中海油石化工程有限公司 CNOOC Petrochemical Engineering Co.,Ltd.	**SPECIFICATION FOR DUPLEX STAINLESS STEEL S31803 PIPING MATERIAL**	Job No.	243007D0796	
		Doc. No.	MP00S16	
		Phase	DETAILED DESIGN	
		Rev.	0	Page 1 of 25
Company:	CMIT CNOOC IRAQ LIMITED			
Project:	WATER INJECTION STATIONS EXPANSION PROJECT			
Company's Doc. No.:	CMIT-230084-1-796-PIP-15.03-00-2016			
Unit Name: `	GENERAL			

PIP

Prepared by: Liu X.Y. 20250410

Checked by: Ma X.R. 20250410

Approved by: Chou D.L. 20250410

0	ISSUED FOR CONSTRUCTION		Liu Xinyu	Ma Xiangrong	Qiu Dongli	20250410
B	ISSUED FOR APPROVAL		Liu Xinyu	Ma Xiangrong	Qiu Dongli	20250319
A	ISSUED FOR REVIEW		Liu Xinyu	Ma Xiangrong	Qiu Dongli	20250108
Rev.	Description		PRED.	CHKD.	APPR.	Date

TABLE OF CONTENTS

1. GENERAL 3

2. CODES, REGULATIONS, STANDARDS 6

3. MATERIAL AND MANUFACTURE 9

4. CHEMICAL COMPOSITION 10

5. FERRITE/AUSTENITE RATIO TEST 11

6. PROPERTIES AND TEST REQUIREMENTS 12

7. INSPECTION REQUIREMENTS 16

8. DIMENSION AND WEIGHT REQUIREMENTS 19

9. INSPECTION FREQUENCY 21

10. PICKLING AND PASSIVATION 22

11. MANUFACTURING AND SUPERVISION 22

12. TEMPORARY PROTECTIVE MEASURES 22

13. STORAGE AND TRANSFORATION 22

14. DOCUMENTATION 23

15. MARKING 24

16. OTHERS 25

1. GENERAL

MISSAN Oil Field is located in the SE of Iraq, close to Iran's border, about 175 km N-NW of BASRA City, and 350 km SE of Baghdad – the capital of Iraq.

MISSAN Oil Field includes three producing fields namely Abu GHIRAB, BUZURGAN and FAUQI. Abu GHIRAB and FAUQI fields extend beyond the Iranian border.

Since MISSAN Oil Field was built in 1976, it has suffered from the Iran-Iraq War and the Iraq War, so a lot of facilities needs to be upgraded and revamped.

The intended project is mainly concerned for the Water Injection Station(s) Expansion in Three Locations namely (BUN, FQS and BUS3).

