MATERIAL AND EQUIPMENT STANDARD

FOR

LINE PIPE

0. INTRODUCTION

This Standard gives technical specifications and general requirements for the purchase of steel line pipe for use in Oil, Gas and Petrochemical Industries under non-sour as well as sour conditions and is based on API Spec. 5L, forty-first edition, April 1,1995 and shall be read in conjunction with that document.

It covers the supplementary specifications for seamless line pipe, longitudinal submerged arc welded line pipe and electric welded line pipe in three following Parts:

Part I: Introduction and general information related to this Standard including references, some definitions, abbreviations, some terms and conditions of purchasing and guidance for the use of this Standard.

Part II: Amendments/supplements to API Spec. 5L covering specifications for line pipes used in oil, gas and petrochemical services under non-sour conditions.

Part III: Amendments/supplements to Part II of this Standard to enhance the quality of the line pipes as to make it suitable for use in oil, gas and petrochemical services under sour conditions.

This Standard has been prepared as a necessity to enhance the pipeline integrity according to the requirements of the Oil, Gas and Petrochemical Industries in Iran and for any deviation from its requirements prior approval of the Company shall be obtained.

PART I

INTRODUCTION AND GENERAL INFORMATION

CONTENTS :

PAGE No.

1. SCOPE

This Standard which is based on API Specification 5L, forty-first edition, April 1995, gives minimum technical specifications and other requirements for manufacturing, testing, inspection and marking of seamless, longitudinal submerged arc and high frequency electric welded line pipe for use in oil, gas and petrochemical services under non-sour and sour conditions and shall be read in conjunction with the purchase order and API Spec. 5L as amended and supplemented herein.

All the line pipes supplied shall meet all the related requirements of this Standard (as specified in the purchase order) despite the fact that API Spec. 5L adopts sampling as a method to determine batch compliance.

The following documents will take precedence in order of priority given hereunder:

1) Purchase order.
2) This Standard.
3) API Specification 5L, forty-first edition, April 1995.

2. REFERENCES

Throughout this Standard the following standards and codes are referred to. The editions of these standards and codes that are in effect at the time of publication of this Standard shall, to the extent specified herein, form a part of this Standard. The applicability of changes in standards and codes that occur after the date of this Standard shall be mutually agreed upon by the Company and the Vendor/Consultant/Contractor/ Manufacturer.

API (AMERICAN PETROLEUM INSTITUTE)

API Spec. 5L, 41 st. Edition, April 1995	"Specification for Line Pipe"

Note:

See also Clause 2 of API Spec. 5L.

ASTM (AMERICAN SOCIETY FOR TESTING AND MATERIALS)

ASTM-7	"Definition of Terms Relating to Metallography"
ASTM E-112	"Standard Test Methods for Determining Average Grain Size"
ASTM E-165	"Practice for Liquid Penetrant Examination"
ASTM E-309	"Standard Practice for Eddy Current Examination of Steel Tubular Products Using Magnetic Saturation"
ASTM E-570	"Standard Practice for Flux Leakage Examination of Ferromagnetic Steel Tubular Products"
ASTM E-709	"Practice for Magnetic Particle Examination"
ASTM F-21	"Standard Test Method for Hydrophobic Surface Films by the Atomizer Test (R 1989)"
ASTM A-370	"Test Methods and Definitions for Mechanical Testing of Steel Products"

GERMAN STANDARDS (DIN)

SEL-072	"Ultrasonically Tested Heavy Plates; Technical Delivery Specifications"

INTERNATIONAL STANDARDS

ISO-1027	"Riographic Image Quality Indicator for Non-Destructive Testing"
ISO-2566-1	"Steel, Conversion of Elongation Values Part 1 Carbon and Low Alloy Steels"
ISO-9001	"Quality Systems–Model for Quality Assurance in Design/Development, Production, Installation and Servicing"
ISO-9712	"Non–Destructive Testing; Qualification and Certification of Personnel"
ISO-10474	"Steel and Steel Products, Inspection Documents"

NACE (NATIONAL ASSOCIATION OF CORROSION ENGINEERS)

NACE TMO-177	"Laboratory Testing of Metals for Resistance to Sulphide Stress Cracking in H_2S Environments".

3. DEFINITIONS AND TERMINOLOGY

3.1 General Terms

Executor

The Executor is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project or operation of a facility. The Company may undertake all or part of the duties of the Executor.

Inspector

The Inspector is the representative of the Company or the Purchaser who is entrusted with the inspection of the products during and/or after manufacturing as well as production records, observance of manufacturing operations, witnessing the quality control tests and checking other requirements for compliance with the purchase order and this Standard.

3.2 Specific Terms

Note:

Some of the definitions given in Clause 3 of API Spec. 5L are amended/supplemented in Part I of this Standard.

Minimum operating temperature

The minimum temperature to which the pipeline or part of the pipeline and/or piping system may be exposed during normal operational activities, including start-up and shut-down operations and controlled blowdown, but excluding abnormal situations such as pipeline ruptures.

Pipe bevel

The total preparation machined on the end of a plain-end pipe for field welding (see Clause 7.9.3 of API Spec. 5L).

4. ABBREVIATIONS

Add.	Addition (see Part I Clause 6.2 of this Standard).
AP	Action required by Purchaser (see Part I Clause 6.1 of this Standard).
CE	Carbon equivalent.
Del.	Deletion (see Part I Clause 6.2 of this Standard).
CTOD	Crack tip opening displacement.
DN	Diameter nominal (in mm).
DWTT	Drop weight tear test.
EMT	Electromagnetic testing.
FBH	Flat battomed hole.
FCAW	Flux cored arc welding
GMAW	Gas metal-arc welding.
HAZ	Heat affected zone.
HFI	High frequency induction.
HFW	High frequency welding.
HIC	Hydrogen induced cracking.
Mod.	Modification (see Part I Clause 6.2 of this Standard).
MT	Magnetic particle testing.
NDT	Non-destructive testing.
OD	Outside diameter.
Pcm	Material cracking parameter.
PNS	Pipeline nominal size (in inches)
PT	Liquid penetrant examination.
RDH	Radial drilled hole.
RT	Radiological (or radiographic) testing.
SAW	Submerged arc welding.
SMLS	Seamless.
SS	Sour service (see Part I Clause 6.2 of this Standard).
Sub.	Substitution (see Part I Clause 6.2 of this Standard).
UT	Ultrasonic testing.

5. UNITS

This Standard is based on International System of Units (SI), unless otherwise specified.

5.1 Equivalent Nominal Diameters

Table 1 gives the equivalent nominal diameters in both ISO Units (DN in mm) and Imperial Units (NPS in inches).

TABLE 1 - EQUIVALENT NOMINAL DIAMETERS

DN (mm)	NPS (in)	DN (mm)	NPS (in)	DN (mm)	NPS (in)	DN (mm)	NPS (in)	DN (mm)	NPS (in)
6	1/8	65	2½	350	14	800	32	1300	52
8	1/4	80	3	400	16	850	34	1400	56
10	3/8	90	3½	450	18	900	36	1500	60
15	1/2	100	4	500	20	950	38	1600	64
20	3/4	125	5	550	22	1000	40	1700	68
25	1	150	6	600	24	1050	42	1800	72
32	1¼	200	8	650	26	1100	44	1900	76
40	1½	250	10	700	28	1150	46	2000	80
50	2	300	12	750	30	1200	48		

6. SPECIAL NOTES

6.1 Information to be Supplied by the Company/Purchaser (See Also Clause 4 of Part II of This Standard)

In addition to Clause 4 of API Spec. 5L, there are a number of items within this Standard which require input from the Company/Purchaser. These are identified by an annotation (AP) in the right hand margin of that paragraph, indicating that an action by the Purchaser is required. If, however, at the time of enquiry or in the purchase order the appropriate information is not supplied, the Manufacturer/Supplier/Vendor shall bring the matter to the attention of the Purchaser/Company before giving quotations and finalizing the purchase agreement.

6.2 Guidance for Use of This Standard

The amendments/supplements to API Spec. 5L (1995 Edition) given in Part II of this Standard are directly related to the equivalent sections or clauses in API Spec. 5L and, therefore, for ease of reference and clarity the section and clause or paragraph numbering of API Spec. 5L has been used as far as possible (for any addendum to API Spec. 5L subsequent number or letter to the related clause or paragraph of the same subject section or for any new section has been used).

In Part II of this Standard the following annotations, as defined hereunder, have been used at the bottom right hand side of each clause or paragraph to indicate the type of change made to the equivalent clause or paragraph of API Spec. 5L and shall mean that the same clause number of API Spec. 5L has been amended and/or changed accordingly:

Sub. (Substitution) "The clause in API Spec. 5L shall be deleted and replaced by the new clause in this Standard".

Del. (Deletion) "The clause in API Spec. 5L shall be deleted without any replacement".

Add. (Addition) "The new clause with the new number shall be added to the relevant section of API Spec. 5L".

Mod. (Modification) "Part of the clause or paragraph in API Spec. 5L shall be modified and/or the new description and/or statement shall be added to that clause or paragraph as given in this Standard".

Those clauses or paragraphs in API Spec. 5L that are not changed/amended by this Standard shall remain valid as written.

Part II of this Standard covers general requirements for line pipes used in Oil, Gas and Petrochemical services under non-sour conditions. However, where annotation (SS) appears in the right hand margin of any section, clause or paragraph in Part II of this Standard it indicates that that section, clause or paragraph is amended/supplemented in Part III of this Standard as to make the line pipe suitable for oil and gas services under sour condition. Therefore that section, clause or paragraph shall be amended or supplemented as directed in Part III when the purchase order is for line pipe under sour conditions.

For annotation (AP) refer to Part I Clause 6.1.

PART II

AMENDMENTS/SUPPLEMENTS TO API SPEC. 5L (1995 EDITION):

SPECIFICATION FOR LINE PIPE FOR USE IN OIL, GAS AND PETROCHEMICAL SERVICES UNDER NON-SOUR CONDITIONS

CONTENTS :

PAGE No.

NEW SECTIONS:

APPENDICES:

1. SCOPE

1.1 First Paragraph of This Clause Shall be Replaced by:

This specification covers seamless and welded steel line pipe. It includes standard-weight plain-end, regular-weight plain-end, special plain-end, extra-strong plain-end, and double-extra-strong plain-end pipe. **(Sub.)**

1.2 First Paragraph of This Clause Shall be Deleted **(Del.)**

Second paragraph of this Clause shall be replaced by: Grades covered by this specification are B, X42, X46, X52, X56, X60, X65 and X70. Pipe shall be ordered only to these grades; intermediate grades shall not be used. **(Sub.)**

The "Note" shall be modified to read:

Note:

The grade designations used herein for grades B do not include reference to the specified minimum yield strength (SMYS). Other grade designations used herein comprise the letter × followed by the first two digits of SMYS. (Mod.)

1.3 This Clause Shall be Replaced by:

Higher grade pipe shall not be substituted for pipe ordered to a lower grade without prior approval of the Purchaser, irrespective of strength level. **(Sub.)**

The following new clauses shall be added to this Section:

1.8 Quality Assurance System

The manufacturer shall establish and maintain a quality assurance system in accordance with ISO 9001, or an approved equivalent. The Purchaser's nominated inspector(s) or representative(s) shall have the right to undertake such audits as he deems necessary to assess the effectiveness of the manufacturer's quality assurance system. **(Add.)**

1.9 Compliance

Although sampling may be adopted to determine batch compliance, nevertheless the manufacturer is responsible to ensure and certify that all pipes meet the requirements of this Standard. **(Add.)**

4. INFORMATION TO BE SUPPLIED BY THE PURCHASER

The following clause shall be added to this Section (see also Part I Clause 6.1).

4.4 Additional information to be supplied by the Purchaser to the manufacturer at the time of order are:

I) Minimum design temperature (Refer to Part II Clause 6.2.6 and Appendix F, SR 5.1).
II) Pipeline category (offshore or onshore) for length requirement (Part II Clause 7.5).
III) The requirements for testing in the simulated heat treated condition (Part II Clause 9.3.1.1).
IV) The requirement for color code or marking to identify pipe mill and wall thickness (Part II Clause 11.1).
V) The requirement for bevel protectors (Part II Clause 11.3).
VI) The requirements for pre-production welding procedure qualifications (Part II Clause 13.2 and 13.2.9)).
VII) Higher absorbed energy requirements for Charpy test (Appendix F- SR 5 B.3).
VIII) The requirements for DWTT (Part II-Clause 14.4.4 and Appendix F, SR 6).
IX) Purchaser inspection, if required and to what extent (Appendix H).
X) Suitability of Line pipe for sour conditions (Part III).

5. PROCESS OF MANUFACTURE AND MATERIAL

5.1 Process of Manufacture

5.1.1 Seamless process

The following sentence shall be at the end of the paragraph:

Cold sizing and straightening are only permitted if the total strain in the seamless pipe does not exceed 3.0%.**(Mod.)**

5.1.2.1.1 Continuous welding

The following sentence shall be added to the existing clause:

Manufacturing pipe by this process is not acceptable. **(Mod.)**

5.1.2.1.2 Electric welding

The following sentence shall be added to the existing clause:

Only the high frequency electric welding process, having a minimum frequency of 150 KHz, shall be used. **(Mod.)**

5.1.2.2.2 Gas metal-arc welding

The following sentence shall be added to the existing clause:

This process is only acceptable for tack welding pipes which will subsequently be welded by the SAW process defined in 5.1.2.2.1. **(Mod.)**

5.1.3.2 Continuous welded pipe

The existing clause shall be deleted and replaced by the following:

Pipe manufactured by this process is unacceptable. **(Sub.)**

5.1.3.3 Electric welded pipe

The following sentences shall be added to the existing clause:

Only HFW pipe made from hot rolled coil is acceptable. A normalizing heat treatment of the weld and heat affected zone shall always be carried out, irrespective of grade and chemical composition. Full body normalizing is also acceptable. **(Mod.)**

5.1.3.4 Longitudinal seam submerged-arc welded pipe

The following paragraph shall be added to the existing clause:

The full length of the weld seam shall be made by automatic submerged arc welding, using run-on and run-off tabs. The welding procedure shall be approved by the Purchaser. Welding shall be checked at regular intervals to ensure that current, voltage and travel speed remain within the ranges of the approved welding procedure. **(Mod.)**

5.1.3.5 Gas metal-arc welded pipe

The following sentence shall be added to the existing clause:

This type of pipe is unacceptable. **(Mod.)**

5.1.3.6 Combination GMAW and SAW pipe

The following sentence shall be added to the existing clause:

GMAW is only acceptable for making a continuous tack weld in SAW pipe which is then considered as SAW pipe. **(Mod.)**

5.1.3.7 Double seam SAW pipe

The following sentence shall be added to the existing clause:

This type of pipe is unacceptable, unless specifically ordered by the Purchaser. **(Mod.)**

5.1.3.8 Double seam GMAW pipe

The following sentence shall be added to the existing clause:

This type of pipe is unacceptable. **(Mod.)**

5.1.3.9 Double seam combination GMAW and SAW pipe

The following sentence shall be added to the existing clause:

This type of pipe is unacceptable, unless specifically ordered by the Purchaser, in which case the conditions of Par. 5.1.3.6 shall hold.

