ASH COMPOSITION. The ash composition shall contain 65% ± 3% by weight of calcium carbonate and 35% ± 3% by weight of titanium dioxide.

4.4 SPECIFIC GRAVITY. The PVC liner extrusion compound shall have a specific gravity range of 1.32-1.47, as determined by ASTM D 792 method A.3 (testing of compound prior to extrusion process).

4.5 CERTIFICATION. Manufacturers shall retain records of certification for all requirements of Section 4. A change of compounder or compound formulation shall require recertification documentation.

SECTION 5
PHYSICAL PROPERTIES, TESTS, AND REQUIREMENTS

5.1 EXTRUDED PRODUCT TESTING AND REQUIREMENTS

(Testing of PVC at extruder location.)

a. TEST CONDITIONS. Tests shall be conducted in laboratory atmosphere of 73.4 ± 3.6° F and 50 ± 5 percent relative humidity, unless otherwise specified in the test methods or in this specification. In cases of disagreement, the tolerances shall be ± 1.8° F and ± 2 percent relative humidity.

b. IMPACT RESISTANCE OF PVC LINER. The method of test shall be ASTM D 2444 with a Tup B and a flat plate support. Use a 20 lb. tup for liners 12 in. and smaller. Impact tests shall exceed the minimum values listed in Table 5.1.; herein.

c. EXTRUSION QUALITY (ACETONE TEST). PVC liners shall meet the requirements of ASTM D 2152. Anhydrous acetone shall be used and the liner exposed not less than 20 minutes.

d. FLATTENING. Three specimens of the liner shall be flattened. The specimens shall be 2 inches long and placed between parallel plates in a suitable press until the distance between the plates is 40 percent of the outside diameter of the liner or the walls of the liner touch. The rate of loading shall be uniform and such that the compression is completed within 2 to 5 minutes. On removal of the load, the specimens shall be examined for evidence of splitting, cracking, or breaking.

e. FREQUENCY OF TESTS. Specific gravity test as specified in 4.4 shall be conducted on a manufacturers batch or lot basis. Impact tests shall be tested at 4-hour intervals for each extrusion line as specified in Par. 5.1.b. Extrusion quality (acetone test) shall be performed at 8-hour intervals for each extrusion line as specified in Par. 5.1.c. Dimensions and tolerances of each piece of liner shall be checked with rejection of any piece exceeding tolerances specified by manufacturer. Flattening tests as specified in Par. 5.1.d shall be run at 8-hour intervals. Quality control records shall contain data of all tests and be open to inspection by the manufacturer.

f. REWORK MATERIAL. Regrind materials shall not be permitted as part of the PVC liner products.

g. RETEST AND REJECTION. When the liner fails to meet the specifications requirements in any test, additional testing shall be made on previously produced liners until 3 separate, sequential, acceptable results are obtained. Liners that do not meet the requirement shall be rejected, and recorded.

TABLE 5.1
IMPACT RESISTANCE @ 73.4°F*
FOR PVC LINERS AS EXTRUDED

1	2
Size OD-Inches	IMPACT RESISTANCE Ft-lbs, All SDR's
1.32 - 1.89	20
1.90 - 2.38	30
2.39 - 2.87	40
2.88 - 3.49	60
3.50 - 4.00	70

*Test Method ASTM D 2444 as specified in Par. 5.1.b

5.2 FABRICATED PRODUCT REQUIREMENTS

a. WORKMANSHIP. The liner shall be homogeneous throughout and free from visible cracks, holes, protrusions, foreign inclusions, or other injurious defects, as established by the manufacturer. The liner shall be uniform within the manufacturers acceptable limits in terms of color, out-of-roundness, density and physical properties.

b. LENGTHS. All liners shall be one continuous extruded piece capable of fully sleeving the entire length of the steel tubular in which it is to be installed. In this context continuous means "one solid piece not requiring splicing to another liner." Therefore, the liner lengths are strictly dependent on the range/length of the steel tubular being lined.

c. NOMINAL INSIDE DIAMETER. The nominal inside diameter of the PVC lined steel pipe or tubing, as shown in Tables 5.2 and 5.3, column 4.

d. WALL THICKNESS. A dimension of the minimum wall thickness at any cross section of the PVC liner prior to the fabrication process, shall be as shown in Tables 5.2 and 5.3, column 5.

e. WEIGHT OF LINING MATERIALS. The nominal weight of the lining materials added to the steel pipe or tubing expressed as pounds per foot, as shown in Tables 5.2 and 5.3, column 6.

f. DRIFT DIAMETER. A specified dimension for which a cylindrical or spherical mandrel shall pass freely through the entire length of the finished PVC lined steel line pipe or tubing, at the manufacturers facility. Cylindrical mandrels shall have a minimum length not less than the drift diameter, as shown in Tables 5.2 and 5.3, column 7.