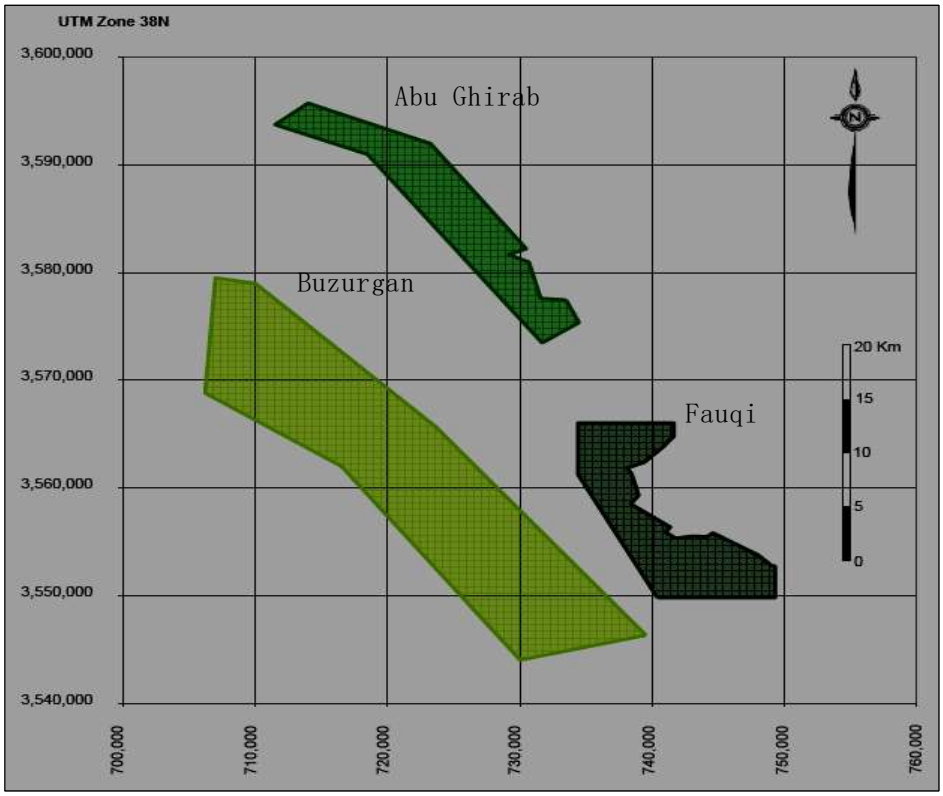

Figure 1.1-1 The overall MISSAN Oil Field

General Field Layout is shown in below figure:

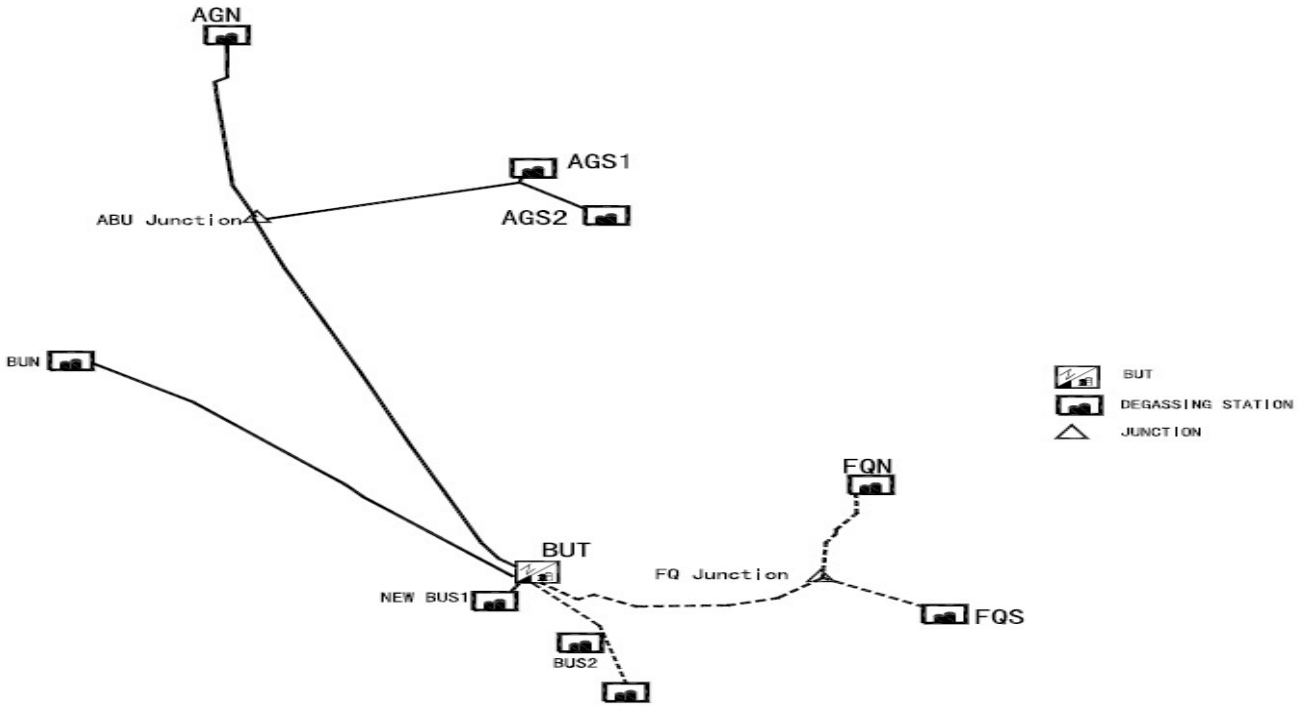

Figure 1.1-2 General Field Layout

1.1. Water Injection Stations (WIS):

A newly-established Water Injection Station are located at BUN, BUS3 and FQS areas adjacent to the newly-established Degassing Stations built therein.

On the three stations, the established Water Injection Stations and the Degassing Stations have been completed since 2021.

BUN Water Injection Stations (WIS) have been equipped with Two Water Storage Tanks, Three Water Feed Pumps, Three Water Injection Pumps, Water Injection Manifold that delivering the pressurized water to its intended manifold or/and well.

FQS Water Injection Station has been equipped with Two Water Storage Tanks, One Water Feed Pump, One Water Injection Pump, Water Injection Manifold that delivering the pressurized water to its intended manifold or/and well.

BUS3 Water Injection Station has been equipped with Two Water Storage Tanks, Two Water Feed Pumps, Two Water Injection Pumps, Water Injection Manifold that delivering the pressurized water to its intended manifold or/and well.

In this project, those three Water Injection Stations will be expanded.

1.2. Abbreviation and Acronyms

The following definitions shall apply to this document:

COMPANY: CNOOC IRAQ LIMITED

PMC:Project Management Consultant

CONTRACTOR :CNOOC Petrochemical Engineering Co.,Ltd (COPCL or CNOOCPEC).

WIS:Water Injection Station

WTP:Water Treatment Plant (Oily Water Treatment)

WIP:Water Injection Pump

DGS or **DS**: Degassing Station

BUT: BUZURGAN CPF Terminal

1.3. Purpose

This specification covers the requirements for the supply of S31803 duplex stainless steel materials for WATER INJECTION STATIONS EXPANSION PROJECT.

1.4. Scope

This specification defines the technical requirements for the design, manufacturing, testing, inspection and shipment of ferritic/austenitic stainless steel S31803 seamless pipe in accordance with ASTM A790/A790M and straight-seam welded steel pipe with filler metal in accordance with ASTM A928/A928M.

The technical requirements in this specification are supplement to ASTM A790/A790M and ASTM A928/A928M, and shall be used with ASTM A790/A790M and ASTM A928/A928M.

Any deviation from this specification must be approved, in writing, by the COMPANY. Such written approval must be obtained prior to the commencement of any work which would constitute such a deviation.

1.5. Abbreviations

WCL	Weld Centre Line
FL	Fusion line
HAZ	Heat Affected Zone
NDT	Non-destructive Testing
NPS	Nominal Pipe Size
OD	Outside Diameter
PREN	Pitting Resistance Equivalent Number
UT	Ultrasonic Testing

2. CODES, REGULATIONS, STANDARDS

2.1. Codes and Standards

The following Section contains lists of International, and project specifications which have been reviewed for extracts or referred to within this specification document.

Vendor shall meet or exceed the requirements of the latest edition of all applicable Codes, Regulations and Standards, except as superseded herein. In cases where more than one code, regulation or standard apply to the same condition, the most stringent shall be followed. In the event of a conflict between this specification and other specifications or correspondence, the COMPANY shall be consulted and a ruling, in writing, shall be obtained before any work is started.