5.1.3.10 Helical seam SAW pipe (SPW pipe)

The following sentence shall be added to the existing clause:

This type of pipe is unacceptable. **(Mod.)**

5.1.4.1 Electric weld

The following sentence shall be added to the existing clause:

High frequency welding process with minimum of 150 KHz shall be used. **(Mod.)**

5.1.4.4 Skelp end weld

The following sentence shall be added to the existing clause:

Skelp end weld is not acceptable. **(Mod.)**

5.1.4.5 Jointer weld

The following sentence shall be added to the existing clause:

Jointers shall not be supplied. **(Mod.)**

5.1.4.6 Tack weld

The second sentence of this clause shall be replaced by the following sentence (first and third sentences remain):

Tack welds shall be made in accordance with a qualified tack welding procedure using automatic SAW, GMAW, gas shielded FCAW, or shielded metal arc welding using low hydrogen electrodes from which the diffusible hydrogen content of the resulting weldment shall not exceed 10 m1/100g of deposited metal. **(Mod.)**

5.2 Cold Expansion

The existing section shall be deleted and replaced with the following:

SAW pipe shall be mechanically cold expanded between a minimum of 0.8% and a maximum of 1.5%. Suitable means shall be provided to protect the weld from contact with the internal expander during mechanical expansion. Non-expanded SAW pipe shall not be supplied unless explicitly stated on the purchase order together with any supplementary test requirements.

For cold sizing of SMLS pipe refer to Clause 5.1.1. of this Standard.

HFW pipe shall not be cold expanded. **(Sub.)**

5.3 Material

The existing clause shall be deleted and replaced with the following:

The steel shall be made in a basic oxygen or electric arc furnace and shall be fully killed and fine grained with a grain size of ASTM E-7 or finer, as defined in ASTM E-112.

For quenched and tempered pipe, this grain size requirement shall not apply. **(Sub.) (SS)**

5.4 Heat Treatment

The existing clause shall be deleted and replaced by the following:

The heat treating process shall be performed in accordance with a documented procedure.

SMLS pipe shall be furnished in the hot formed, normalized, normalized and tempered or quenched and tempered condition.

For hot formed pipe, the finishing temperature shall be greater than 780°C. Pipe finished at a lower temperature than 780°C shall be subjected to a further normalizing heat treatment, with a minimum holding time of 30 minutes.

SWA pipe shall be furnished in the as-rolled, normalized, controlled rolled, controlled rolled plus accelerated cooled, or quenched and tempered condition.

HFW pipe shall be furnished from hot-rolled coil and the entire weld plus HAZ shall be normalised. Alternatively the pipe may be full body normalized, normalized and tempered or quenched and tempered.

Details of heat treatment shall be agreed with the Purchaser prior to the start of production (see Section 13 of this Standard). **(Sub.)**

5.5 Skelp End Weld - Helical Seam Pipe

The following sentence shall be added to this Clause:

Skelp end weld and helical seam pipe are not acceptable.

5.7 Preparation of Edges for Welding

The edges of the plates or strip to be welded shall be profiled by machining and at least 10 mm or 1.5 times the wall thickness, whichever is greater shall be removed from each side of the plate or strip either by machining or shearing. The abutting edges of the plate or strip shall be so aligned for welding that any local offset does not exceed 1.5 mm and adequate provision shall be made to ensure that the alignment is maintained during the progress of the welding operation and that any root gap is controlled within limits approved in the procedure test. All surfaces to be welded shall be thoroughly cleaned of scale, oil and other foreign matter before welding is started. The weld shall be of uniform width and profile and shall merge smoothly into the surface of the strip without appreciable deviation from the line of the joint. The forming procedure must ensure that there is a minimum of peaking and this shall be demonstrated in the procedure test to be within the acceptable limits defined in Par. 7.8.12 of this Standard.

5.8 Manufacturing Procedure Qualification

The manufacturing procedure shall be recorded and qualified in accordance with Section 13 of this Standard. The procedure qualification tests shall be witnessed by the Purchaser. The Purchaser may at his discretion, accept the results of previously authenticated tests. The Purchaser shall reserve the right to require requalification in the case of a change in the procedure specification.

6. MATERIAL REQUIREMENTS

6.1.1 Chemical composition

The existing section shall be detected and replaced with the following:

For each enquiry/order the manufacturer shall propose a chemical composition for the pipe to be supplied. The composition shall be contained in the manufacturing procedure specification and, as determined by product analysis, shall comply with the maximum allowable limits specified in Table 2 given hereunder. The limitations on heat and product analysis shall be those agreed following acceptance of the manufacturing procedure specification (see Clause 6.1.3 of this Standard). **(Sub.)**

Table 2 shall be deleted and replaced with the following:

TABLE 2 - CHEMICAL REQUIREMENTS FOR PRODUCT ANALYSIS BY PERCENTAGE OF WEIGH

ELEMENT	MAXIMUM PERMITTED ALLOY CONTENT, wt%			MAXIMUM VARIATION ON AGREED COMPOSITION (SEE 6.7.3)	NOTES
	SAW	SMLS	HFW		
C	0.16	0.16	0.16	0.03	
Mn	1.60	1.60	1.60	0.30	
Si	0.40	0.40	0.40	0.25	
P	0.025	0.025	0.025		
S	0.01	0.01	0.005		
V	0.08	0.08	0.08	0.02	1
Nb	0.05	0.05	0.05	0.02	1
Ti	0.04	0.04	0.04	0.02	1
Cr	0.20	0.20	0.20	0.05	2
Mo	0.10	0.25	0.25	0.05	2
Ni	0.30	0.30	0.30	0.10	2
Cu	0.25	0.25	0.25	0.10	2
Al	0.05	0.06	0.06		3
N	0.012	0.012	0.012		3
B	0.0005	0.0005	0.0005		
Ca	0.006	0.006	0.006		
CE	0.40	0.41	0.40		4
Pcm	0.21	0.22	0.21		5

Notes:

1) V+ Nb + Ti shall not exceed 0.12%.

2) Cr + Mo + Ni + Cu shall not exceed 0.6%.

3) The total Al: N ratio shall not be less than 2:1.

4) $$CE = C + \frac{Mn}{6} + \frac{(Cr + Mo + v)}{5} + \frac{(Ni + Cu)}{15}$$

5) $$Pcm = c + \frac{Si}{30} + \frac{(Mn + Cu + Cr)}{20} + \frac{Ni}{60} + \frac{Mo}{15} + \frac{V}{10} + 5B$$ **(Sub.) (SS)**

6.1.2 Elements analyzed

The existing clause shall be deleted and replaced with the following:

For Grade B pipe only C, Mn, Si, S and P levels shall be determined. For higher grades, analysis for all elements in Table 2 shall be performed. **(Sub.)**

6.1.3 Product analysis variation

The existing clause shall be deleted and replaced with the following:

The manufacturer shall propose a nominal product analysis in the manufacturing specification. The range of acceptable variations in the product analysis is given in Table 2 (in this Standard).

This shall be applied to the chemical composition proposed by the manufacturer in the manufacturing specification. The maximum variation on agreed composition is allowed provided that the final maximum alloy content given in Table 2 is not exceeded. **(Sub.)**

6.2 Mechanical Properties

6.2.1 Tensile properties

The existing clause shall be deleted and replaced with the following (Table 3 remains):

Grades B, × 42, × 46, × 52, × 56, × 60, × 65 and × 70 shall conform to the tensile requirements specified in Table 3. For all pipes, the ratio of body yield strength to body ultimate tensile strength shall not exceed 0.90 when tested using flattened bar tensile specimen and shall not exceed 0.93 when tested using round bar and non-flattened rectangular specimen.

For steel grades × 46 and higher the measured yield strength shall not exceed the minimum values given in column 2 of Table 3 by more than 150 MPa.

The yield strength shall be the tensile stress required to produce a total elongation of 0.5% of the gage length as determined by an extensometer. When elongation is recorded or reported, the record or report shall show the nominal width of the test specimen when strip specimens are used and the diameter and gage length when round bar specimens are used, or shall state when full section specimens are used.

The required minimum tensile elongation shall be determined according to the formula given in footnote 1 of Table 3 but shall be not less than 20%. **(Sub. except for Table 3)**

6.2.2 Flattening test acceptance criteria

The existing clause shall be deleted and replaced with the following:

No cracks or breaks shall occur in either weld or parent metal during flattening of the test specimen to 50% of its original OD. The specimen shall be further flattened to 1/3 of original OD without cracks or breaks other than in the weld. **(Sub.)**

6.2.6 Fracture toughness tests

The existing clause shall be deleted and replaced with the following:

For all pipes, Charpy v-notch tests shall be performed on each test ring taken for tensile testing and tested in accordance with Appendix F Section, SR 5. Evidence shall be required to show that the notch ductility of the pipe is adequate for service conditions.

If stress relieving is required for field welds, Charpy testing is also required in the simulated stress relieved condition. The Purchaser/Company shall inform the manufacturer at the time of enquiry/order of the need for testing in the stress relieved condition. **(AP)**

For gas transmission lines with a pipe diameter of DN 400 (NPS 16) or greater, DWTTs shall be carried out on one pipe from each heat of steel in accordance with the requirements of Appendix F, section SR 6. **(Sub.) (AP)**

6.2.7 Metallographic examination

The existing clause shall be deleted and replaced by the following:

Specimens for metallographic examination shall be extracted from HFW pipe such that the weld, complete heat treated zone and parent material on both sides of the weld are visible over the full wall thickness. A minimum of 3 specimens shall be microscopically examined from one pipe in each heat, or after each break in production, whichever is the more frequent. The examination shall determine the adequacy of microstructure and heat treatment. **(Sub.)**

The following new clauses shall be added to this Section:

6.2.8 Hardness testing

Hardness testing shall be performed in accordance with Section 14.5 of this Standard. The hardness of weld, HAZ and base material shall not exceed 325 HV10. **(Add.) (SS)**

6.2.9 Preparation of samples

Samples removed for the determination of tensile, toughness or microstructural properties shall be prepared by machining. Where thermal cutting has been used to remove pipe coupons from which test specimens are prepared, the full extent of the heat affected region shall be removed during machining of the specimen. (See also 9.2.2.2). **(Add.)**

7. DIMENSIONS, WEIGHTS, LENGTHS, DEFECTS AND END FINISHES

7.2 Diameter

The existing clause shall be deleted and replaced with the following:

The outside diameter of the pipe body, as measured by taping the circumference, shall not deviate from the value given in Tables E-1A, E-1B and E-1C of Appendix E by more than the tolerances given below:

SIZE DESIGNATION			TOLERANCE
< DN 60	(NPS 2 $^{3}/_{8}$)		+0.4, -0.8 mm.
≥ DN 60 and ≤ DN 400	(NPS 2 $^{3}/_{8}$)	(NPS 16)	±0.75% OD
≥ DN 400	(NPS 16)		±3 mm.

For a length of 100 mm from each pipe end, the average internal diameter shall not deviate from the nominal internal diameter by more than the tolerances given below:

SIZE DESIGNATION	TYPE OF PIPE	MINUS TOLERANCE mm.	PLUS TOLERANCE mm.
≤ DN 250 (NPS 10)	Welded	0.5	1.5
	SMLS	1.0	2.0
DN 250 (NPS 10) and ≤ DN 500 (NPS 20)	Welded	1.0	1.5
	SMLS	1.5	2.0
> DN 500 (NPS 20)	Welded	1.5	1.5
	SMLS	2.0	2.0

Notes:

1) The nominal internal diameter is defined as the outside diameter D (given in Metric Tables E-1A, E-1B and E-1C of Appendix E) minus twice the nominal wall thickness.

2) The internal diameter shall be measured using an internal gage or a measuring tape inside the pipe. The method and equipment shall be approved by the Purchaser/Company. For pipe of DN 200 (NPS 8) and smaller, the internal diameter may be calculated by measuring the outside diameter with a circumference tape and subtracting twice the actual wall thickness from this value.

3) The end of each pipe shall be tested for out-of-roundness using an internal ring gage of diameter 5.0 mm less than the nominal internal diameter. The gage shall pass freely into each end of the pipe through 100 mm distance when held normal to the pipe axis.

4) On welded expanded pipe, the internal diameter of one end of the pipe shall not differ by more than 2 mm from that of the other end.

Any pipe found to be out of tolerance shall be the cause for individual diameter measurement of all pipe back to the last, and up to the next, two sequential pipes measured and found to be within tolerance. **(Sub.)**

7.3 Wall Thickness

The existing clause shall be deleted and replaced with the following:

For all sizes and grades of welded pipe, the wall thickness at any place in the pipe measured during inspection shall not deviate from the nominal wall thickness by more than the tolerances specified in the following Table (except that the weld area shall not be limited by the plus tolerance):

WALL THICKNESS, t (mm)	TOLERANCE	
	Minus	Plus
$t \leq 7$	0.35 mm	10%
$7 < t \leq 10$	5%	10%
$t > 10$	0.5 mm	10%

For all sizes and grades of seamless pipe, the wall thickness at any point shall not deviate from the nominal thickness by more than + 15% or -10%. **(Sub.)**

7.5 Length

The existing clause shall be deleted and replaced with the following:Unless otherwise indicated in the purchase order, pipe shall be supplied in the following lengths:

Onshore lines:

The average length of pipes in one order shall be not less than 11.6 m with a minimum of 95% of pipes between 11 and 12.2 m in length.

No pipe shall be less than 10 m in length.

No pipe shall be greater than 12.8 m in length.

Offshore lines:

The average length of pipes in one order shall be not less than 12.2 m with a minimum of 95% of pipes between 11.9 and 12.5 m in length.

No Pipe shall be less than 11.6 m in length.

No pipe shall be greater than 12.8 m in length.