NOTE: *Manufacturers written specifications for weights and dimensions should be used as reference for engineering design. Inside diameters and lining weights may vary due to the process of manufacture.*

TABLE 5.2
PVC LINED LINE PIPE
DIMENSIONS & WEIGHTS
See Appendix E For Metric Conversion

1 NOMINAL PIPE SIZE (inches)	2 PIPE SCHEDULE	3 MFG PROCESS (Refer Sec 3)	4 NOMINAL INSIDE DIA. (inches)	5 WALL THICKNESS (inches)	6 WEIGHT OF LINER SYSTEM (Lbs/Ft)	7 MINIMUM DRIFT DIA. (inches)
2	40	A	1.900	.065	.260	1.840
3	40	A	2.900	.070	.435	2.800
4	40	A	3.850	.075	.623	3.750
2	40	B	1.770	.065	.44	1.67
2	80	B	1.770	.065	.44	1.67
2 1/2	40	B	2.160	.070	.65	2.06
2 1/2	80	B	2.160	.070	.65	2.06
3	40	B	2.735	.070	.75	2.635
3	80	B	2.735	.070	.75	2.635
2	40	C	1.780	.060	.50	1.700
2 1/2	40	C	2.195	.073	.55	2.110

TABLE 5.3
PVC LINED TUBING
DIMENSIONS & WEIGHTS
See Appendix E For Metric Conversion

1	2		3	4	5	6	7
SIZE	NOMINAL WEIGHTS			NOMINAL		WEIGHT	MINIMUM
	NON-UPSET	UPSET	MFG	INSIDE	WALL	LINER	DRIFT
(inches)	T & C	T & C	PROCESS (Refer Sec. 3)	DIAMETER (inches)	THICKNESS (Lbs/Ft)	SYSTEM (Lbs/Ft)	DIA. (inches)
1.660	2.30	2.40	A	1.240	.060	.153	1.15
1.900	2.75	2.90	A	1.475	.060	.190	1.360
2 3/8	4.60	4.70	A	1.860	.065	.260	1.750
2 7/8	6.40	6.50	A	2.300	.065	.320	2.200
3 1/2	9.20	9.30	A	2.830	.070	.435	2.70
1.315	1.70	1.80	B	.840	.050	.20	.740
1.900	2.75	2.90	B	1.425	.060	.22	1.325
2.063	3.25	NA	B	1.425	.060	.53	1.325
2 3/8	4.60	4.70	B	1.770	.065	.44	1.670
2 7/8	6.40	6.50	B	2.160	.070	.65	2.060
3 1/2	9.20	9.30	B	2.735	.070	.75	2.635
4 1/2	12.60	12.75	B	3.635	.090	1.19	3.535
1.660	2.30	2.40	C	1.189	.063	.25	1.115
2 3/8	4.60	4.70	C	1.780	.060	.50	1.700
2 7/8	6.40	6.50	C	2.195	.073	.55	2.110

SECTION 6
END PROTECTION

6.1 THREADED ENDS. Thread condition is important to the sealing effectiveness of the PVC lining system, but gauging the thread elements (lead, taper, height, stand-off) is beyond the scope of this document. Couplings shall be screwed onto the pipe power-tight. A thread compound shall be applied to cover the full surface of either the coupling or pipe engaged thread before making up the joint. All exposed threads shall be coated with a thread compound or a storage compound of distinct color. Unless otherwise specified on the purchase order, the manufacturer may use any thread compound which meets the performance objectives set forth in API Bulletin 5A2. Whichever compound is used shall be applied to a surface that is clean, free of moisture and cutting fluids, as established by Manufacturers procedures.

6.2 END PROTECTION. The manufacturer shall provide pin end thread protection of such design, material, and mechanical strength to protect the pin ends of the lined tubular from damage under normal handling and transportation and to prevent damage by ultra-violet radiation and other weather elements. Threaded box ends do not require protection, unless specified in writing by purchaser. Non-threaded connections may have special end protection requirements and are subject to written agreement between purchaser and manufacturer.

NOTE: *End closures are effective in keeping debris out of the ID, however, with both ends closed there is some concern with excessive heat buildup in hot climates. Therefore, this standard only requires protection to pin ends.*

SECTION 7
COUPLINGS

Each manufacturer shall be responsible for the corrosion barrier integrity of the coupling placed in the PVC liner system. Any connection covered under API Specification 5CT may be used by each fabrication process. Proprietary connections may also be used on products covered by this specification but such connections are beyond the scope of this specification.

SECTION 8
INSPECTION

8.1 PURCHASER INSPECTION. Unless otherwise provided, the provisions of Appendix E shall apply.

8.2 INSPECTION SUMMARY. Table 8.1 below summarizes the inspection and documentation required for both new and used products. Refer to the relevant paragraph for detailed requirements.

