

The Engineering Equipment and Materials Users Association

PUBLICATION N° 169

SPECIFICATION FOR HIGH FREQUENCY ELECTRIC WELDED LINE PIPE

ERRATA

P.10, Sub-sec 3.2, equations (1) and (2) should read:

- (1) For all carbon levels
$$C + Mn/6 + (Cr + Mo + V)/5 + (Ni + Cu)/15 = 0.42 \text{ max}$$
- (2) For carbon ≤ 0.12
$$C + V/10 + Mo/15 + (Cr + Mn + Cu)/20 + Si/30 + Ni/60 + 5B = 0.23 \text{ max}$$

CICW/dm

Nov 97

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THE ENGINEERING EQUIPMENT AND MATERIALS USERS ASSOCIATION

SPECIFICATION FOR HIGH FREQUENCY ELECTRIC WELDED LINE PIPE

PUBLICATION No. 169

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THE ENGINEERING EQUIPMENT AND MATERIALS USERS ASSOCIATION

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FOREWORD

This EEMUA specification has been prepared as a joint industry users' document for the manufacture of High Frequency Electric Welded (HFW) pipe for high pressure oil and gas pipelines. The specification has been adapted from API Specification 5L but specifies a generally higher level of control on pipe manufacture to ensure consistency of performance during welding and service. The grade designations have been changed to EP to make pipe manufactured to this more onerous specification readily distinguishable from normal API line pipe. This does not preclude the use of intermediate grades, but the EP prefix should be used throughout.

1. INTRODUCTION

1.1. Scope and General Requirements

- 1.1.1** This specification covers the manufacture and testing of HFW carbon steel pipes up to 16 mm wall thickness for oil and gas transmission pipelines. The specified minimum yield strengths (SMYS) are within the range 240-485 N/mm² and both Non-sour and Sour service requirements are covered.

Note: Carbon steel includes micro-alloyed steels but corrosion resistant grades fall outside the scope of this specification.

- 1.1.2** To avoid the need to revise this specification for each application, certain requirements are given 'as specified on the Pipeline Data Sheet'. Such a Data Sheet shall be completed and supplied by The Purchaser. A typical Data Sheet form is shown in Appendix A.

- 1.1.3** The Manufacturer shall supply data on the weldability of the proposed material. If these do not meet his requirements, the Purchaser may require weldability trials to be undertaken by the Manufacturer. In this situation the details of the tests shall be defined by the Purchaser.

- 1.1.4** The Manufacturer shall also take note of the following appendices:

APPENDIX B - Manufacturing Procedure Specification

APPENDIX C - Manufacturing Procedure Qualification

APPENDIX D - Bead-on-pipe Test

1.2 Application of this Specification

- 1.2.1** Certain requirements in this specification are optional and may be specified by the Purchaser at the time of enquiry. The requirements shall not apply unless so specified by the Purchaser.

- 1.2.2** This specification shall be used in conjunction with the Pipeline Data Sheet.

1.3 Definitions

The Purchaser is the Company, or organisation acting on its behalf, which will use the pipe.

The Supplier is the organisation which receives the order from the Purchaser.

The Manufacturer is the company which manufactures the steel products.

'Approval' is a written response from the Purchaser confirming agreement to a proposal from the Supplier or Manufacturer.

'Shall' is a mandatory requirement.

For definitions of terms relating to welding including defects refer to BS 499 Pt 1.

1.4 Abbreviations

DWTT	—	Drop Weight Tear Test
HFW	—	High Frequency Electric Welded
EP	—	EEMUA Pipe Grade
SMYS	—	Specified Minimum Yield Strength
TS	—	Tensile Strength
NDT	—	Non-Destructive Testing
TM	—	Thermo-mechanically Rolled Plate or Strip
PWHT	—	Post Weld Heat Treatment
MPI	—	Magnetic Particle Inspection
CSR	—	Crack Sensitivity Ratio
HIC	—	Hydrogen Induced Cracking
HAZ	—	Heat Affected Zone

1.5 Quality Assurance

The Manufacturer shall establish and maintain a quality assurance system, in accordance with the applicable part of BS EN 29000 or an approved equivalent, to ensure that the goods or services supplied comply in all respects with the requirements of this EEMUA specification.

The Purchaser's nominated representative shall have the right to undertake such audits as he deems necessary to assess the effectiveness of the Manufacturer's quality system.

The Purchaser's nominated representative shall have the right to undertake inspection of the production or testing of the pipe during any stage of manufacture at which the quality of the finished product may be affected. The Purchaser shall also have the right to undertake inspection or testing of material purchased by the Manufacturer.

The accuracy of all measuring and testing equipment shall be demonstrated to the Purchaser prior to the start of production.

1.6 Referenced Standards

The latest editions of the specifications shall be used. Equivalent internationally recognised standards may be used subject to approval by the Purchaser.