Note:

For heavy wall seamless pipe, where supply of the pipe lengths stated above may not be possible, the Purchaser and the Manufacturer shall agree on an alternative pipe length. (Sub.) (AP)

7.6 Straightness

The second part of the second sentence shall be amended as follows (other parts remain unchanged):

Deviation from a straight line shall not exceed 0.15 percent of the length. **(Mod.)**

7.7 Jointers

The existing Clause shall be deleted and replaced with the following:

Jointers shall not be supplied. (See also Clause 5.1.4.5 of this Standard). **(Sub.)**

7.8 Workmanship and Defects

7.8.1 Dents

The last sentence of existing clause shall be deleted and replaced with the following:

All cold formed dents with a sharp bottom gouge and all sharp gouges (without dents) deeper than 1.0 mm shall be considered defects requiring rectification or rejection. **(Mod.)**

7.8.2 Offset of plate edges

The existing clause shall be deleted and replaced with the following:

The radial offset of plate edges (misalignment) for pipe with a nominal wall thickness of 10 mm or less shall be no more than 1.0 mm for SAW pipe and 0.5 mm for HFW pipe. For pipe with a nominal wall thickness greater than 10 mm, the maximum allowable radial offset shall be 1.6 mm for SAW pipe and 5% of the nominal wall thickness for HFW pipe. **(Sub.)**

7.8.4 Height of outside and inside weld beads - SAW

The following paragraph shall be added to the existing clause:

At pipe ends and other areas which are radiographed, the reinforcement of both inside and outside bead shall allow radiographic sensitivity requirements of Section 9.7.3 to be met. **(Mod.)**

7.8.5 Height of flash of HFW pipe

The second paragraph of the existing clause shall be deleted and replaced with the following:

The inside flash of HFW pipe shall not extend above the prolongation of the original inside surface by more than (0.5 mm + 5% of nominal wall thickness). **(Mod.)**

7.8.6 Trim of inside flash of HFW pipe

The following phrase shall be added at the end of the first sentence:

Provided that the remaining wall thickness is not less than that allowed in Clause 7.3 of this Standard.

7.8.7 Hard spots (see part III of this standard) (Mod.) (SS)

7.8.12 Other defects

The following Clause shall be added to this Section:

Local irregularities of SWA pipe welds:

The ends of each SAW pipe and two positions along the length shall be checked for out-of-roundness at the position of the longitudinal weld. Templates with a minimum chord length of 75% of the pipe internal diameter shall be used for measurement of local irregularity in profile. For pipes of DN 400 and above, a template of 300 mm minimum chord length shall be used. The template profile shall have a radius equal to the nominal radius of the pipe outer or inner circumference for measurement of the outer or inner surface, respectively. The nominal inner radius shall be taken as the nominal outer radius minus twice the nominal wall thickness.

The template gaging surface shall have an appropriate cut-out to accommodate the weld bead of the pipe. The cut-out shall be at the center of the gaging surface and shall have a width of less than the weld bead width plus 5 mm. Any local irregularity shall be measured by a calibrated taper gage inserted in any gap between the template and the pipe surface. The local irregularity shall not exceed 1.5 mm. **(Mod.)**

In addition, the outside weld bead shall not extend above the prolongation of the original outside surface profile more than 3.2 mm.

7.9 Pipe Ends

7.9.3 Plain ends

The following sentences shall be added to this Clause:

The entire end bevel shall be machined with special care exercised to keep the root face as close to 1.6 mm as possible; i.e. with minimum use of ±0.8 mm tolerance. If , however, the root face is less than 0.8 mm or more than 2.4 mm it shall not be brought into tolerance by filing or grinding; The entire bevel shall be remachined.

For wall thickness greater than 21 mm the ends shall be beveled as shown in Fig. A. **(Mod.)**

9. INSPECTION AND TESTING

9.1 Test Equipment

The following paragraphs shall be added to this Clause:

Measuring equipment for inspection and testing shall be selected such that it has a resolution and accuracy at least five times finer than the tolerance of the parameter being measured. Similarly, standards against which a piece of equipment is calibrated shall be at least five times as accurate as the equipment being calibrated.

Only measuring equipment which can be demonstrated to have been previously calibrated satisfactorily and still be within its documented calibration period or interval shall be used for inspection and testing. **(Mod.)**

9.2 Testing of Chemical Composition

9.2.2 Product analysis

9.2.2.2 Sampling methods

The following paragraph shall be added to this Clause:

Samples may be taken using any of the methods indicated in API Spec. 5L provided that they are taken from finished pipe. In this instance, finished pipe shall mean the pipe which has been formed and welded (if applicable) but before trimming to final pipe lengths. **(Mod.)**

9.3 Testing of Mechanical Properties

9.3.1 Tensile tests

9.3.1.1 Tensile testing specimens

The existing Clause shall be deleted and replaced with the following (Except Figs. 3 and 4 which remain):

Tensile properties shall be determined from specimens removed from pipe which has been subjected to all mechanical and heat treatment operations. Where stress relieving of pipe is required to be performed, e.g. after field welding, additional tensile testing of parent metal and weldments shall be performed on stress relieved specimens. The Purchaser shall specify on the purchase order if this requirement applies (see also Clause 4 in Part II and Clause 6.1 in Part I of this Standard). **(AP)**

The testing procedure shall be in accordance with ASTM A 370 (see API Spec. 5L, Clause 9.8.1.1). Tensile test specimen orientation shall be as shown in Fig. 3. **(Sub.)**

9.3.1.2 Tensile testing frequency

The existing clause shall be deleted and replaced with the following:

Tensile tests shall be performed on samples taken from two pipes per heat. For heats less than 100 tones, tests on only one pipe shall be required. **(Sub.)**

9.3.1.3 Longitudinal tensile tests

The existing clause shall be deleted and replaced with the following:

Longitudinal tensile test specimens shall be either non-flattened rectangular or round bar specimens. **(Sub.)**

9.3.1.4 Transverse tensile tests

The existing section shall be deleted and replaced with the following:

Transverse tensile properties shall be determined on flattened rectangular specimens. The ring expansion method shall only be applied after specific approval of the Purchaser/Company has been obtained. **(Sub.)**

9.3.1.5 Weld tensile tests

The following sentences shall be added to the existing section and hence the second sentence shall be deleted from the existing section:

Weld tensile specimens shall be taken from the same part of the pipe used for preparing parent metal tensile specimens. The weld reinforcements shall be removed before tensile testing. **(Mod.)**

9.4 Hydrostatic Tests

9.4.1 Hydrostatic test requirements

The existing section shall be deleted and replaced with the following:

Each length of pipe shall withstand, without leakage, an inspection hydrostatic test to at least the pressure specified in 9.4.3. Hydrostatic testing shall be performed after cold expansion. The test pressure for all sizes and types of pipe shall be held for not less than 10 Seconds. **(Sub.)**

9.4.3 Test pressure

The existing section shall be deleted and replaced with the following:

The test pressure for all types and sizes of pipe shall be such that the hoop stress, calculated on the basis of the minimum specified wall thickness and including stresses from end loading, is at least 95% of the Specified Minimum Yield Strength (SMYS).

If applied, the end load compensation factor as determined by the formula given in Appendix E Section SR14 of API Spec. 5L shall be used. **(Sub.)**

9.5 Dimensional Testing

This Section shall be also subject to the requirements of Section 9.1 (Test Equipment) of this Standard. **(Mod.)**

9.6 Visual Inspection

The existing Clause shall be deleted and replaced with the following:

The full body and welds (if applicable) of every pipe shall be examined, internally and externally, for surface defects. For internal examination of pipe DN 600 (NPS 24) and larger, the inspector shall pass through the bore of the pipe. Adequate illumination shall be provided to enable proper inspection. **(Sub.)**

9.7 Non-Destructive Inspection

9.7.1 Purchaser inspection

The existing Clause shall be deleted and replaced with the following:

The requirements of Appendix H of API Spec. 5L shall apply. **(Sub.)**

9.7.2 Methods of Inspection

The existing section (including its sub-sections) shall be deleted and replaced with the following:

All personnel performing NDT activities shall be qualified in the technique applied, in accordance with ISO 9712 or equivalent.

For UT, at least one level III qualified inspector shall be available to the mill (on call) for overall supervision.

A level II inspector is required for shift supervision, manual weld inspection and calibration of all systems (both manual and automated).

A level I inspector is acceptable for all other NDT methods. A level II inspector is acceptable for supervision of all other NDT methods.

All NDT shall be performed in accordance with written procedures. These procedures shall have the prior approval of the Purchaser/Company.

NDT for acceptance of the pipe (final inspection) shall take place after all heat treating and expansion operations and, for welded pipe, after hydrostatic testing of the pipe. It may, however, take place before cropping, beveling and end sizing.

9.7.2.1 Submerged arc welds shall be inspected over their entire length, for both longitudinal and transverse defects, using ultrasonic examination in accordance with 9.7.4.1 through 9.7.4.4. In addition, each end of the weld seam shall be examined radiographically for a distance of at least 230 mm in accordance with 9.7.3.1 through 9.7.3.12.

9.7.2.2 HFW pipe welds shall be examined for longitudinal defects over their entire length by ultrasonic methods in accordance with 9.7.4.1 through 9.7.4.12.

9.7.2.3 Lamination detection

Each plate or strip rolled shall be ultrasonically tested for laminations using an oscillating scanning pattern. The scanning coverage using this technique shall be a minimum of 12.5%.

Alternatively, the scanning shall be executed along straight, evenly distributed parallel lines with a scanning coverage of at least 25%. Coil for HFW pipe may be tested after welding of the longitudinal seam by rotary ultrasonic testing of the pipe body. The coverage in this case shall be 100%.

In addition, the longitudinal edges of a plate or coiled strip shall be 100% ultrasonically tested, over a width of at least 25 mm from the trimmed plate/coil edge. This may be performed either before or after pipe forming. For HFW pipe subjected to 100% rotary ultrasonic testing of the pipe body, strip edge testing is not required.

9.7.2.4 Seamless pipe

Ultrasonic lamination testing of each seamless pipe body shall be performed using a helical pattern with at least 25% scanning coverage of the pipe surface.

Ultrasonic thickness testing of the pipe body and ends of seamless pipe shall be performed by scanning along a helical or straight pattern in such a way that at least 10% of the pipe surface is covered.

The body and ends of all seamless pipes shall be 100% ultrasonically tested for inside and outside surface defects as well as transverse, longitudinal and inclined embedded defects.

EMT may be applied for nominal wall thicknesses less than 6 mm.

9.7.2.5 Pipe ends

After beveling, the complete circumference of the pipe end shall be tested ultrasonically from the inside for laminations covering a width which includes the entire bevel. Alternatively the pipe may be tested from the outside prior to beveling, in which case a band of at least 25 mm wide, to include the eventual beveled area, shall be tested.

If UT has not been performed from the outside before beveling and if UT from the inside is not feasible due to dimensional limitations, then MT or PT shall be applied to the bevel face in accordance with 9.7.5.1 through 9.7.5.4. Defects visible to the naked eye such as laps, cracks or laminations shall not be permitted. (Sub.)

9.7.3 Radiographical inspection

9.7.3.1 Radiographical inspection equipment

The existing section shall be deleted and replaced by the following:

The radiographic examination shall be executed with X-ray equipment using fine-grain type film (e.g. Gevaert Type D7 or equivalent) and lead intensifying screens.

For acceptance of the radiographic films, the technique used shall result in a sensitivity better than 2% of the thickness of the weld metal and in a relative film density of 2.0 to 3.5 in the weld metal.

The Manufacturer shall record on a review form accompanying the radiograph or within the mill computer system, the interpretation of each radiograph and disposition of the pipe inspected. **(Sub.)**

9.7.3.2 Fluoroscopic operator qualification

This Clause shall be deleted. **(Del.)**

9.7.3.3 Operator certification

This Clause shall be deleted. **(Del.)**

9.7.3.4 NDT reference standards

The existing Clause shall be deleted and replaced with the following:

The penetrameter used shall be of the wire type in accordance with ISO 1027. The selection of penetrameter wire diameters shall be based on a sensitivity of 2% of weld metal thickness. **(Sub.)**

9.7.3.5 API standard penetrameter

This Clause shall be deleted. **(Del.)**

9.7.3.8 Procedure for evaluating in-motion operation of a fluoroscope

This Clause shall be deleted. **(Del.)**

9.7.3.10 Imperfections observed during radiographical inspection

The following Clause shall be added to the existing Clause:

In addition to the acceptance limits shown in Tables 18 and 19 and Figures 7 and 8, the following limits shall be deemed unacceptable if exceeded:

1) Any total area of porosity projected radially through the weld equal to 6.5 Sq. mm (or equivalent to three 1.5 mm in diameter) in any 645 Sq. mm of projected weld area.

2) Any single slag inclusion with a length of 3 mm or a total cumulative length of slag inclusion equal to 6.3 mm in any 150 mm length of the weld. A slag inclusion of 1.6 mm in width.

The stringiest of all specified limits shall prevail. **(Mod.)**

9.7.4 Ultrasonic and electromagnetic inspection

9.7.4.1 Equipment

The existing clause shall be deleted and replaced with the following:

9.7.4.1.a Ultrasonic equipment

The automatic ultrasonic equipment shall incorporate:

1) A device which monitors the effectiveness of the coupling.

In case where a zero degree compression wave probe is used to monitor coupling, or where a through transmission technique is used for seamless or HFW pipe, loss of coupling exists when the sensitivity (echo height) decreases by more than 10 dB relative to the static calibration.

In case where a through transmission technique through the weld seam is used for SAW line pipe, loss of coupling exists when the signal drops below the electronic noise level plus 10 dB at the position of the through transmission signal.

A clear acoustic warning system and an automatic paint spray system (or equivalent) shall be activated when loss of coupling occurs.

2) An automatic paint-spraying device or equivalent system, which is activated when the received ultrasonic echo exceeds the preset acceptance limit. This alarm shall operate without any interference of the ultrasonic operator and shall be applied within 25 mm advancement past the detected defect. The reset time of the alarm system, after detection of a defect, to be again available for detection, shall be shorter than the time needed for 25 mm advancement in the scanning direction.

3) An automatic weld tracking system for correct positioning of the crystal's/probes with respect to the weld center of all welded pipes.

Entrance angles of shear wave probes shall be as follows:

Seamless pipe	:	45 (40-48) degrees
HFW pipe	:	45 (40-48) degrees
SAW pipe - longitudinal defect detection	:	50-70 degrees
SAW pipe-transverse defect detection	:	45 (40-48) degrees (on weld bead)
	:	50-70 degrees (X or K transmission)

Lamination testing may be performed in pulse echo or transmission mode. If pulse echo mode is employed for detecting lamination in plates or strips, the probe shall be applied on the side of the plate or strip which will eventually be on the inside of the finished pipe. Wall thickness measurement should be done only in pulse echo mode. The probe(s) used for wall thickness/lamination checks should satisfy the following requirements:

- Twin crystal probes: The focal length should be 50% of the wall thickness.