Table 8.1
INSPECTION SUMMARY

INSPECTION CATEGORY	INSPECTION ATTRIBUTE	SUMMARY OF CRITERIA	RELEVANT PARAGRAPH
STEEL SURFACE PREP.	ABRASIVE BLAST	The interior shall be essentially free of mill varnish, oil, paraffin, corrosion products, scale, loose mill scale, thread lubricant and any other foreign material. 'Essentially free' means a minimum of NACE #4 Brush-Off Blast surface finish. Tightly adhering coatings are acceptable after blasting.	Note 1
PVC LINER COMPO-SITION	MATERIAL CLASS	Document that PVC is ASTM D 1784 Class 12454B or 12454C	4.1, 4.5
	POLYMER CONTENT	Document that homopolymer portion of PVC compound contains at least 88% vinyl chloride.	4.2, 4.5
	ASH COMPO-SITION	Document that ash contains 65 ± 3 WT. % $CaCO_3$ and 35 ± 3 WT. % TiO_2	4.3, 4.5
	SPECIFIC GRAVITY	Document that ASTM D 792 (Method A.3) specific gravity is within range of 1.32-1.47	4.4, 4.5
PVC LINER REQUIRE-MENTS	IMPACT	Document ASTM D 2444 (TUP B, 20 lb for liners ≤ 12 in.) Impact results are per Table 5.1	5.1.b, 5.1.g

Note 1: See National Association of Corrosion Engineers (NACE) Standard TM0170-70 for Brush-Off Blast NACE #4.

INSPECTION CATEGORY	INSPECTION ATTRIBUTE	SUMMARY OF CRITERIA	RELEVANT PARAGRAPH
	ACETONE TEST	Document ASTM D2152 tests using anhydrous acetone for not less than 20 minutes	5.1.c, 5.1.g
	FLATTENING	Document flattening tests	5.1.d, 5.1.g
	REWORK MATERIAL	No regrind material allowed.	5.1.f
FINAL LINED PRODUCT	PVC LINER	Visually verify that liner is one continuous piece, free from cracks, holes, protrusions, inclusions, or other injurious defects as established by the manufacturer. The liner shall be uniform in terms of color and out of roundness.	5.2.a, 5.2.b
	DIMENSIONS	Document dimensions are per Tables 5.2 and 5.3	5.2.c, 5.2.d
	DRIFT	Verify minimum drifts per Tables 5.2 & 5.3	5.2.f
	THREADS	Verify that: • Couplings are applied power tight • Thread/storage compounds are applied • Pin end protectors installed • Box end protectors installed if specified (2)	 6.1 6.1 6.2 6.2
		(Note: This specification does not require inspection of the threads themselves)	(6.1)
	MARKING	Verify each joint marked with water resistant paint or ink stencil. • As above with die stamping if specified (2)	9.1, 9.2 9.1, 9.2

NOTES: (2) This item is subject to agreement between manufacturer and purchaser.

SECTION 9
EQUIPMENT MARKING

9.1 METHODS AND REQUIREMENTS. PVC lined tubulars which have been lined in conformance with this specification shall be marked by the manufacturer as specified in Par 9.2. (Additional marking as desired by the Manufacturer or as requested by the Purchaser are not prohibited). Markings shall be readily visible as applied by water resistant paint or ink stencil. Die stamping may be substituted for any marking requirements as agreed upon between purchaser and manufacturer. Markings shall not overlap and shall be applied in such a manner as not to injure the pipe or couplings. Markings shall be applied within three feet of the connection.

NOTE: *Die stamping is prohibited by API Spec 5CT Group 2 products.*

9.2 SEQUENCE:

a. Specification and process designation, see Section 3, Ex.: 15LT-A for process A.

When applicable,* the API license number shall be applied in lieu of 15 LT.

b. Date of Manufacture; month and year, Ex.: Jan. 93 = 1/93.

c. Unique manufacturers lot identification number.

Example: Tubulars lined by process A on January 1993 should be marked as follows:

15LT-A-1/93-(ID#)

*Users of this specification should note that there is no longer a requirement for marking a product with the API monogram. The American Petroleum Institute continues to license use of the monogram on products covered by this specification but it is administered by the staff of the Institute separately from the specification. The policy describing use of the monogram is contained in Appendix B herein. No other use of the monogram is permitted. Non-Licensees may mark products in conformance with Section 9 and Licensees may mark products in conformance with Appendix B.

SECTION 10
RECORD RETENTION REQUIREMENTS

10.1 PURPOSE. The quality control records required by this specification are necessary to substantiate that all materials and products made to meet this specification do conform to the specified requirements.

10.2 RECORDS CONTROL.

a. Quality control records required by this specification shall be legible, identifiable, retrievable and protected from damage, deterioration, or loss.

b. Quality control records required by this specification shall be retained by the Manufacturer for a minimum of five years following the date of manufacture.

c. All quality control records required by this specification shall be signed and dated, as established by the Manufacturer's procedures.