BS EN 10002-1:	Tensile testing of metallic materials; Method of test at ambient temperature.
BS EN 10045-1:	The Charpy impact test on metallic materials; Test method (V- and U- notches).
BS 427:	Method for Vickers hardness test and for verification of Vickers hardness testing machines.
BS499 Pt1:	Welding terms and symbols: Glossary for welding, brazing and thermal cutting.
BS 709:	Method of destructive testing fusion welded joints and weld metal in steel.
BS EN 29000:	Quality systems
API Spec. 5L:	Specification for Line pipe.
API RP 5L3:	Recommended practice for conducting drop weight tear tests.
NACE TM-01-77:	Test method. Testing of metals for resistance to Sulphide Stress Cracking at ambient temperatures.
NACE TM-02-84:	Test method. Evaluation of pipe line steels for resistance to step wise cracking.
EN...* based on ISO/DIS 11484:	Steel tubes for pressure purposes — Qualification and certification of non-destructive testing (NDT) personnel.
EN...* based on ISO 9764:	Electric resistance and induction welded steel tubes for pressure purposes — ultrasonic testing of the weld seam for the detection of longitudinal and/or transverse imperfections.
pr EN 29303:	Seamless and welded (except submerged arc welded) steel tubes for pressure purposes — full peripheral ultrasonic testing for the detection of longitudinal imperfections.
EN...* based on ISO/DIS 12094:	Ultrasonic testing for the detection of laminar imperfections in strip/plate used in the manufacture of welded tube.

*EN number not yet available.

EN...* based on ISO/DIS 10124:	Seamless and welded (except submerged arc welded) steel tubes for pressure purposes — ultrasonic testing for the detection of laminar imperfections.
EN...* based on ISO TC17/SC19/WG1 Document N236:	Ultrasonic testing of the area adjacent to the weld seam for the detection of laminar imperfections.
EN...* based on ISO/DIS 11496	Ultrasonic testing of the tube ends for the detection of laminar imperfections..
EN...* based on ISO TC17/SC19/WG1 Document N237:	Magnetic particle inspection of tube ends for the detection of laminar imperfections.
EN...* based on ISO TC17/SC19/WG1 Document N241:	Magnetic particle inspection of the tube body for the detection of surface imperfections.

*EN number not yet available.

2. PROCESS OF MANUFACTURE AND MATERIAL

2.1 Process of Manufacture

Pipe shall be made by the high frequency electric welding (HFW) process.

The pipe shall be made in accordance with the agreed Manufacturing Procedure Specification.

The Manufacturer shall carry out a Manufacturing Procedure Qualification in accordance with Appendix C, witnessed by the Purchaser. Pipe manufactured during a successful procedure qualification may be supplied as part of the order.

For pipe manufactured from material supplied from established sources and having known and approved characteristics, the requirements for the manufacturing procedure qualification may be waived at the discretion of the Purchaser.

No change may be made to a successfully qualified manufacturing procedure without the Approval of the Purchaser and, as a condition of such Approval, the Purchaser may require a Manufacturing Procedure Qualification to be carried out on the new procedure.

The total strain introduced in the pipe during manufacture, after completion of the weld (e.g. strain due to cold sizing and straightening) should be limited to 3%. Otherwise the pipe shall be full body heat treated.

2.2 Steelmaking

All steel shall be made by the basic oxygen process or the electric furnace process. Steel shall be fully killed and made to clean steel practice. Where enhanced 'cleanness' is required, vacuum degassing or alternative procedures shall be applied.

At the option of the Purchaser, steel for Sour service shall be treated for inclusion shape control to increase resistance to HIC.

2.3 Heat Treatment

All pipes shall be subject to:-

Either (a) Full body normalising or full body quenching and tempering after welding.

- Or (b) An in-line austenitizing treatment of the weld zone provided the full width and thickness of the weld, including the HAZ, is treated. For Grades EP 415 and above the parent material shall be in the quenched and tempered or TM condition.

2.4 Skelp End Welds

Any skelp end welds shall be marked and completely removed.

3. CHEMICAL PROPERTIES AND TESTS

Target composition shall lie within the limits given in Table I; actual ranges to be achieved in production for each element shall however be agreed with the Purchaser.

3.1 Chemical Requirements

TABLE I
Chemical Requirements

ELEMENT	NON-SOUR SERVICE	SOUR SERVICE
C	0.16 max	0.14 max.
Mn	0.40 - 1.50	0.40 - 1.20
S	(a) 0.015 max. without skelp splitting (b) 0.005 max. with skelp splitting	0.002 max.
Si	0.15 - 0.40	0.15 - 0.40
P	0.025 max.	0.015 max.
Al	2 × N content with 0.060 max.	2 × N content with 0.050 max.
V	0.080 max. (1)	0.080 max. (1)
Nb	0.040 max. (1)	0.040 max. (1)
V+Nb+Ti	0.12 max. (1)	0.12 max. (1)
Cu + Ni	(2)	0.45 max.
Cr + Mo	(2)	0.20 max.
Ca	—	0.006 max.
N	—	0.010 max.

Notes

- (1) Either vanadium, niobium or titanium may be used singly or in combination subject to agreement between the Purchaser and the Manufacturer.
- (2) For Non-sour service the total of Cu + Ni + Cr + Mo shall be 0.80 max.

3.2 Carbon Equivalents

Steel supplied to this specification shall have maximum carbon equivalent values based on product analysis and calculated using the following formulae:-