- Single crystal probes in pulse echo mode: The near surface resolution should be better than 25% of the wall thickness, measured at the primary reference sensitivity level.

The transducer arrangement shall be such that sound intensity in both the longitudinal and circumferential directions does not decrease by more than 3 dB at any point in the pipe wall, referred to the maximum sound intensity adjusted in the static calibration.

The equipment shall be checked with an applicable reference standard (test piece) as described in Figs. B and C in Section 9.7.4.2 at every four hours and at the beginning and end of a batch in order to demonstrate the effectiveness of the inspection procedures and the correct functioning of the equipment.

In case discrepancies of more than 3 dB occur, then all pipes, plates or strips inspected since the previous check shall be reinspected. Proper functioning of the UT equipment and the linearity of the electronic instrumentation shall be checked once every six months or when a change is made to the equipment.

From each pipe under test, an automatic "on-line" record shall be made without operator intervention. For every pipe, a summary record shall be made showing pipe identification number, time and examination results, including re-examinations.

If parts of the finished pipe ends are not covered by an automatic UT system (untested area), manual ultrasonics shall be carried out using approved procedures for manual ultrasonic examination based on the requirements given above.

The complete circumference of seamless pipe ends or rotary tested HFW pipe ends, shall be tested manually over the length of the untested area plus 25 mm overlap of the automatically tested area.

9.7.4.1.b Electromagnetic equipment

If permitted by the Purchaser, EMT methods such as Eddy current testing or magnetic flux leakage testing may be applied for surface defect detection in seamless pipe.

EMT shall be performed in accordance with ASTM E570. Testing shall be performed by automatic equipment over the entire surface of the pipe.

If parts of the finished pipe ends are not covered by an automatic EMT system (untested area), then manual ultrasonic examination based on the requirements given above shall be performed. The complete circumference of the pipe ends shall be tested by manual UT, over the length of the untested area plus 25 mm overlap of the automatically tested area. **(Sub.)**

9.7.4.2 NDT reference standards

The existing clause shall be deleted and replaced with the following:

The reference (calibration) standard shall have the same specified diameter and thickness as the product being inspected and shall be of sufficient length to permit calibration of ultrasonic inspection equipment at the speed to be used in production. The reference standard shall also be of the same material type and have the same surface finish and heat treatment as the product to be inspected. It shall be free from discontinuities or other conditions giving indications that may interfere with detection of the reference reflectors.

The reference standard shall contain machined notches (N5 or N10) or radially drilled holes (3.2 mm) as shown in Fig. 9, and/or flat bottomed holes. The type and location of the notches and drilled holes in the reference standard for welded pipe, shall be in accordance with Figs. B and C (see page 60 of this Standard).

The manufacturer may use a type of reference reflector not specified above, provided he can demonstrate to the Purchaser that the examination is at least as sensitive as prescribed in this Standard. In such cases the Manufacturer shall obtain the approval of the Purchaser.

The primary reference sensitivity level shall be adjusted on the following reference reflectors:

TYPE OF EXAMINATION	TYPE OF PIPE		
	SMLS	SAW	HFW
Lamination detection	FBH 6.3 mm	FBH 6.3 mm	FBH 6.3 mm
Surface defect detection	Notch N5		
Defect detection (body and pipe ends)	Notch N5		
Defect detection (weld)		RDH 3.2 mm	Notch N10
Defect detection (plate and axial defect)		Notch N5	

For all reference reflectors, except for RDH 3.2 mm, the acceptance limit signal shall be equal to the primary sensitivity level, i.e. equal to the height of the signal produced by the reference reflector. For the RDH 3.2 mm reference reflector, the acceptance limit signal shall be 10 dB below the primary reference sensitivity level.

All sensitivity adjustments shall be carried out dynamically.

Flat bottomed holes for lamination detection shall be drilled to the midwall position. **(Sub.)**

9.7.4.3 Acceptance limits

The existing section shall be deleted and replaced with the following:

For all examination types, indications exceeding the acceptance limit signals are unacceptable.

For lamination detection in plate/coil, seamless pipe body and pipe ends, the acceptance limits shall be based on the lamination size and frequency and be in accordance with classification of SEL-072 (German Standards DIN), as described below:

LOCATION	SEL-072 LAMINATION ACCEPTANCE LEVELS
Plate/coil body	Table 1 Class 3
Plate/coil edges	Table 2 Class 1
Seamless pipe body	Table 1 Class 3

9.7.5 Magnetic particle inspection **(Sub.)**

9.7.5.1 Equipment

The following sentences shall be added to the existing clause:

MT shall be performed in accordance with the requirement of ASTM E-709.

Prior to the inspection, the surface to be examined and all adjacent areas within 25 mm shall be dry and free of all dirt, grease, lint, scale, welding flux and spatter, oil or other extraneous matter that could interfere with the examination. **(Mod.)**

9.7.5.4 Disposition of defects

9.7.5.4.a

The following paragraph shall be added to the existing clause:

In all cases where grinding repairs are made as a result of imperfections being disclosed by NDT, the part of the pipe containing such repairs shall be subjected to additional NDT using the same technique, and MT, after the grinding operation. **(Mod.)**

9.7.5.4.e

The following clause shall be added to the existing section:

If more than 10% of the pipe in final inspection on any one day fails to meet any or all of the foregoing requirements, production shall cease pending establishment and rectification of the cause of defects. **(Mod.)**

10. MARKING

10.1 General

The following paragraphs shall be added to the existing clause:

For pipes DN 100 (NPS 4) and above, stencil marking required by this specification, shall be executed in white block capitals of minimum height 20 mm. For smaller pipe diameters, stencil marking height shall be a minimum 10 mm.

On HFW pipe, the manufacturer shall apply a 50 mm wide daub of heat resistant white paint on the inside surface at each end of each pipe to mark the location of the weld line.

Marking of test pressures, size (diameter, wall thickness and length) and weight shall be in SI Units. **(Mod.)**

10.2 Location of Markings

The existing section shall be deleted and replaced with the following:

Unless specified otherwise on the purchase order, marking shall be located as follows:

For pipe diameters DN 450 (NPS 18) and larger, all paint marking shall be on the inside surface. For smaller pipe diameters, the paint marking shall be on the outside surface. **(Sub.)**

10.3 Sequence of Markings

The first sentence of this Section shall be deleted and replaced with the following:

The following sequence of marking shall be applied:

10.3.1, 10.3.2, 10.3.3, 10.3.4, 10.3.5, 10.3.7, 10.3.8, 10.3.9.

In addition the words [IPS-M-PI-190 "Non-sour Service"] shall be added in the stencil area. **(Sub.) (SS)**

10.5 Length

The following modification shall be applied to this Clause:

The length of pipe or bundle shall be in meters with 2 decimal points. **(Mod.)**

10.7 Die Stamping

The existing clause shall be deleted and replaced with the following:

Die stamping shall not be used. **(Sub.)**

10.11 Mill Number

The following clause shall be added o the existing section:

Every pipe shall be individually identified by Mill Number. **(Add.)**

11. COATING AND PROTECTION

11.1 Coatings

The existing clause shall be deleted and replaced with the following:

The pipe shall be supplied bare and unoiled, protective coating or varnishing of the pipe identity markings is , however, permitted. The Purchaser reserves the right to establish a color code or marking system to identify both the pipe mill and wall thickness. **(Sub.) (AP)**

11.3 Bevel Protectors

The following Clause shall be added to the existing section:

If specified in the Purchase Order, suitable bevel protectors shall be used at both ends of the pipe to protect the bevels from damage under normal handling and transportation condition. **(Add.) (AP)**

12. DOCUMENTS

12.1 Certification

The existing Clause shall be deleted and replaced with the following:

The Manufacturer shall furnish to the Purchaser a certificate of compliance including the requirements of Appendix F, SR 15.

The certificate shall comply with ISO-10474 Type 3.1.B. For tests witnessed by the Purchaser, Type 3.1.C certificates shall be issued. See Appendix H. **(Sub.)**

12.3 Supply of Records

The following Clause shall be added to the existing section:

The Manufacturer shall supply the Purchaser with lists of pipe produced stating pipe identification numbers, heat numbers, dimensions, weights of lots of pipes or individual pipe lengths, purchase order numbers, type of certificates issued and any further items that may be indicated on the purchase order. **(Add.)**

NEW SECTIONS

The following sections shall be added to API specification 5L.,edition 1995.

SECTION 13 - MANUFACTURING PROCEDURE AND WELDING PROCEDURE

13.1 Manufacturing Procedure Specification

The Manufacturer shall produce a manufacturing procedure specification which shall be submitted for the Purchaser's approval at least two weeks prior to the start of production. The manufacturing procedure specification shall include the following as a minimum:

Steel supply

- Steelmaker
- Steel making and casting techniques
- Details of chemical composition including:

  a) target chemistry;
  b) ranges for deliberately added elements;
  c) maxima for other elements specified in 6.1.1;
  d) method of making rare earth addition. **(SS)**

Seamless pipe

- Pipe forming procedure
- Pipe heat treatment procedure
- Hydrostatic test procedure
- NDT procedure.

HFW pipe

- Strip manufacturing method including details of rolling, skelp splitting and any specialized cooling and heat treatment.

- Strip NDT procedures

- Pipe making method including details of methods used for preparing the edge of he strip for welding and for control of misalignment of edges and pipe shape.

- Welding procedure including details of the following:

  - Methods to be used for heating plate edges and for the control and monitoring of power input in relation to the temperature of the pipe surface and to the speed of the pipe

  - Frequency (in KHz) of the welding power supply

  - Details of any protective atmosphere used for welding

  - Methods used to accomplish and control two upset forge welding of the heated pipe edges

  - Method used for trimming of the weld bead

- Weld seam heat treatment procedure
- Hydrostatic test procedure
- NDT procedure

SAW pipe

- Plate manufacturing method including details of specialized cooling and heat treatment
- Plate NDT procedures
- Pipe forming procedure
- Seam welding procedure including details of the following:

  - Method of alignment, clamping and tack welding (if any) of the joints to be welded together with details of run-on and run-off tabs to be used and the method of their attachment to the pipe.

  - For pipe made by the cage-forming process, details of the methods used to maintain the alignment of the inside and outside welds

  Note:

  The center lines of the inside and outside welds as shown on the X-ray films should preferably not be displaced by more than 4 mm.

  - Welding process

  - Brand name, classification, size and grade of filler metal and flux

  - Speed of welding

  - Number of electrodes and polarity for each electrode

  - Welding current for each wire

  - Welding voltage for each wire

  - Dimensions of welding preparation

  - Number of weld passes and their disposition

  - Details of tracking system for both inside and outside welding and also method for checking the set up of the system

  - Limits on internal and external weld reinforcement

  - Repair welding procedure

- The method and degree of expansion to be applied
- Pipe heat treatment procedure (when appropriate)
- Hydrostatic test procedure
- NDT procedure. **(Add.)**

13.2 Welding Procedure Qualification

The seam welding procedure for welded pipe may be qualified by the first day production tests. If qualification prior to the start of production is required, the Purchaser shall notify the Manufacturer at the time of enquiry/order. **(AP)**

For qualification of the welding procedure, the following tests shall be executed on a full length test weld made in accordance with the manufacturing procedure specification. **(Add.)**

13.2.1 UT

The weld seam shall be examined in accordance with Section 9.7.4. This shall be performed at least 48 hrs after completion of the test weld. **(Add.)**

13.2.2 RT

The complete welded seam of SAW pipe shall be examined in accordance with Section 9.7.3. **(Add.)**

13.2.3 PT or MT

The weld seam shall be subjected to PT or MT in order to check for surface defects in the weld material in accordance with Section 14.3.3. **(Add.)**

13.2.4 All weld tensile tests (SAW only)

One specimen of the weld shall be subjected to an all-weld tensile test. Test results shall meet the minimum specified requirements of the plate with regard to yield, tensile strength and elongation. **(Add.)**

13.2.5 Flattening tests (HFW only)

The weld shall be subjected to flattening tests in accordance with Sections (9.3.2), (6.2.2) and (9.10.3). **(Add.)**

13.2.6 Macrographic, micrographic and hardness testing

A specimen shall be removed from the weld seam and subjected to macrographic, micrographic and hardness testing in accordance with Section 14.5. **(Add).**

13.2.7 Fracture toughness testing

The weld shall be subjected to fracture toughness testing in accordance with Sections 6.2.6 and Appendix F, SR5 and SR6. **(Add.)**

13.2.8 Weld ductility test (HFW only)

The welded pipe shall be tested as specified in Sections (6.2.5) and (9.10.6). **(Add.)**

13.2.9 Witness

The preparation of the test weld and execution of the welding procedure qualification tests shall be witnessed by the Purchaser if so specified. **(Add.) (AP)**

SECTION 14 - FIRST DAY PRODUCTION TESTS

14.1 General

Three of the completely finished pipes of the first day's production shall be selected at random for testing to verify that the submitted manufacturing procedure results in fully acceptable pipe. If more than one heat is used in the first day production pipes, at least two heats shall be represented by the tests pipes. At the Purchaser's discretion, the Purchaser may make the selection. For orders of less than 50 tones, first day production tests are not required.

If the pipes have been made from coiled skelp, the pipes made from each end of the coil shall be tested in addition to the above pipes.

The pipes tested as above shall be considered to be test pipe(s) per heat or per shift as required by this Standard. The above first day production test shall be repeated after any change in the manufacturing procedure or interruption to the program.

The Manufacturer shall submit to the Purchaser a report giving the results of all tests indicated below together with macrographs of the weld cross section and micrographs confirming the microstructure of the plate and seamless pipe. **(Add.)**

14.2 Visual Examination

All pipes shall be examined visually for dimensional tolerances and for surface defects in accordance with Section 7. **(Add.)**

14.3 Non-Destructive Testing

14.3.1 UT

The weld seams of all pipes shall be examined by means of an automatic ultrasonic scanning device in accordance with Section 9.7.4.1 and shall meet the requirements of Section 9.7.4.3. **(Add.)**

14.3.2 RT

The weld seams of all SAW pipes shall be radiographically examined throughout their full length in accordance with Section 9.7.3. **(Add.)**

14.3.3 PT or MT

The weld seams of all welded pipes greater than or equal to DN 600 (NPS 24) shall be subjected to PT or MT, throughout their full length both inside and outside, to check for longitudinal and transverse surface defects in the weld material.