10.3 OTHER RECORDS TO BE MAINTAINED BY MANUFACTURER.

Any records related to Manufacturer's process documentation, as defined in the manufacturer's procedures, shall be maintained by manufacturer as noted in Par. 10.2.

APPENDIX A
RECOMMENDED CHEMICAL RESISTANCE TABLE
(These test values are valid at 0 PSIG pressure only)

E = Excellent	U = Unsuitable
G = Good	O = No test
L = Limited	

Chemical	72°F.	140°F.
Acetaldehyde	U	U
Acetamide	O	O
Acetate Solvents – Crude	U	U
Acetate Solvents – Pure	U	U
Acetic Acid 0-10%	E	E
Acetic Acid 10-20%	E	E
Acetic Acid 20-30%	E	G
Acetic Acid 30-60%	E	E
Acetic Acid 80%	G	L
Acetic Acid – Glacial	G	U
Acetic Acid – Vapors	E	E
Acetic Anhydride	U	U
Acetone	U	U
Acetylene	L	L
Adipic Acid	E	E
Alcohol – Allyl – 96%	G	L
Alcohol – Amyl	E	L
Alcohol – Butyl	E	G
Alcohol – Ethyl	E	E
Alcohol – Methyl	E	E
Alcohol – Propargyl	E	E
Alcohol – Propyl	E	E
Allyl – Chloride	U	U
Alum	E	E
Alum, Ammonium	E	E
Alum, Chrome	E	E
Alum, Potassium	E	E
Aluminum Chloride	E	E
Aluminum Fluoride	E	E
Aluminum Hydroxide	E	E
Aluminum Oxychloride	E	E
Aluminum Nitrate	E	E
Aluminum Sulfate	E	E
Ammonia – Dry Gas	E	E
Ammonia, Aqua (10%)	E	E
Ammonia – Liquid	L	U
Ammonium Acetate	E	E
Ammonium BiFluoride	E	E
Ammonium Carbonate	E	E
Ammonium Chloride	E	E
Ammonium Fluoride – 25%	E	L
Ammonium Hydroxide – 28%	E	E
Ammonium Metaphosphate	E	E
Ammonium Monophosphate	E	E
Ammonium Nitrate	E	E
Ammonium Persulfate	E	E
Ammonium Phosphatel (Ammoniacal)	E	E
Ammonium Phosphate – Neutral	E	E
Ammonium Sulfate	E	E
Ammonium Sulfide	E	E
Ammonium Thiocyanate	E	E
Amyl Acetate	U	U
Amyl Chloride	U	U
Aniline	U	U
Aniline Chlorohydrate	U	U
Aniline Dyes	U	U
Aniline Hydrochloride	U	U
Anthraquinone	E	E
Anthraquinonesulfonic Acid	E	E
Anitimony Trichloride	E	E
Aqua Regia	E	L
Arsenic Acid – 80%	E	G
Arylsulfonic Acid	E	E
Asphalt	E	E
Barium Carbonate	E	E
Barium Chloride	E	E
Barium Hydroxide	E	E
Barium Sulfate	E	E
Barium Sulfide	E	E
Beer	E	E
Beet – Sugar Liquor	E	E

Chemical	72°F.	140°F.
Benzaldehyde	U	U
Benzene	U	U
Benzenesulfonic Acid – 10%	E	E
Benzenesulfonic Acid	U	U
Benzoic Acid	E	E
Benzol	U	U
Bismouth Carbonate	E	E
Black Liquor (Paper Industry)	E	E
Bleach – 12.5% Active Cl_2	E	G
Borax	E	E
Borax Liquors	E	E
Boric Acid	E	E
Boron, TriFluoride	E	E
Breeder Pellets – Fish Derivative	E	E
Brine	E	E
Bromic Acid	E	E
Bromine – Liquid	U	U
Bromine (Gas) – 25%	E	E
Bromine – Water	E	E
Butadiene	E	E
Butane	E	E
Butane, Buthylene	E	E
Butane, Diol	E	E
Butanol	E	U
Butanol – Primary	E	E
Butanol – Secondary	E	L
Buttermilk	E	E
Butyl Acetate	U	U
Butyl Phenol	E	U
Butylene	E	O
Butynediol (Erthritol)	E	U
Butyric Acid 20%	G	U
Butyric Acid	E	U
Calcium Bisulfide	E	E
Calcium Bisulfite	E	E
Calcium Carbonate	E	E
Calcium Chlorate	E	E
Calcium Chloride	E	E
Calcium Hydroxide	E	E
Calcium Hypochlorite	E	E
Calcium Nitrate	E	E
Calcium Oxide	E	E
Calcium Sulfate	E	E
Cane Sugar Liquors	E	E
Carbolic Acid	E	E
Carbon Bisulfide	U	U
Carbon Dioxode (Aqueous S.L.)	E	E
Carbon Dioxide Gas (Wet)	E	E
Carbon Monoxide	E	E
Carbon Tetrachloride	L	U
Carbonated Water	E	E
Carbonic Acid	E	E
Casein	E	E
Castor Oil	E	E
Caustic Potash	E	E
Caustic Soda	E	E
Cellosolve	G	L
Chloracetic Acid	E	L
Chloral Hydrate	E	E
Chloric Acid 20%	E	E
Chlorinated Solvents	U	U
Chlorine (Dry)	E	L
Chlorine Gas (Moist)	G	L
Chlorine Water	E	E
Chloroacetic Acid	E	E
Chlorobenzene	U	U
Chlorobenzyl Chloride	U	U
Chloro Form	U	U
Chlorosulfonic Acid (100%)	E	U
Chrome Alum	E	E
Chromic Acid 10%	E	E