ASME B16.25	Buttwelding Ends
ASME B31.3	Process Piping
ASME B36.19	Stainless Steel Pipe
ASTM A790 /A790M	Standard Specification for Seamless and Welded Ferritic /Austenitic Stainless Steel Pipe
ASTM A923	Standard Test Methods for Detecting Detrimental Intermetallic Phase in Duplex Austenitic/Ferritic Stainless Steels
ASTM A928 /A928M	Standard Specification for Ferritic/Austenitic (Duplex) Stainless Steel Pipe Electric Fusion Welded with Addition of Filler Metal

ASTM A999 /A999M	Standard Specification for General Requirements for Alloy and Stainless Steel Pipe
ASTM A370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A700	Practices for Packaging, Marking, and Loading Methods for steel Products for Domestic Shipment
ASTM A923	Standard Test Methods For Detecting Detrimental Intermetallic Phase In Duplex Austenitic/Ferritic Stainless Steels
ASTM E18	Standard Test Methods for Rockwell Hardness of Metallic Materials
ASTM E92	Standard Test Method for Vickers Hardness of Metallic Materials
ASTM E340	Standard Test Method for Macroetching Metals and Alloys
ASTM E407	Standard Practice for Microetching Metals and Alloys
ASTM E562	Standard Test Method for Determining Volume Fraction by Systematic Manual Point Count
ASTM G48	Standard Test Methods for Pitting and Crevice Corrosion Resistance of Stainless Steels and Related Alloys by Use of Ferric Chloride Solution
ISO 10893-4	Non-Destructive Testing of Steel Tubes. Part 4: Liquid Penetrant Inspection of Seamless And Welded Steel Tubes for the Detection of Surface Imperfections
ISO 10893-6	Non-destructive Testing of Steel Tubes - Part 6: Radiographic Testing of the Weld Seam of Welded Steel Tubes for the Detection of Imperfections
ISO 10893-8	Non-destructive Testing of Steel Tubes. Part 8: Automated Ultrasonic Testing of Seamless and Welded Steel Tubes for the Detection of Laminar Imperfections
ISO 10893-9	Non-destructive Testing of Steel Tubes. Part 9: Automated Ultrasonic Testing for the Detection of Laminar Imperfections in

	Strip/Plate Used for the Manufacture of Welded Steel Tubes
ISO 10893-10	Non-destructive Testing of Steel Tubes - Part 10: Automated Full Peripheral Ultrasonic Testing of Seamless and Welded (Except Submerged Arc-Welded) Steel Tubes for the Detection of Longitudinal and/or Transverse Imperfections
ISO10893-11	Non-destructive Testing of Steel Tubes - Part 11:Automated Ultrasonic Testing of the Weld Seam of Welded Steel Tubes for the Detection of Longitudinal and/or Transverse Imperfections
ISO10893-12	Non-destructive Testing of Steel Tubes - Part 12: Automated Full Peripheral Ultrasonic Thickness Testing of Seamless and Welded (Except Submerged Arc-welded) Steel Tubes
NACE MR0175 / ISO 15156	Petroleum, Petrochemical, and Natural Gas Industries-Materials for Use in H_2S-containing Environments in Oil and Gas Production
NACE TM0177	Laboratory Testing of Metals for Resistance to Sulfide Stress Cracking and Stress Corrosion Cracking in H_2S Environments
NACE TM0284	Evaluation of Pipeline and Pressure Vessel Steels for Resistance to Hydrogen-Induced Cracking
BS EN 10204	Metallic Products - Types of Inspection Documents

Note: This list covers the majority of references, but it is not exhaustive.

2.2. Reference Documents

The following General Specifications shall be used in conjunction with this specification where applicable:

CMIT-230084-1-796-PCS-15.65-00-0001	DESIGN BASIS
CMIT-230084-1-796-PIP-15.03-00-2011	SPECIFICATION FOR PROCESS PIPING MATERIALS

Some requirements in this specification may be modified by specific requirements in the Purchase Specification. In case of conflict, the specific requirements supersede this specification.

Any deviation from this specification must be approved, in writing, by COMPANY. Such written approval must be obtained prior to the commencement of any work which would constitute such a deviation.