For pipe less than DN 600 (NPS 24), the full length of the weld seam outside surface, plus the equivalent length of one pipe diameter each end of the internal surface, shall be examined. Seamless pipe shall also be subjected to PT or MT over the entire outside pipe body.

PT shall be in accordance with ASTM E165.

Acceptance of discontinuities shall be in accordance with Section 9.7.5.3. Cracks are unacceptable and their causes shall be investigated. **(Add.)**

14.4 Physical Testing

The physical properties of all pipes shall be tested as specified below. Test results shall meet the requirements for the specified grade and type of pipe. **(Add.)**

14.4.1 Weld seam

The weld seam of all selected welded pipes shall be physically tested as required by Sections 6.2, 9.3, 9.8, 9.9 and 9.10. For SAW pipe, in addition, an all-weld metal tensile test shall be made including the determination of tensile strength, yield strength and elongation. For determination of the elongation value, the "Oliver" formula, as specified in ISO 2566-1 may be used. Results of the all-weld metal tensile tests shall meet the minimum specified requirements of the plate, from which the pipe is made. For SAW pipe, in addition, weld impact tests shall be carried out in accordance with Appendix F, SR5. **(Add.)**

14.4.2 Pipe material

Tensile tests shall be carried out on the two pipes made from each end of a coiled skelp, or on two pipes made from different heats, as required by Sections 6.2, 9.3, 9.8, 9.9 and 9.10, except that for pipes greater than DN 200 (NPS 8) tensile tests shall be performed in both the transverse and longitudinal directions. **(Add).**

14.4.3 Charpy impact test

Tests shall be carried out on all selected pipes in accordance with Section 6.2.6 and Appendix F, SR 5. In addition, full transition temperature curves shall be produced, showing impact energy (in Joules) and percentage shear (fibrous) of the fracture surface, plotted against temperature, over a temperature range sufficient to reproduce fracture acceptance from 10% to 100% fibrous shear. **(Add.)**

14.4.4 Drop weight tear test

For pipe to be used in gas transmission lines, drop weight tear tests shall be carried out in accordance with Section 6.2.6 and Appendix F, SR 6. **(Add.) (AP)**

14.5 Macrographic, Micrographic and Hardness Examination

14.5.1 SAW and HFW pipe

For SAW pipe, three specimens shall be extracted from one pipe at three locations along the weld and shall be cross-sectioned, polished and etched for macroexamination which shall provide evidence that proper fusion has been achieved throughout the full thickness of the joint, the extent of interpenetration and the alignment of internal and external weld passes.

For HFW pipe, a total of three specimen shall be taken from the selected pipes for microexamination, to provide proof that heat treatment of the weld zone has been adequate.

For SAW and HFW pipe, a series of Vickers hardness (HV 10) tests shall be made on one of the etched specimens selected by the Purchaser. These series of readings shall extend from unaffected base metal on one side across the weld to unaffected base metal on the other side. Three traverses shall be made, one 2 mm from the outer edge, the second across the center and the third 2 mm from the inner edge. The spacing between the hardness impressions shall be 0.75 mm. The location of the hardness impressions for SAW pipe is shown in Fig. D. The hardness impressions nearest the fusion line shall be within 0.5 mm of the fusion line. (see Section 6.2.8). **(Add.)**

14.5.2 Seamless pipe

Three specimens from one pipe shall be extracted from locations 120ø apart from a position chosen by the Purchaser, polished and etched for examination and checked for microstructure. A hardness survey shall be made on one of the above specimen selected by the Purchaser. Three traverses shall be made, one 2 mm from the outer edge, the second across the center and the third 2 mm from the inner edge. A minimum of 12 readings shall be taken at 5 mm intervals. **(Add.)**

14.5.3 Acceptance criteria

No hardness measurement shall exceed 325 HV10 (Ref. Section 6.2.8). **(Add.) (SS)**

APPENDICES

APPENDIX B
REPAIR OF DEFECTS BY WELDING (NORMATIVE)

B.1 Types of Pipe

B.1.1 Seamless pipe and parent metal of welded pipe

The existing clause shall be deleted and replaced with the following:

Repair welding on seamless pipe and on parent metal of welded pipe is not acceptable. **(Sub.)**

B.1.2 Welded seam of welded pipe

The existing clause shall be deleted and replaced with the following:

Repair of the weld seam or heat treated region of HFW pipe is not acceptable.

Repair of the weld seam of SAW pipe is not acceptable within 200 mm of the bevel ends.

The nature of any weld defect indicated by non-destructive inspection shall be ascertained before any repair is performed. Where necessary, complementary ultrasonic and radiographic inspections shall be carried out to characterize the defect. Repair welding to rectify pipe welds containing cracks is not permitted.

Repairs to the weld seam shall be limited to three per pipe. The length of repair weld shall not exceed 5% of the total weld length on each pipe.

Weld repairs shall not be carried out after cold expansion or hydrostatic testing of a pipe. **(Sub.)**

B.2 Procedure for Repair by Welding of Seamless Pipe and Parent Metal of Welded Pipe

The existing section shall be deleted and replaced by the following:

Repair welding on seamless pipe and on parent metal of welded pipe is not acceptable. **(Sub.)**

B.3 Procedure for Repair of Submerged-Arc Welds

The phrase "and gas metal-arc" shall be deleted from the title and the first line of the first paragraph of this Section. **(Del.)**

The following new clause shall be added to this Section.

B.3.4 Repair welding shall be executed using qualified procedures and in accordance with the requirements of Appendix C.

The repaired area shall be non-destructively tested by RT, manual UT and MT. **(Add.)**

B.4 Procedure for Repair of Electric Welds

The existing section shall be deleted and replaced with the following:

Repair welding of HFW welds is not acceptable. **(Sub.)**

APPENDIX C
REPAIR WELDING PROCEDURE (NORMATIVE)

C.2.2 Mechanical testing

The following new clause shall be added to this Section.

C.2.2.5 Charpy v-notch impact test

Charpy v-notch impact testing shall be performed on the repair welding procedure qualification test weld. Specimens shall be taken from the locations shown in Fig. E. The test temperature and acceptance criteria shall be the same as those given for the pipe in Appendix F, SR5. **(Add.)**

APPENDIX F
SUPPLEMENTARY REQUIREMENTS (NORMATIVE)

SR 5 Fracture toughness testing (Charpy v-notch) for outside diameter 114.3 mm (4.500 inches) or larger.

SR 5.1 The existing section shall be deleted and replaced with the following:

The fracture toughness of the pipes shall be determined by Charpy v-notch impact testing in accordance with ASTM A-370. The impact test temperature shall be lower than or equal to that specified in the Table below:

NOMINAL WALL THICKNESS Wt (mm)	TEST TEMPERATURE (°C)	MAXIMUM TEST TEMPERATURE(°C)
$Wt \leq 16.0$	T*	0
$16.0 < Wt \leq 25$	T-10	0
$25 < Wt \leq 32$	T-20	0
$Wt > 32$	T-30	0

*** T is the minimum design temperature, which shall be specified in the purchase order. If no minimum design temperature is indicated, it shall be taken as 0°C. (Sub.) (AP)**

SR 5.3 The existing section shall be deleted and replaced with the following (Fig. F.2 and Note remain):

Impact testing shall be carried out using 10 × 10 or 10 × 7.5 or 10 × 5 mm cross section specimens with or without tapered ends (see Fig. F.2 and Note). The largest possible specimen shall be used. Where the pipe dimensions are insufficient to extract a 10 × 5 mm specimen, impact testing is not required.

For pipes of DN 250 (NPS 10) or less, impact test specimens shall be taken parallel to the axis of the pipe (i.e. longitudinal specimens shall be taken).

For pipes greater than DN 250 (NPS 10), impact test specimens shall be taken transverse to the axis of the pipe, except where the wall thickness prevents extraction of a 10 × 5 mm specimen, in which case longitudinal specimens shall be taken.

For weld center line and HAZ impact tests, only transverse specimens shall be used. **(Sub.)**

SR 5 B.3 The existing Clause shall be deleted and replaced with the following:

The minimum absorbed energy requirements for full size (10 × 10 mm) specimens taken transverse to the pipe axis are given in the Table below:

GRADE	MINIMUM AVERAGE VALUE (J)	MINIMUM INDIVIDUAL VALUE (J)
B	27	22
× 42	27	22
× 46	32	24
× 52	36	27
× 56	39	29
× 60	41	31
× 65	45	34
× 70	48	36

(to be continued)

APPENDIX F (continued)

For other specimen sizes and orientations, the above values shall be multiplied by the following corresponding factors:

SIZE (mm)	ORIENTATION	FACTOR
10 × 10	Longitudinal	1.5
10 × 7.5	Transverse	0.75
10 × 7.5	Longitudinal	1.125
10 × 5	Transverse	0.5
10 × 5	Longitudinal	0.75

The shear area at the fracture surface of the test specimens shall be recorded. Each sample shall exhibit not less than 50% fibrous shear.

The charpy test requirements specified are based on crack initiation principles. For gas transmission and two phase lines, higher absorbed energy requirements may be specified to avoid the risk of running fractures. In this case the Purchaser shall state the required values in the Purchase order. **(Sub.) (AP)**

SR 6 The existing title shall be deleted and replaced with the following :

SR 6 Drop-weight tear testing on welded pipe sizes DN 400 (NPS 16) and larger, grade × 52 and higher. **(Sub.) (AP)**

SR 6.1 The existing Clause to be deleted and replaced with the following:

Drop weight tear tests are required on pipes of DN 400 (NPS 16) and larger. **(Sub.)**

SR 6.2 The existing Clause shall be deleted and replaced with the following:

Two transverse DWTT specimens shall be taken from one length of pipe from each heat supplied in the order. The specimens shall be taken at the locations shown in Fig. F.3. Tests shall be performed at the minimum design temperature.

Full transition curves shall be established for one heat out of ten, with a minimum of one. **(Sub.)**

SR 6.4 The existing clause shall be deleted and replaced with the following:

All specimens shall exhibit a minimum of 75% shear on the fracture surface. **(Sub.)**

SR15 Test Certificates for Line Pipe

SR 15.1 The following sentence shall be added to the first paragraph of this clause:

The manufacturer's certificate shall state that the pipe complies with IPS-M-PI-190 Parts I and II. **(Add.) (SS)**

APPENDIX H
PURCHASER INSPECTION (NORMATIVE)

The following clause shall be added to this Section:

The Purchaser shall specify if, and to what extent, he will monitor the Manufacturer's production, quality control and inspection. **(AP)**

Sufficient fluorescent lighting both overhead and at pipe ends shall be provided at the inspection area. Facilities shall be provided for rolling each pipe joint for inspection. The Manufacturer shall make ultrasonic or other suitable equipment available for use by the Purchaser to check the remaining wall thickness where any defects have been ground out of the pipe.

If the Purchaser has to reject pipe repeatedly for any recurring cause, this shall be reason to refuse further pipes for final examination until the cause has been rectified. **(Add.)**

APPENDIX K
HYDROGEN INDUCED CRACKING SENSITIVITY TEST

(APPLICABLE TO PART III ONLY)

(SS)

SUMMARY OF TESTING AND INSPECTION REQUIREMENTS
(APPLICABLE TO PART II)

TYPES OF TEST/INSPECTION	FIRST-DAY PRODUCTION TESTS		DURING PRODUCTION	
	FREQUENCY	REMARKS	FREQUENCY	REMARKS
VISUAL INSPECTION				
- Dimensions	All pipes		All pipes	
- Out of roundness at weld position	All SAW pipes		All SAW pipes	
- Pipe end squareness	All pipes		2 pipes per shift	
- Straightness	All pipes		Random	
- Surface defects	All pipes	External (plus internal ≥DN 600)	All pipes	External (plus internal ≥ DN 600)
ULTRASONIC EXAMINATION				
- Pipe ends	All pipes	25 mm of pipe ends	All pipes	25 mm of pipe ends
- Welded pipe				
- Plate/skelp	All plates/skelp	25 mm of trimmed plate material	All plates/skelp	25 mm of trimmed plate material
- Weld seam	All pipes	SAW pipe ends shall be radiographed	All pipes	SAW pipe ends shall be radiographed
- Seamless pipe	All pipes	25% of surface	All pipes	25% of surface
RADIOGRAPHY				
- Weld seam	All selected SAW pipes	100 % weld	All SAW welds	End 200 mm
- Weld repair areas on seam weld	All weld repairs		All weld repairs	
MT				
- Seam weld	All selected pipes			
- Seamless pipe body	All selected pipes			
- Bevel faces	All pipes	Only if ultrasonic testing is impossible	All pipes	Only if ultrasonic testing is impossible

(to be continued)

TYPES OF TEST/INSPECTION	FIRST-DAY PRODUCTION TESTS		DURING PRODUCTION	
	FREQUENCY	REMARKS	FREQUENCY	REMARKS
PHYSICAL TESTS				
- Tensile test	Two selected pipes		Two pipes per heat	
- Weld tensile test	All selected pipes	Welded pipe only	As above	
- All weld tensile test	One pipe	SAW only		
- Charpy V-Notch	All pipes			
- At temperature in Part II, App. F, SR 5.1	All selected pipes		As required for tensile test	
- Transition curve	One pipe			
- Drop Weight Tear Test				
- Transition curve	One pipe		One pipe per ten heats	
- At minimum design temperature	All heats		All heats	
- Flattening test				HFW only
- Weld manipulation test			One pipe per 50 pipes	SAW only
- Weld ductility test			One test per lot (see 4.17 API Spec. 5L)	HFW only
- Macro, micro plus hardness	One pipe (3 specimens) Three pipes (3 specimens)	SAW & SMLS HFW	One pipe per heat or after each stop in production	HFW only
HYDROTEST	All pipes		All pipes	
CHEMICAL COMPOSITION				
- Ladle analysis	Once per heat		Once per heat	
- Check analysis	Twice per heat		Twice per heat	

PART III

AMENDMENTS/SUPPLEMENTS TO PART II OF THIS STANDARD FOR LINE PIPE TO BE SUITABLE FOR USE IN OIL, GAS AND PETROCHEMICAL SERVICES UNDER SOUR CONDITIONS

(AP)

CONTENTS :

PAGE No.