Chemical	72°F.	140°F.
Chromic Acid 25%	E	L
Chromic Acid 30%	E	L
Chromic Acid 40%	E	L
Chromic Acid 50%	E	L
Citric Acid	E	E
Coconut Oil	E	E
Coke Oven Gas	E	E
Copper Carbonate	E	E
Copper Chloride	E	E
Copper Cyanide	E	E
Copper Fluoride	E	E
Copper Nitrate	E	E
Copper Sulfate	E	E
Core Oils	E	E
Corn Oil	E	E
Corn Syrup	E	E
Cottonseed Oil	E	E
Cresol	U	U
Cresylic Acid 50%	E	E
Croton Aldehyde	U	U
Crude Oil – Sour	E	E
Crude Oil – Sweet	E	E
Cuprous Chloride	E	E
Cyclohexane	U	U
Cyclohexanol	U	U
Cyclohexanon	U	U
Demineralized Water	E	E
Dextrin	E	E
Dextrose	E	E
Diazo Salts	E	E
Diesel Fuels	E	E
Diethye Amine	U	U
Dioctylphthalate	U	U
Disodium Phosphate	E	E
Diethyl Ether	U	U
Diglycolic Acid	E	G
Dioxane – 1, 4	O	O
Divinyl Benzene	O	O
Drying Oil	O	O
Ethers	U	U
Ethyl Acetate	U	U
Ethyl Acrylate	U	U
Ethyl Chloride	U	U
Ethyl Ether	U	U
Ethylene Bromide	U	U
Ethylene Chlorohydrin	U	U
Ethylene Dichloride	U	U
Ethylene Glycol	E	E
Ethylene Oxide	U	U
Fatty Acids	E	E
Ferric Chloride	E	E
Ferric Nitrate	E	E
Ferric Sulfate	E	E
Ferrous Nitrate	E	E
Fish Solubles	E	E
Fluorine Gas – Dry	L	U
Fluorine Gas – Wet	L	U
Fluoroboric Acid – 25%	E	E
Fluorosilicic Acid	E	E
Formaldehyde	E	G
Food Products such as Milk, Buttermilk, Molasses, Salad Oils, Fruit	E	E
Formic Acid	E	U
Freon – 12	E	G
Fructose	E	E
Fruit Pulps and Juices	E	E
Fuel Oil (containing H_2SO_4)	E	E
Furtural	U	U
Gallic Acid	E	E
Gas – Coke Oven	E	E
Gas – Manufactured	U	U

Chemical	72°F.	140°F.
Gas – Natural (Dry)	E	E
Gas – Natural (Wet)	E	E
Gasoline (Leaded)	E	E
Gasoline (Unleaded)	E	E
Gasoline – Refined	E	
Gasoline – Sour	E	E
Gelatine	E	E
Glucose	E	E
Glycerine (Glycerol)	E	E
Glycol	E	E
Glue	E	E
Glycolic Acid 30%	E	E
Green Liquor (Paper Industry)	E	E
Heptane	E	G
Hexane	E	L
Hexanol Tertiary	E	E
Hydrobromic Acid – 20%	E	E
Hydrochloric Acid – 0-25%	E	G
Hydrochloric Acid – 25-40%	E	E
Hydrocyanic Acid or Hydrogen Cyanide	E	E
Hydrofluoric Acid 4%	E	L
Hydrofluoric Acid 10%	E	L
Hydrofluoric Acid 48%	E	L
Hydrofluoric Acid 60%	E	L
Hydrofluoric Acid 100%	G	L
Hydrogen	E	E
Hydrogen Peroxide – 30%	E	E
Hydrogen Peroxide – 50%	E	E
Hydrogen Peroxide – 90%	E	E
Hydrogen Sulfide – Aqueous Solution	E	E
Hydrogen Sulfide – Dry	E	E
Hydroquinone	E	E
Hydroxylamine Sulfate	E	E
Hypochlorous Acid	E	E
Hypo-(Sodium Thiosulfate)	E	E
Iodine	U	U
Iodine (in Alcohol)	U	U
Iodine Solution (10%)	U	U
Iodoform	O	O
Isopropylalcohol	E	E
Jet Fuels, JP4 & JP5	E	E
Kerosene	E	E
Ketones	U	U
Kraft Liquor (Paper Industry)	E	E
Lacquer Thinners	L	U
Lactic Acid 28%	E	E
Lard Oil	E	E
Lauric Acid	E	E
Lauryl Chloride	E	E
Lauryl Sulfate	E	E
Lead Acetate	E	E
Lime Sulfur	E	E
Linoleic Acid	E	E
Linseed Oil	E	E
Liquers	E	E
Liquors	E	E
Lithium Bromide	E	E
Lubricating Oil	E	E
Machine Oil	E	E
Magnesium Carbonate	E	E
Magnesium Chloride	E	E
Magnesium Citrate	E	E
Magnesium Hydroxide	E	E
Magnesium Nitrate	E	E
Magnesium Sulfate	E	E
Maleic Acid	E	E
Malic Acid	E	E
Mercuric Chloride	E	E
Mercuric Cyanide	E	E