3. MATERIAL AND MANUFACTURE

3.1. General Requirements

Any clauses and contents not covered by this specification for seamless steel pipe shall meet the requirements in ASTM A790/A790M and welded pipe shall meet the requirements in ASTM A928/A928M.

Any non-conformance of this specification with ASTM A790/A790M and ASTM A928/A928M shall be implemented as per more stringent regulations.

Substantive deviation to this specification and ASTM A790/A790M and ASTM A928/A928M by MANUFACTURER is not allowed, except getting the permission of COMPANY.

Except as otherwise agreed between the MANUFACTURER and the COMPANY, all inspections and tests required for qualification and pipe acceptance shall be performed at the manufacturing mill.

The pipe shall be made by seamless or an automatic welding process, with no addition of filler material in the welding operation, otherwise the pipe type is required in purchase order. The pipe shall be free of scale.

A sufficient discard shall be made from each ingot to secure freedom from injurious piping and undue segregation.

The chemical composition of duplex steels is balanced to give approximately equal amounts of ferrite and austenite. The ferrite content (volume fraction) shall be in the range 40%~60% for parent material & HAZ, 35%~60% for weld metal.

For sour service, S31803 pipes shall comply with related requirement of NACE MR0175/ISO 15156.

3.2. Material

Material: UNS S31803 duplex (ferritic/austenitic) stainless steel.

3.3. Cold Expansion

Where appropriate to the manufacture process, seam-welded pipe shall be subjected to cold expansion. Expansion shall be by mechanical process.

The cold expansion ratio S_r, % is defined as follows:

$$S_r=(D_a-D_b)/D_b \times 100\%$$

Where:

1) D_a: OD after expansion;

2) D_b: OD before expansion.

The cold expansion shall be not exceeded 1.5% for sizing.

3.4. Heat Treatment

All pipes shall be fully body solution annealed and water quenched.

For seamless pipe, as an alternate to final heat treatment in a continuous furnace or batch-type furnace, immediately following hot forming while the temperature of the pipes is not less than the specified minimum solution treatment temperature, pipes shall be individually quenched in water.

The heat treatment temperature shall be 1020°C~1100°C and be avoided to form precipitation of sigma phase and intermetallic phase.

The temperatures and times during the heat treatment shall be permanently recorded.

3.5. Traceability

The MANUFACTURER shall establish and follow documented procedures for maintaining the heat identity and/or lot identity until all required heat and/or lot tests are performed and conformance with specification requirements has been shown.

Manufacture shall provide the material test certificates conforming to BS EN 10204 Type 3.1.

4. CHEMICAL COMPOSITION

Chemical composition of steel (product analysis) shall comply with the requirements of Table 4.0-1, as follows.

Table 4.0-1 Chemical Composition

Grade Steel	Content (wt%)a									PREN[b] Min.
	C	Si	Mn	P	S	Ni	Cr	Mo	N	
S31803	0.030	1.00	2.00	0.030	0.020	4.50-6.50	21.0~23.0	2.50~3.50	0.08~0.20	34

Notes:

1) Maximum, unless a range is indicated.

2) PREN = %Cr + 3.3×%Mo+ 16×%N.

5. FERRITE/AUSTENITE RATIO TEST

The test pieces shall be extracted from the sample(s) removed for mechanical acceptance tests at a location around the pipe circumference. For longitudinally welded pipe, the test piece shall contain the full cross-section of the longitudinal weld.

Test pieces shall be electrolytically etched as per ASTM E407.

The ferrite content shall be measured 1 mm from both the internal and external surfaces and be reported for the parent material, weld metal and the parent material within 0.2 mm of the FL, as relevant to the method of manufacture.

Measurement of ferrite content shall be done by point counting in accordance with ASTM E562 and the maximum percent error shall be less than 10%. Original photomicrographs shall be included in the inspection documents.

The ferrite content shall be in the range 40%~60% for parent material & HAZ, 35%~60% for weld metal.