APPENDICES:

FIGURES :

5.3 Material

The following paragraph shall be added to this Clause:

The steel shall be calcium treated and vacuum degassed. **(Add.)**

6.1.1 Chemical composition (Table 2)

Table 2 shall be deleted and replaced with the following:

ELEMENT	MAXIMUM PERMITTED ALLOY CONTENT, wt%			MAXIMUM VARIATION ON AGREED COMPOSITION (SEE 6.1.3)	NOTES
	SAW	SMLS	HFW		
C	0.16	0.16	0.16	0.03	
Mn	1.30	1.40	1.30	0.30	1
Si	0.40	0.40	0.40	0.25	
P	0.015	0.015	0.015		
S	0.003	0.01	0.003		
V	0.08	0.08	0.08	0.02	2
Nb	0.05	0.05	0.05	0.02	2
Ti	0.04	0.04	0.04	0.02	2
Cr	0.20	0.30	0.20	0.05	3
Mo	0.10	0.35	0.25	0.05	3
Ni	0.35	0.40	0.35	0.10	3
Cu	0.25	0.25	0.25	0.05	3
Al	0.05	0.06	0.06		4
N	0.012	0.012	0.012		4
B	0.0005	0.0005	0.0005		
Ca	0.006	0.006	0.006		5
CE	0.39	0.41	0.39		6
Pcm	0.21	0.22	0.21		7

Notes:

1. For SAW pipes in × 70 grade, the maximum Mn content may be increased to 1.4 Wt%.
2. V + Nb + Ti shall not exceed 0.15%.
3. Cr + Mo + Ni + Cu shall not exceed 0.6%.
4. The total Al : N ratio shall not be less than 2 : 1.
5. Calcium shall be 2 times sulphur content for sulphur in the range 0.0015 - 0.003%.
6. CE = C + Mn/6 + (Cr + Mo + V) /5 + (Ni + Cu)/15.
7. Pcm = C + Si/30 + (Mn + Cu + Cr)/20 + Ni/60 + Mo/15 + V/10 + 5B **(Sub.)**

6.2.8 Hardness testing

The last sentence of this Clause shall be modified to read:

The hardness of weld, HAZ and base material shall not exceed 248 HV 10. **(Mod.)**

7.8.7 Hard spots

The first paragraph of this Clause (of API 5L Spec.) shall be replaced with:

Any hard spot with a hardness greater than 22 HRC (250 HV) shall be rejected. **(Mod.)**

10.3 Sequence of Markings

The second sentence of this Section shall be replaced with:

In addition the words [IPS-M-PI-190-Sour Service] shall be added in the stencil area. **(Mod.)**

13.1 Manufacturing Procedure Specification

The clause under "steel Supply" is replaced with the following (the rest of the section 13.1 remains):

- Steel supply
- Steelmaker
- Steel making and casting techniques including details of the following:

  - Details of steel making process, including deoxidation and desulphurization practice, inclusion shape control method and the use of vacuum degassing.

  - Details of casting process, i.e. ingot or continuous casting, including casting speed, tundish superheat, segregation control measures, etc.

  - Details of plate and strip manufacture, including slab reheating temperatures, start and finish rolling temperatures and reduction ratios.

  - Heat treatment details.

  - Chemical composition:

    a) Target chemistry;
    b) Ranges for deliberately added elements;
    c) Maxima for other elements specified in Section 6.1.1. **(Mod.)**

14.5.3 Acceptance criteria

This Clause is modified to read:

No hardness measurement shall exceed 248 HV10 (Ref. Section 6.2.8). **(Mod.)**

SR 15 Test certificates for line pipe

SR 15.1 The last sentence shall be modified to read:

The Manufacturer’s certificate shall state that the pipe complies with IPS-M-PI-190 Parts I, II and III and is suitable for oil, gas and petrochemical operations under sour conditions.

APPENDICES

APPENDIX K
HYDROGEN INDUCED CRACKING SENSITIVITY TESTS (HIC SENSITIVITY TESTS)

K.1 Qualification of Test Method

Before commencement of the order, the Manufacturer shall provide the Purchaser with a detailed procedure for the testing, metallographic preparation and evaluation of HIC specimens. The Manufacturer shall qualify his test method using samples from a steel of known crack sensitivity. All tests shall be witnessed by the Purchaser.

K.2 Selection of Samples

The Manufacturer shall perform HIC sensitivity tests. One pipe from each of the first three heats of pipe produced shall be tested. One pipe out of every subsequent ten heats shall be tested. The pipes for testing shall be selected by the Purchaser from the heats exhibiting the higher sulphur contents. The tests shall be witnessed by the Purchaser and the results submitted to the Purchaser. If a sample fails to pass the test, the situation shall be reviewed by the Purchaser to decide on further testing to distinguish heats which are acceptable.

K.3 Sampling

K.3.1 Removal of test coupons

K.3.1.1 Welded pipes

Two coupons, each to be sectioned into three specimens, shall be selected and tested for each pipe selected:

Coupon 1:

Cut from the pipe opposite the weld seam and in direction parallel to the rolling direction, (see Fig. F).

Coupon 2:

Cut from the pipe traverse to the weld (see Fig. G).

K.3.1.2 Seamless pipes

Three specimens shall be removed from the test pipes as shown in Fig. F. A curved specimen may be taken from pipe with thin wall or whose shape makes it impossible to remove a flat specimen at least 5 mm thick.

An alternative coupon comprising three sets of three separate specimens taken radially, as shown in Fig. K, may also be used.

K.3.2 Specimen preparation

Three adjacent specimens shall be cut from each coupon with dimensions as shown in Figs. F and G. They shall firstly be rough ground on a belt grinder or by surface grinding. This shall be followed by final grinding to a 320 grit finish, using silicon carbide papers. They shall then be degreased in acetone. The effectiveness of degreasing shall be demonstrated by using the atomizer test of ASTM F 21.

(to be continued)

APPENDIX K (continued)

Thereafter, extreme care must be taken not to contaminate the coupons. They should be handled with tongs or clean gloves. One set of specimens from both the seam weld and base pipe material shall be tested, without applied stress, in the test solution, Tests shall be carried out with specimens that are not coated in any way before exposure in the test environment.

K.4.4 Test solution

The test shall be performed in the NACE TM0 177 Test Solution, i.e. 0.5% acetic acid +5% NaCl + H_2S. The testing shall be performed in glass vessels.

The solution shall be deaerated by bubbling nitrogen through it at a rate of 100 CC/L/min. for one hour. The specimens shall be immersed in the solution with the face of 100 mm × 20 mm in the vertical position and the lower face raised from the cell bottom on bars of teflon or glass. When stacked, the specimens shall also be separated by similar bars (see Fig. H).

Nitrogen bubbling shall be continued for a further one hour after which the solution shall be saturated by bubbling H_2S at the rate of 2 to 5 L/min. for one hour through an open-ended tube with a 5 mm internal diameter. Upon reaching saturation, the H_2S flow rate may be reduced to 100 CC/min, for a ten liter solution or pro rata, and maintained at this rate for the test period. The H_2S parity shall be 99.5% (by volume) or better.

A small positive pressure of H_2S should be maintained in the test cell by the use of an outlet trap to prevent oxygen contamination from the air. If at any time during the test, a white haze clouds the solution, the test shall be stopped and repeated after preparation of new specimens.

Test conditions shall be as follows:

Temperature	25 ±3°C
H_2S concentration	(2300 - 3500 ppm) saturated condition
pH value - initial	2.9 to 3.3
pH value - final	3.5 to 4.0
Test period	96 hours

The pH value of the solution shall be measured at the beginning and the end of the test and the H_2S concentration in the solution determined at the end by iodometric titration.

K.5 Evaluation of Blistering and Hydrogen Induced Cracking

K.5.1 Blistering

The tendency to blister shall be reported after visual examination. Photographs shall be taken of the two wide faces of each coupon to show any blistering. Where photography does not adequately show blisters, a dimensioned sketch may be substituted.

K.5.2 Hydrogen induced cracking

Specimens taken with their long axis (100 mm) parallel to the rolling direction shall be sectioned transversely at three points, as shown in Fig. I. Specimens containing the weld, cut from longitudinally welded pipe (Fig. G), shall be sectioned as shown in Fig. J. The intention of the above sectioning procedure is to examine for cracks, in each case on a plane transverse to the rolling direction.

(to be continued)

APPENDIX K (continued)

The sections shall be mounted in epoxy resin, or an equivalent, and polished. To avoid the possible obscuring of fine cracks, the metallographic preparation shall entail polishing to a finish of 1 (m or less. Cracking shall then be estimated by micrographic examination at magnifications of × 30 and × 100.

K.5.3 Evaluation

For each crack observed, the length and extent of stepwise propagation (Fig. L) shall be measured. For each section containing cracks, one photograph shall be taken showing one of the complete transverse sections with examples of cracking.

HIC is evaluated in terms of Crack Length Ratio (CLR), Crack Thickness Ratio (CTR) and Crack Sensitivity Ratio (CSR).

These values shall be reported for each section examined and as the average of three sections per specimen. The result for each specimen, i.e. the average of the three sections examined, shall be used for evaluating HIC susceptibility. In this evaluation, cracks associated with surface blistering which have no part more than 1 mm from the specimen surface shall be disregarded.

K.5.4 Acceptance criteria

The following acceptance criteria shall be met:

CLR	15%	maximum
CSR	1.5%	maximum
CTR	5%	maximum

The maximum individual crack length on any section shall not exceed 5 mm.

Blistering area shall not be more than 1% of the exposed area of two wide faces of each coupon.

If any specimen fails to meet the above acceptance criteria, the heat of steel represented by the test shall be rejected. (see also K.2).

K.6 Reporting

The following information shall be supplied in a report together with the test certificates:

a) Results of cracking evaluation indicating CLR, CTR and CSR for each section and also averaged over 3 sections, and whether pass or fail.

b) Photomicrographs of the specimens showing cracking, together with photomicrographs of adjacent material structures:

i) Unetched, showing the type of inclusions in the steel.

ii) Etched, showing the parent material microstructure.

c) pH of H_2S saturated solution at the beginning and at the end of the test, the H_2S content and type of solution.

d) Photographs of specimens, showing any blisters, or alternatively dimensioned sketches.

e) Locations and dimensions of specimens, and whether taken from pipe body or weld.

f) Full chemical analysis of material tested.

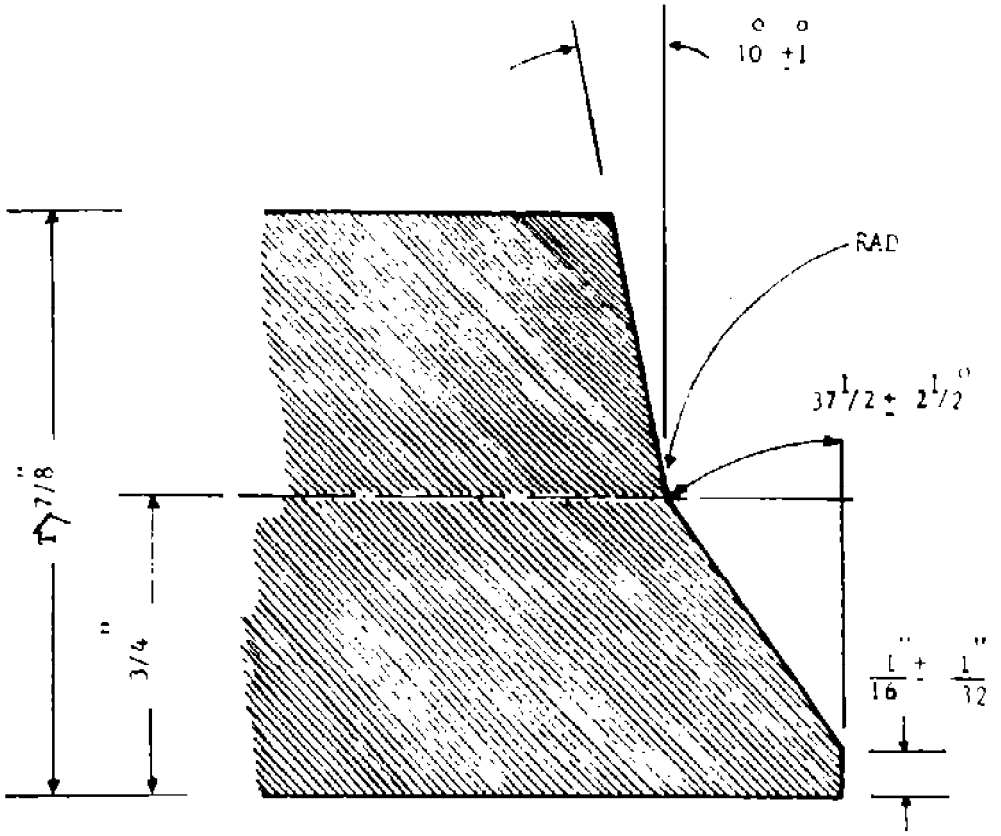
g) Mechanical properties of materials tested.