Chemical	72°F.	140°F.
Mercurous Nitrate	E	E
Mercury	E	E
Methane	E	E
Methyl Bromide	U	U
Methyl Cellosolve	U	U
Methyl Chloride	U	U
Methyl Chloroform	U	U
Methyl Ethyl Ketone	U	U
Methyl Iso-Butyl Ketone	U	U
Methyl Salicylate	E	E
Methyl Sulfate	E	L
Methyl Sulfonic Acid	E	E
Methyl Sulfuric Acid	E	E
Methylene Chloride	U	U
Milk	E	E
Mineral Oils	E	E
*Mixed Acids (H_2SO_4 & HNO_3)	E	E
Molasses	E	E
Monoethanolamine	U	U
Muriatic Acid	E	E
Naptha	E	E
Napthalene	U	U
Natural Gas, Dry & Wet	E	E
Nickel Acetate	E	E
Nickel Chloride	E	E
Nickel Nitrate	E	E
Nickel Sulfate	E	E
Nickel Sulphate	E	E
Nicotine	E	E
Nicotine Acid	E	E
Nitric Acid Anhydrous	U	U
Nitric Acid 10%	E	E
Nitric Acid 20%	E	L
Nitric Acid 35%	E	G
Nitric Acid 40%	E	G
Nitric Acid 60%	E	L
Nitric Acid 68%	G	U
Nitric Acid 70%	E	E
Nitric Acid 100%	E	U
Nitric Acid, Red Fuming	U	U
Nitrobenzene	U	U
Nitropropane	O	O
Nitrous Acid (10%)	E	E
Nitrous Oxide	E	E
Ocenol (Unsaturated Alcohol)	E	E
Oil and Fats	E	E
Oleic Acid	E	E
Oleum	U	U
Oxalic Acid	E	E
Oxygen	E	E
Ozone	G	L
Palmitic Acid 10%	E	E
Palmitic Acid 70%	E	U
Paraffin	E	E
Pentane	O	O
Peracetic Acid 40%	E	U
Perchloric Acid 10%	E	L
Perchloric Acid 15%	E	U
Perchloric Acid 70%	E	U
Perchloroethylene	O	O
Petrolatum	E	E
Phenol	L	U
Phenol (90%)	U	U
Phenylhydrazine	U	U
Phenylhydrazine -- Hydrochloride	E	U
Phosgene (Gas)	E	G
Phosgene (Liquid)	U	U
Phosphoric Acid 0-25%	E	G
Phosphoric Acid 25-50%	E	E
Phosphoric Acid 50-75%	E	E
Phosphoric Acid -- 85%	E	E
Phosphorous (Yellow)	E	G