The microstructure shall be considered acceptable if it displays a uniform ferrite and austenite phase distribution and freedom from third phase precipitates.

For first-day production, the microstructure shall be checked at each end on each test pipe in 3 location 120° apart around the pipe. For welded pipe one of these locations shall be taken across the weld seam.

6. PROPERTIES AND TEST REQUIREMENTS

6.1. Tensile Test

Tensile test orientation shall be in both the transverse and longitudinal direction at ambient temperature, and conform to the tensile properties prescribed in Table 6.1-1.

Table 6.1-1 Tensile Test Requirements (Parent Pipe and Weld)

Pipe Grade	Yield Strength $R_{t0.5}$, (MPa), Min.	Tensile Strength R_m, (MPa), Min.	Elongation A_f(%),Min.	$R_{t0.5}$/Rm, Max.
S31803	450	620	25	0.9

6.2. Impact Test

The tests shall be performed in accordance with ASTM A370/A370M.

For seamless pipe, one set of three transverse Charpy test pieces shall be taken from the base material of each first-day-production test pipe and one pipe representing each lot.

Test pieces shall be located at the mid thickness.

For welded pipe, in addition to a parent material test, sets of three transverse Charpy test pieces shall be taken from each of the WCL, FL, and FL+ 5 mm. If the pipe wall thickness exceeds 20.0mm, additional sets of three Charpy test pieces shall be taken from all corresponding locations within 3 mm of the outside surface of the pipe.

For parent material tests, the descending hierarchy of test piece size and orientation shall be as follows:

Table 6.2-1 Sample Choice Sequence

Choice	Orientation	Size, mm
1	Transverse	10x10
2	Transverse	10x7.5
3	Transverse	10x5
4	Longitudinal	10x10
5	Longitudinal	10x7.5

Choice	Orientation	Size, mm
6	Longitudinal	10x5

Lower choice test pieces shall only be used when the higher choice is impractical. If pipe dimensions preclude the use of transverse specimens subject to prior agreement with the Purchaser, testing may be done in the longitudinal direction only. For pipe of wall thickness less than 5 mm, Charpy testing may be omitted. For all test pieces, the notch shall be perpendicular to the pipe surface.

The test temperature shall be 0°C. For the full size (10mm ×10mm) test, the required minimum average (set of three test pieces) absorbed energy values (transverse direction) shall be 60J, and any individual values shall be no less than 75% of the required minimum average (set of three test pieces) absorbed energy values.

For other specimens, the following factors shall be applied to the acceptance criteria, see Table 6.2-2.

Table 6.2-2 Impact Energy Factor

Size, mm	Orientation	Factor
10x10	Longitudinal	1.5
10x7.5	Transverse	0.8
	Longitudinal	1.2
10x5	Transverse	0.5
	Longitudinal	0.8

6.3. Guided-Bend Test

Guided-Bend test shall be undertaken for welded pipe. Two bend test specimens shall be taken transversely from the pipe. The test frequency shall be once per lot of pipes.

The bend test shall be acceptable if no cracks or other defects exceeding 3 mm in any direction are present in the weld metal or between the weld and the pipe metal after bending. Cracks that originate along edges of the specimen during testing, and that are less than 6.5 mm measured in any direction, shall not be considered.

6.4. Hardness Test

Hardness testing on pipe shall be performed using the Vickers test in accordance with the requirements of ASTM E92, and the individual maximum hardness at any position shall be not higher than 290 HV10 for seamless pipe and parent material and HAZ of welded pipe, and the HAZ hardness value shall be not higher than parent materials. For weld metal of weld pipe, the individual maximum hardness at any position shall be not higher than 320 HV10 and maximum hardness limit of the respective alloy used for the welding consumable, whichever is stricter.

6.5. Metallographic Examination

Two full thickness samples for seamless pipes and two full thickness transverse samples from the longitudinal weld for welded pipes from both ends of each first day- production test pipe and from one pipe representing each lot shall be extracted.