SUMMARY OF TESTING AND INSPECTION REQUIREMENTS (APPLICABLE TO PART III)

TYPES OF TEST/INSPECTION	FIRST-DAY PRODUCTION TESTS		DURING PRODUCTION	
	FREQUENCY	REMARKS	FREQUENCY	REMARKS
VISUAL INSPECTION				
- Dimensions	All pipes		All pipes	
- Out of roundness at weld position	All SAW pipes		All SAW pipes	
- Pipe end squareness	All pipes		2 pipes per shift	
- Straightness	All pipes		Random	
- Surface defects	All pipes	External (plus internal ≥ DN 600)	All pipes	External (plus internal ≥ DN 600)
ULTRASONIC EXAMINATION				
- Pipe ends	All pipes	25 mm of pipe ends	All pipes	25 mm of pipe ends
- Welded pipe				
- plate/skelp	All plates/skelp	25 mm of trimmed plate material	All plates/skelp	25 mm of trimmed plate material
- weld seam	All pipes	SAW pipe ends shall be radiographed	All pipes	SAW pipe ends shall be radiographed
- Seamless pipe	All pipes	25% of surface	All pipes	25% of surface
RADIOGRAPHY				
- Weld seam	All selected SAW pipes	100 % weld	All SAW welds	End 200 mm
- Weld repair areas on seam weld	All weld repairs		All weld repairs	
MT				
- Seam weld	All selected pipes			
- Seamless pipe body	All selected pipes			
- Bevel faces	All pipes	Only if ultrasonic testing is impossible	All pipes	Only if ultrasonic testing is impossible

(to be continued)

TYPES OF TEST/INSPECTION	FIRST-DAY PRODUCTION TESTS		DURING PRODUCTION	
	FREQUENCY	REMARKS	FREQUENCY	REMARKS
PHYSICAL TESTS				
- Tensile test	Two selected pipes		Two pipes per heat	
- Weld tensile test	All selected pipes	Welded pipe only	As above	
- All weld tensile test	One pipe	SAW only		
- Charpy V-Notch	All pipes			
- At temperature in Part II, App. F, SR 5.1	All selected pipes		As required for tensile test	
- Transition curve	One pipe			
- Drop Weight Tear Test				
- Transition curve	One pipe		One pipe per ten heats	
- At minimum design temperature	All heats		All heats	
- Flattening test				HFW only
- Weld manipulation test			One pipe per 50 pipes	SAW only
- Weld ductility test			One test per lot (see 4.17 API Spec. 5L)	HFW only
- Macro, micro plus hardness	One pipe (3 specimens) Three pipes (3 specimens)	SAW & SMLS HFW	One pipe per heat or after each stop in production	HFW only
HYDROTEST	All pipes		All pipes	
CHEMICAL COMPOSITION				
- Ladle analysis	Once per heat		Once per heat	
- Check analysis	Twice per heat		Twice per heat	
HYDROGEN INDUCED CRACKING TEST	First three heats		One pipe per ten heats	

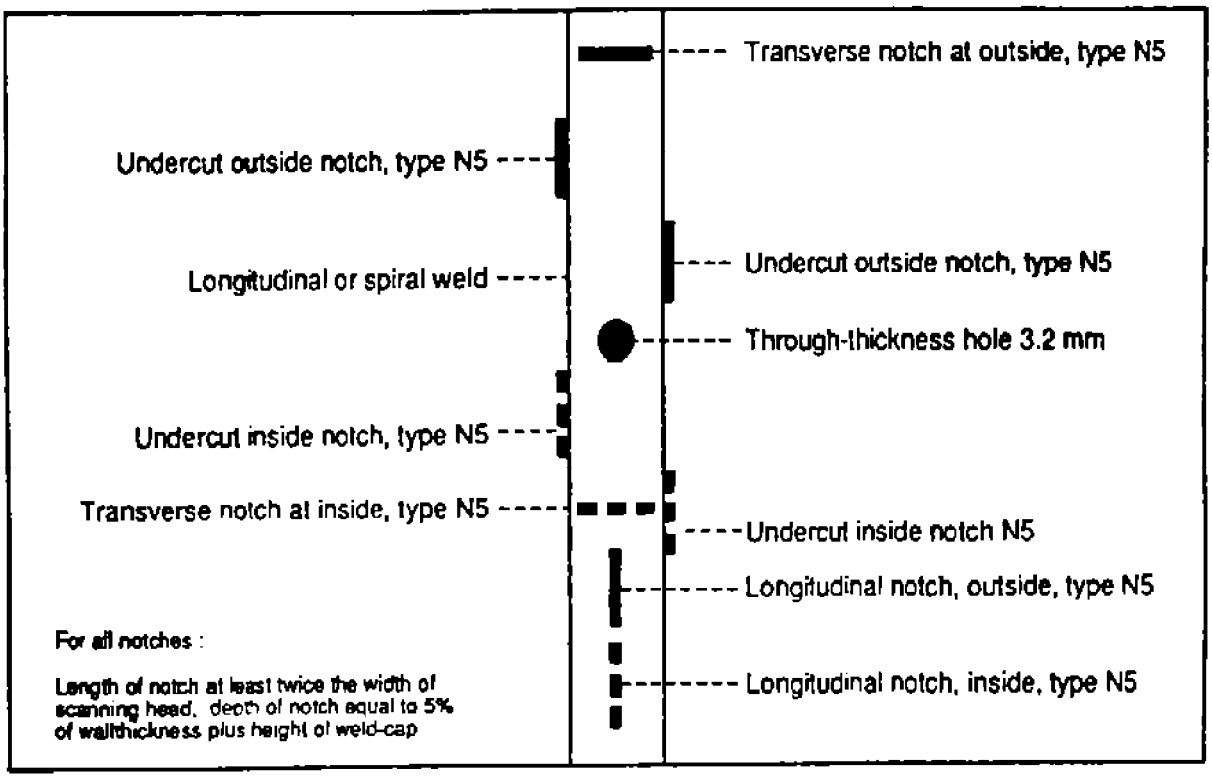


END PREPARATION FOR PIPE AND FITTINGS OVER 21 mm($^{7}/_{8}$") THICKNESS
Fig. A

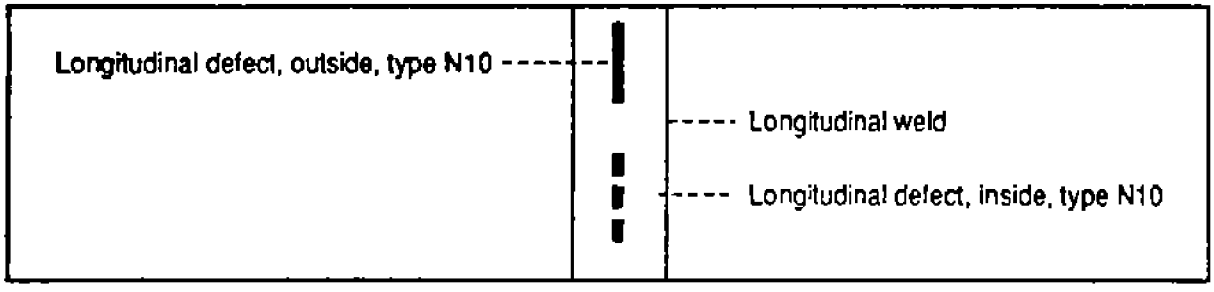
(Ref. Clause 7.9.3 of Part II)

REFERENCE STANDARD PIPE/PLATE FOR INSPECTION OF WELDS

Type and size of notches shall be as given in (Part II, Section 9.7.4.1.a)

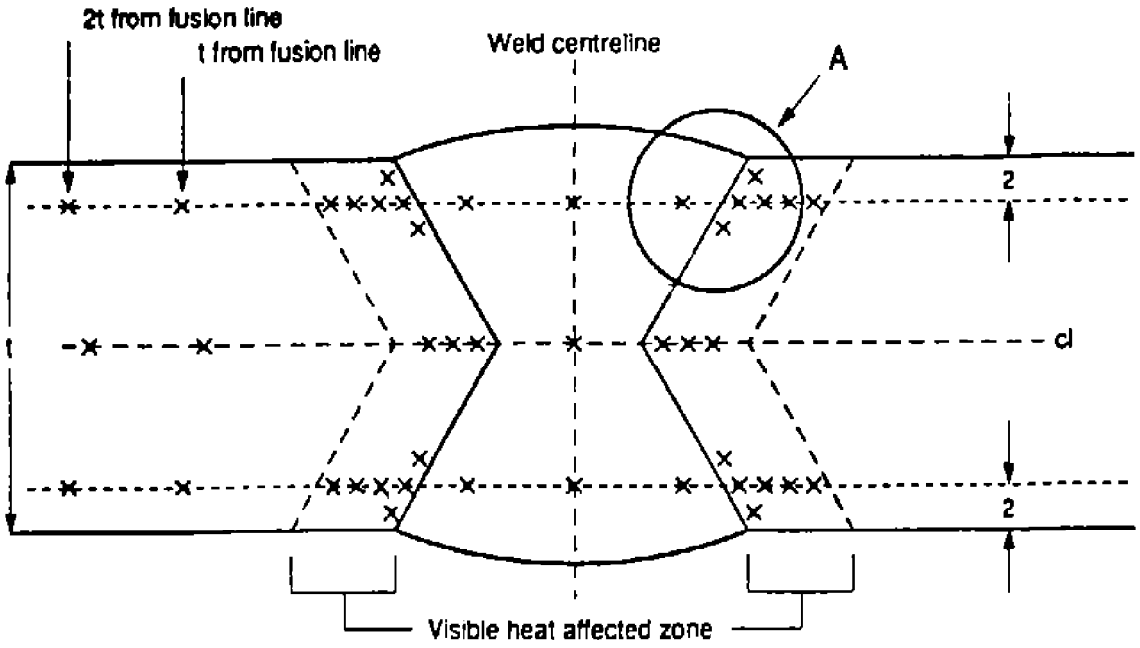


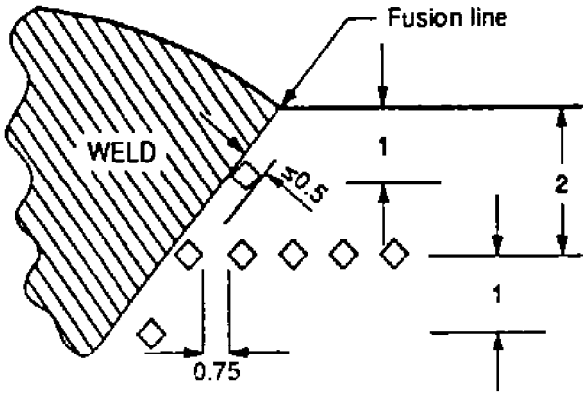
TEST PLATE OR SECTION FOR SAW PIPE**
Fig. B



TEST PIPE OR SECTION FOR HFW PIPE**
Fig. C

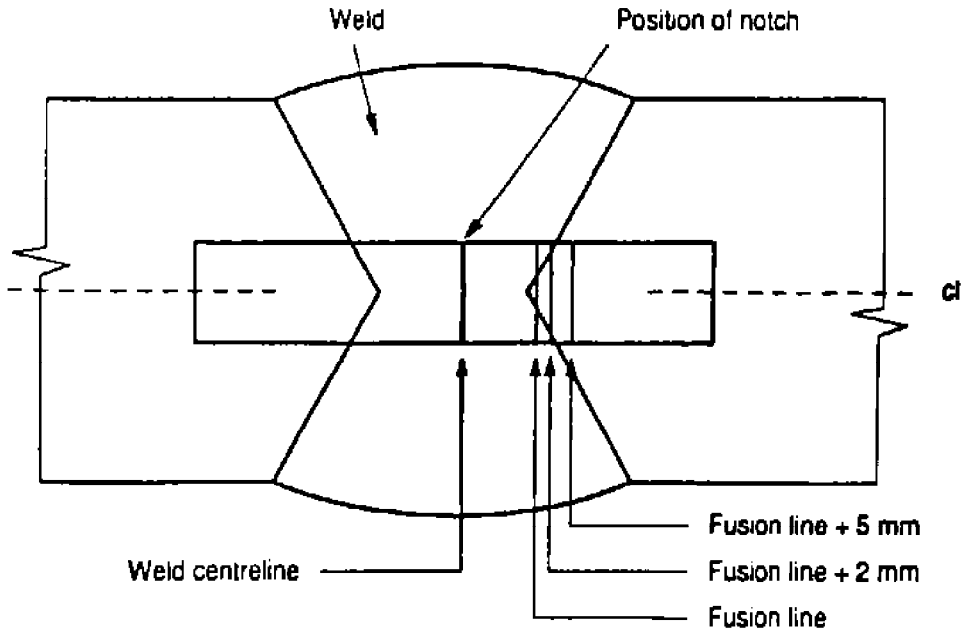
** The location of each reference standard may be at the manufacturer's option, provided that no interference will occur.



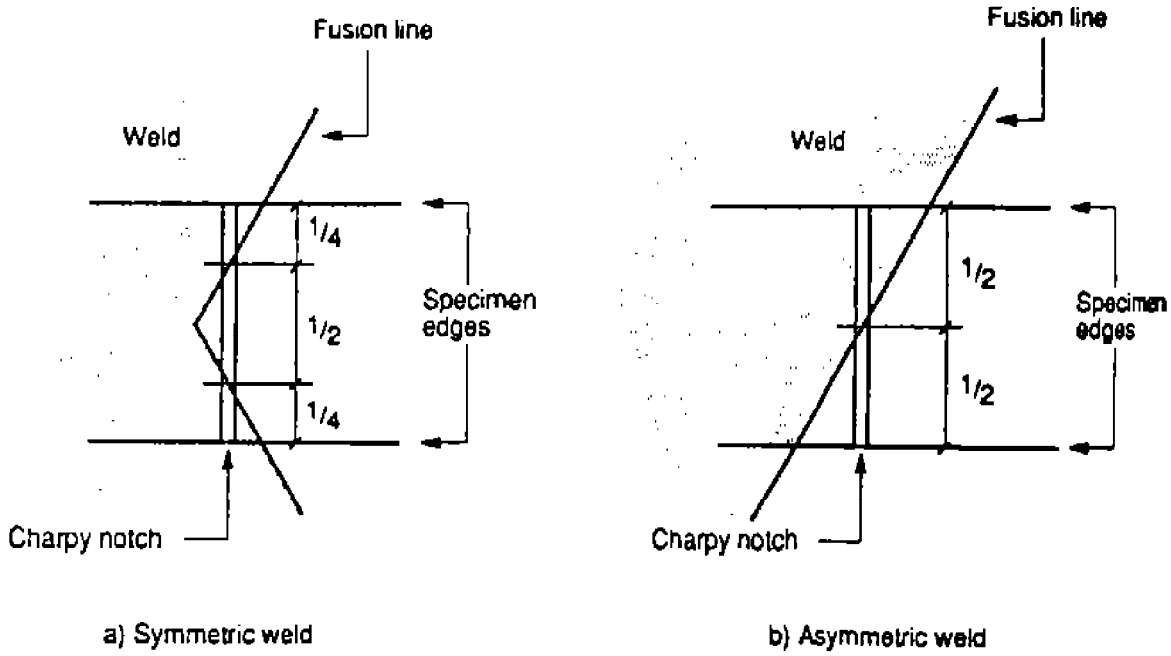


Enlargement of area A
(all dimensions in millimeters)

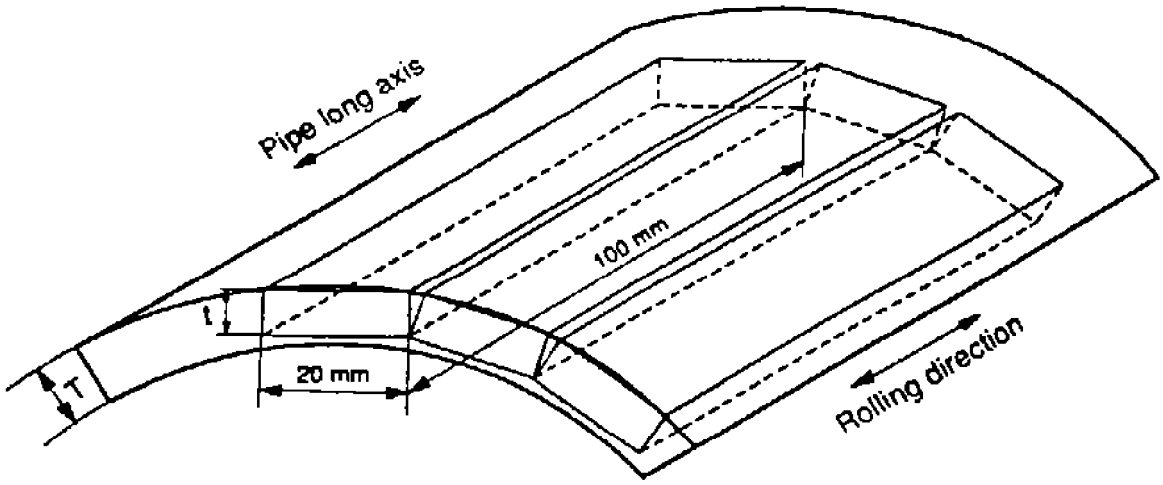
LONGITUDINAL WELD HARDNESS SURVEY
Fig. D