Chemical	72°F.	140°F.
Phosphorous (Red)	E	E
Phosphorous Pentoxide	E	L
Phosphorous Trichloride	U	U
Photographic Chemicals	E	E
Photographic Solutions	E	E
Phthalic Acid	O	O
Picric Acid	U	U
Plating Solutions:		
Brass	E	E
Cadium	E	E
Chromium	E	G
Copper	E	E
Gold	E	E
Iron	E	E
Judium	E	E
Lead	E	E
Nickel	E	E
Rhodium	E	E
Silver	E	E
Tin	E	E
Zinc	E	E
Potassium Acid Sulfate	E	E
Potassium Aluminum Sulfate	E	E
Potassium Alum	E	E
Potassium Antimonate	E	E
Potassium Bicarbonate	E	E
Potassium Bichromate	E	E
Potassium Bisulfite	E	E
Potassium Borate 1%	E	E
Potassium Borate	E	E
Potassium Bromate 10%	E	E
Potassium Bromate	E	E
Potassium Bromide	E	E
Potassium Carbonate	E	E
Potassium Chlorate (ag)	E	E
Potassium Chlorate	E	E
Potassium Chloride	E	E
Potassium Chromate (Aln)	E	E
Potassium Chromate (Neut.)	E	E
Potassium Chromate 40%	E	E
Potassium Cuprocyanide	E	E
Potassium Cyanide	E	E
Potassium Dichromate 40%	E	E
Potassium Dichromate	E	E
Potassium Dichrom (Alkaline)	E	E
Potassium Dichron (Neutral)	E	E
Potassium Diphosphate	E	E
Potassium Ferricyanide	E	E
Potassium Ferrocyanide	E	E
Potassium Fluoride	E	E
Potassium Hydroxide	E	E
Potassium Hypochlorite	E	G
Potassium Iodide	E	E
Potassium Nitrate	E	E
Potassium Perborate	E	E
Potassium Perchlorate	E	E
Potassium Perchlorite	E	E
Potassium Permanganate 10%	E	E
Potassium Permanganate 25%	G	L
Potassium Persulfate	E	E
Potassium Sulfate	E	E
Potassium Sulfide	E	E
Potassium Thiosulfate	E	E
Propane	E	E
Propylene Dichloride	U	U
Propylene Glycol	E	E
Pyrogallic Acid	O	O
Rayon Coagulating Bath	E	E
Rochelle Salts	E	E
Sea Water	E	E
Salenis Acid (Aqueous)	O	O
Salicylaldehyde	O	O
Salt Water	E	E

Chemical	72°F.	140°F.
Selenic Acid	E	E
Sewage	E	E
Silicic Acid	E	E
Silver Cyanide	E	E
Silver Nitrate	E	E
Silver Sulfate	E	E
Soap Solution	E	E
Soaps	E	E
Sodium Acetate	E	E
Sodium Alum	E	E
Sodium Acid Sulfate	E	E
Sodium Aluminate	E	E
Sodium Antinonate	E	E
Sodium Arsenite	E	E
Sodium Benzoate	E	E
Sodium Bicarbonate	E	E
Sodium Bisulfate	E	E
Sodium Bisulfite	E	E
Sodium Borate	E	E
Sodium Bromide	E	E
Sodium Carbonate (Soda Ash)	E	E
Sodium Chlorate	E	G
Sodium Chloride	E	E
Sodium Chlorite	E	E
Sodium Cyanide	E	E
Sodium Dichromate	E	E
Sodium Dichromate (Neutral)	E	E
Sodium Ferricyanide	E	E
Sodium Ferrocyanide	E	E
Sodium Fluoride	E	E
Sodium Hydroxide 10%	E	E
Sodium Hydroxide 15%	E	E
Sodium Hydroxide 35%	E	E
Sodium Hydroxide 70%	E	E
Sodium Hydroxide (Satr)	E	E
Sodium Hypochlorite	E	E
Sodium Iodide	E	E
Sodium Nitrate	E	E
Sodium Nitrite	E	E
Sodium Perborate	E	E
Sodium Peroxide	E	E
Sodium Phosphate	E	E
*Sodium Phosphate – Acid	E	E
Sodium Silicate	E	E
Sodium Sulfate	E	E
Sodium Sulfide	E	E
Sodium Sulfite	E	E
Sodium Thiosulfate (Hypo)	E	E
Sour Crude Oil	E	E
Stannic Chloride	E	E
Stannous Chloride (50%)	E	E
Stannous Chloride	E	G
Starch	E	E
Stearic Acid	E	E
Stoddards Solvent	E	E
Sulfated Detergents	E	E
Sulfur	E	E
Sulfur Dioxide Gas – Dry	E	E
*Sulfur Dioxide Gas – Wet	E	L
Sulfur Trioxide	E	E
Sulphur Dioxide – Liquid	G	U

Chemical	72°F.	140°F.
Sulphuric Acid 0-10%	E	E
Sulphuric Acid 10-30%	E	E
Sulphuric Acid 30-50%	E	E
Sulphuric Acid 50-75%	E	E
Sulphuric Acid 75-90%	E	E
Sulphuric Acid 95%	E	G
Sulphurous Acid	G	U
Tan Oil	E	E
Tannic Acid	E	E
Tanning Liquors	E	E
Tartaric Acid	E	E
Tetrachloroethane	O	O
Tetraethyl Lead	E	G
Tetrahydro Furane	U	U
Thionyl Chloride	U	U
Tepineol	G	L
Tin Chloride	E	E
Titanium Tetrachloride	E	U
Toluol or Toluene	U	U
Toxaphene (90%)	O	O
Tributyl Phosphate	U	U
Trichloroacetic Acid	E	E
Trichloroethylene	U	U
Tricresylphosphate	U	U
Triethanolamine	E	G
Triethylamine	E	E
Trimethyl Propane	E	G
Trisodium Phosphate	E	E
Turpentine	E	E
Urea	E	E
Urine	E	E
Vegetable Oil	E	E
Vinegar	E	E
Vinyl Acetate	U	U
Water – Acid Mine	E	E
Water – Distilled	E	E
Water – Fresh	E	E
Water – Salt	E	E
Water – Sewage	E	E
Whiskey	E	E
White Gasoline	E	E
White Liquor (Paper Industry)	E	E
Wines	E	E
Xylene or Xylol	U	U
Zinc Chloride	E	E
Zinc Chromate	E	E
Zinc Cyanide	E	E
Zinc Nitrate	E	E
Zinc Sulfate	E	E
Mixtures of Acids:		
Nitric 15% – Hydrofluoric 4%	E	E
Sodium Dichromate 13% – Nitric Acid 16%/Water 71%	E	E

This information may be used as a guide to assist in the proper application of PVC lined tubulars. It is suggested tests be run for critical applications.

APPENDIX B
MARKING INSTRUCTIONS FOR API LICENSEES

a. GENERAL. Products manufactured in conformance with this specification may be API monogrammed by the API licensed manufacturer, such Products which are monogrammed shall be marked as specified hereinafter. (Additional markings as desired by the manufacturer or as requested by the Purchaser are not prohibited.) Markings shall be readily visible as applied by water resistant paint or ink stencil. Die stamping may be substituted for any marking requirements as agreed upon between purchaser and manufacturer. Markings shall not overlap and shall be applied in such a manner as not to injure the pipe or couplings. Markings shall be applied within three feet of the connection.

NOTE: *Die stamping is prohibited by API Spec 5CT Group 2 products.*

b. SEQUENCE:

1. API Monogram (API).

2. Specification and process designation, see Section 3, Ex.: 15LT-A for process A.

When applicable the API License number shall be applied in lieu of 15 LT.

3. Date of Manufacture, month and year, ex.: Jan 93 = 1/93

4. Unique manufacturers lot identification number.

Example: Tubulars lined by process A on January 1993 should be marked as follows:

API 15LT-A-1/93-(ID#)

Example: Tubulars lined by a Licensee issued License number 15LT0001 and using process A on January 1993 should be marked as follows:

API 15LT0001-A-1/93-(ID#)

APPENDIX C
REFERENCE STANDARDS

Designation	Title	Applicable Revision
API Spec 5CT	Specification for Casing & Tubing	11/01/92
API Spec 5L	Specification for Line Pipe	5/01/90
API RP 5L7	Recommended Practices for Unprimed Internal Fusion Bonded Epoxy Coating of Line Pipe	6/30/88
ASTM D-1784	Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds	1981
ASTM D-2241	Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-rated Pipe (SDR series)	1987
ASTM D-2855	Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings	1983
ASTM D-792	Specific Gravity and Density of Plastics by Displacement	1966
ASTM D-2152	Test Method for Degree of Fusion of Extruded Poly (Vinyl Chloride) (PVC) Pipe and Molded Fittings by Acetone Immersion	1980
ASTM D-2444	Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by means of a Tup (falling weight)	1984
ASTM D-883	Standard Definitions of Terms Relating to Plastics	1983
NACE TMO170-70	Visual Standard for Surfaces of New Steel Airblast Cleaned with Sand Abrasive	1970

APPENDIX D
METRIC CONVERSIONS

A decimal/inch system is the standard for the dimensions shown in this Specification.

LENGTH

1 inch (in.) = 25.4 millimetres (mm) exactly

PRESSURE

1 pound per square inch (psi) = 0.06894757 Bar

NOTE: 1 Bar = 100 kilopascals (kPa)

STRENGTH OR STRESS

1 pound per square inch (psi) = 0.006894757 Megapascals (MPa)

IMPACT ENERGY

1 foot-pound (ft-lb) = 1.3558181 Joules (J)

TORQUE

1 foot-pound (ft-lb) = 1.3558181 newtron-metres (N m)

TEMPERATURE

The following formula was used to convert degrees Fahrenheit (°F) to degrees Celsius (°C)

$$°C = 5/9 (F-32)$$

MASS

1 pound (lb) = 0.4535924 kilograms (kg)

APPENDIX E
PURCHASER INSPECTION

a. INSPECTION NOTICE. Where the inspector representing the purchaser desires to inspect this pipe or witness quality control tests, reasonable notice shall be given of the time at which the product is to be manufactured.

b. PLANT ACCESS. The inspector representing the purchaser shall have ready access at all times, while work on the contract of the Purchaser is being performed, to all parts of the Manufacturer's facility which will concern the product ordered. The Manufacturer shall afford the Inspector all reasonable and safe facilities to satisfy him that the product is being manufactured in accordance with this specification. All inspections should be made at the place of manufacture prior to shipment, unless otherwise specified on the purchase order, and shall be so conducted as not to interfere unnecessarily with the operation of the facility.

c. ACCEPTANCE. The purchase order may require, if agreed upon by manufacturer and purchaser, that written acceptance be required from purchaser's inspectors for each lot prior to shipment.

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