LOCATION OF CHARPY V-NOTCH SPECIMENS IN SAW PIPE WELDS
Fig. E1



DETAIL OF FUSION LINE CHARPY NOTCH LOCATION
Fig. E2

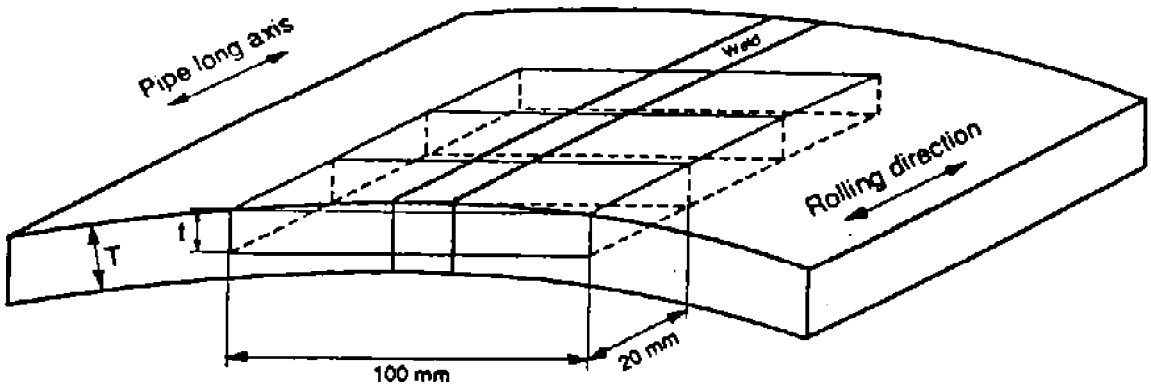


COUPON FROM PIPE PARENT MATERIAL
Fig. F

Note:

i) t shall be as large as possible. If t cannot be greater than T minus 2.5 mm, coupons may be extracted from flattened specimens.

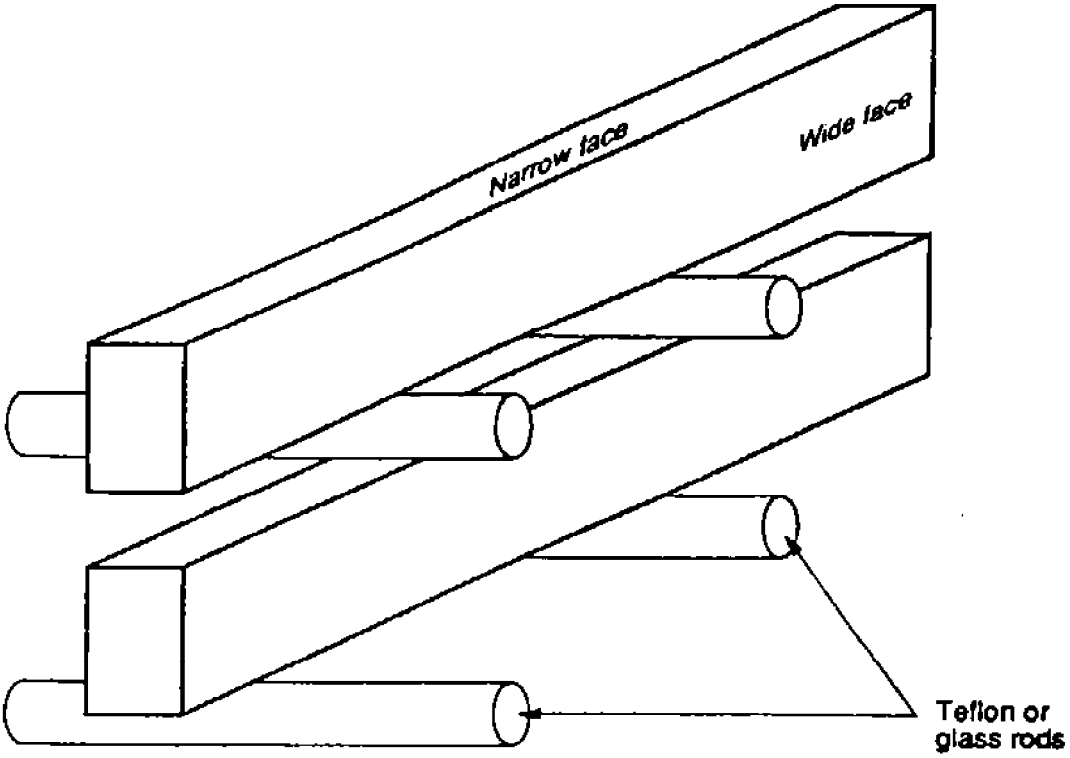
ii) For seamless pipe and fittings the specimens are 60 mm long × 20 mm wide.



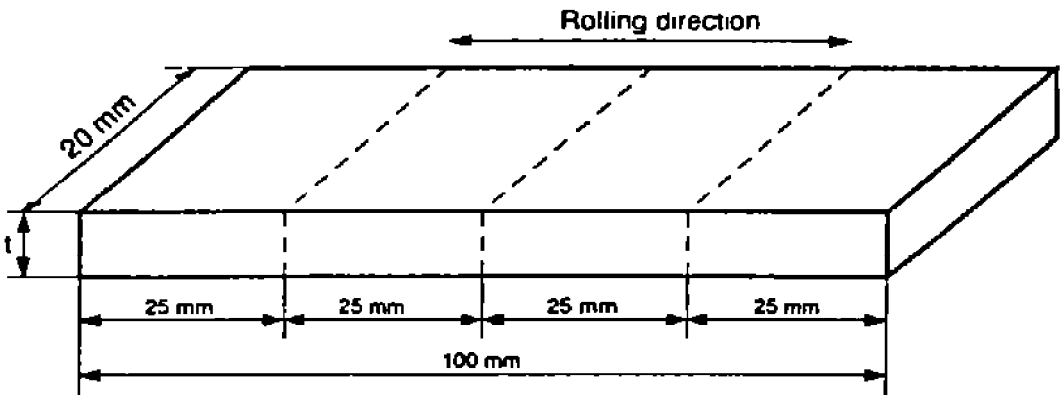
COUPON FROM LONGITUDINALLY WELDED PIPE
Fig. G

Note:

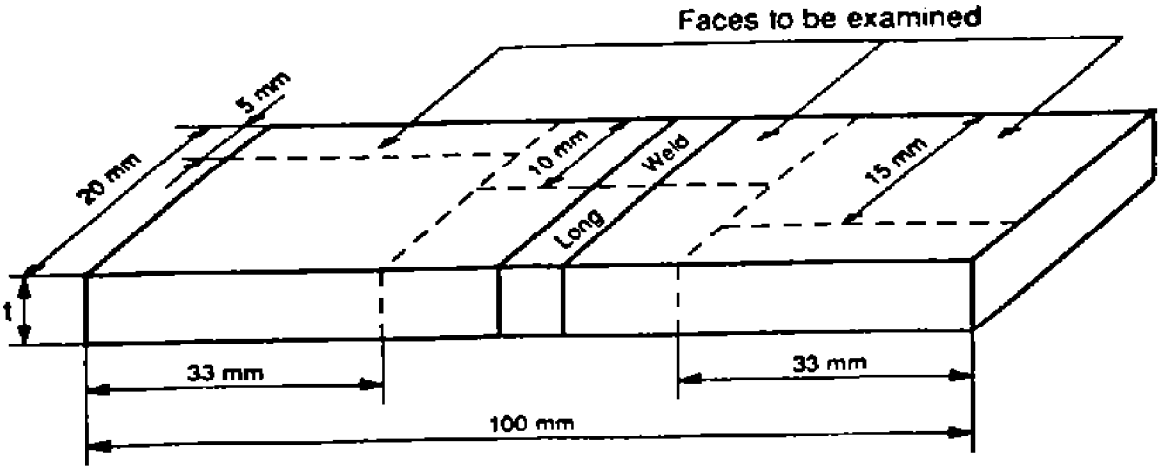
i) t shall be as large as possible. If t cannot otherwise be greater than T minus 2.5 mm, coupons may be extracted from flattened specimens.



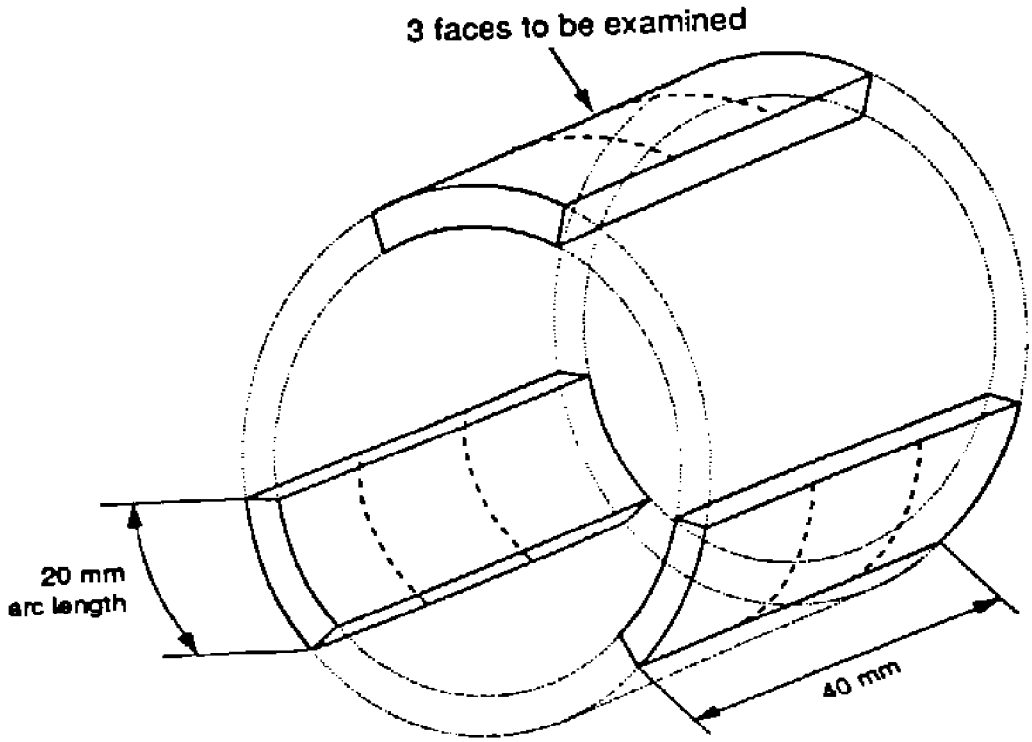
SPECIMEN ARRANGEMENT IN CELL
Fig. H



SECTIONING OF SPECIMENS FROM PIPE PARENT MATERIAL
Fig. I

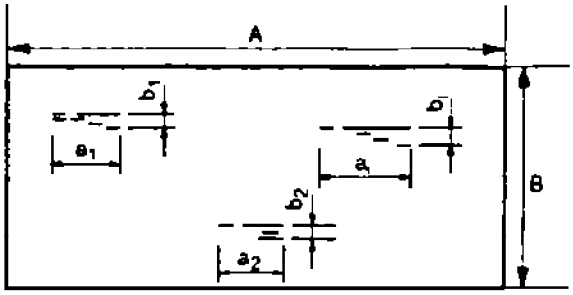


SECTIONING OF SPECIMENS FROM WELD SEAM
Fig. J



SECTIONING OF ALTERNATIVE SPECIMENS FROM SEAMLESS PIPE AND FITTINGS
Fig. K

Cracks are evaluated according to crack length ratio (CLR), crack thickness ratio (CTR) or crack sensitivity ratio (CSR) by measuring the total crack length, extent of stepwise cracks or stepwise crack area respectively.



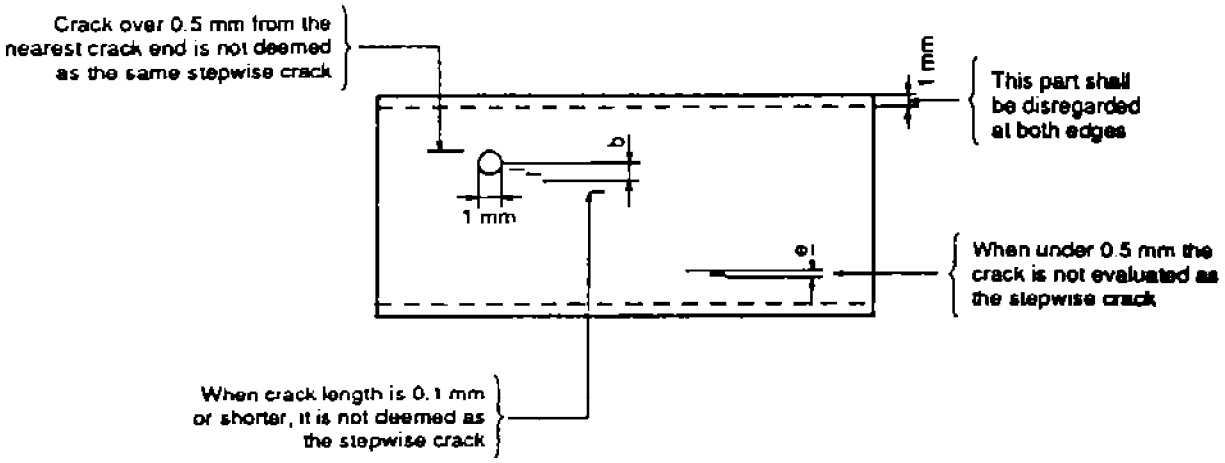
Length of stepwise crack: Σa_i
Extent of stepwise crack: Σb_i

CLR, CTR and CSR values can be calculated with the following equations.

$$CLR = \frac{\sum_{i=1}^{n} a_i}{A} \times 100\ (\%)$$

$$CTR = \frac{\sum_{i=1}^{n} b_i}{B} \times 100\ (\%)$$

$$CSR = \frac{\sum_{i=1}^{n} a_i . b_i}{A.B} \times 100\ (\%)$$



Definition of stepwise crack.

EVALUATION OF HIC
Fig. L