Test pieces from the samples shall be polished and etched for metallographic examination in accordance with ASTM E340, and the test specimens shall clearly reveal all microstructural features such as inter-metallic phases such as sigma, and third phase precipitates such as nitrides.

The macro-examination shall be performed at a minimum ×5 magnification, and the acceptance criteria shall show sound and reasonably uniform material free of injurious laminations, cracks, and similar objectionable defects.

The microstructure shall be suitably etched and examined at ×400 magnification and shall have grain boundaries with no continuous precipitates. The content of deleterious phases in the microstructure shall be carried out using an etchant that will clearly identify such phases in accordance with ASTM E562. The total of intermetallic phases (such as sigma phase, etc.) and third phases (including nitrides, carbides, etc.) shall not exceed 0.5% volume fraction based on an area of 1 mm^2.

6.6. Flattening Test

The flattening test shall be performed according to ASTM A999/A999M Section 21, and the test specimen shall be taken from both ends of pipe. If a specimen from any length fails because of lack of ductility prior to satisfactory completion of the first step of the flattening test

requirement, that pipe shall be rejected subject to retreatment in accordance with ASTM A999/A999 and satisfactory retest. If a specimen from any length of pipe fails because of a lack of soundness that length shall be rejected, unless subsequent retesting indicates that the remaining length is sound.

6.7. Pitting Corrosion Resistance Test

The pitting corrosion test procedure shall be carried out according to the Method A defined in ASTM G48.

The test specimen shall have a dimension of full wall thickness by 25mm along the weld and 50 mm across the weld. The test shall expose the external and internal surface and a cross section surface including the weld zone in full wall thickness.

Specimens may only be pickled and passivated prior to testing if this will also be part of the final product manufacturing specification. Test specimen shall be prepared according to ASTM G48.

- Test solution: ASTM G48 ferric chloride test solution (about 6% $FeCl_3$ by mass).
- Test temperature: 25±1°C.

The acceptance criteria, as follows:

- No evidence of pitting, under visual examination with a magnification of 20x.
- Weight loss shall be recorded and no more than 4g/m^2.

6.8. Intergranular Corrosion Test

The intergranular corrosion test shall be carried out according to the Method C defined in ASTM A923.

The test specimen shall have a dimension of full wall thickness by 25mm along the weld and 50 mm across the weld. The test shall expose the external and internal surface and a cross section surface including the weld zone in full wall thickness. Test specimen shall be prepared according to ASTM A923.

- Test solution: ASTM A923 ferric chloride test solution (approximately 6% $FeCl_3$ by weight). The pH of the test solution shall be adjusted to approximately 1.3.

- Test temperature: 25±1°C.

The acceptance criteria, as follows:

- The corrosion rate shall not exceed 10 mdd.

Note: The corrosion rate is calculated in accordance with the following: corrosion rate (mdd)= weight loss (mg) /[specimen area (dm^2) x time (days)

7. INSPECTION REQUIREMENTS

7.1. Visual Inspection

All test pipes shall be examined visually for dimensional tolerances, and surface defects.

All finished pipe shall be visually examined such as scratches, surface roughness, dings, straightener marks, cutting chips, steel die stamps, stop marks, or pipe reducer ripple, the pipe is permitted to be accepted based upon visual examination provided that the depth of the imperfection is less than 0.1 mm or 10% of the specified wall thickness, whichever is the greater.

All internal and external surface shall be supplied free of scale, oxide film, oil, grease, and lacquers (expect for paint marking characters).

7.2. Hydrostatic Test

Hydrostatic test shall be carried out in factory to all steel pipes. Test pressure for all sizes of pipe shall such that the hoop stress calculated on the basis of minimum allowable wall thickness and including stresses from end locating is at least 90% of the specified minimum proof strength at room temperature. The hydrostatic test pressure need not exceed 17.0MPa for outside diameters less than 4", or 19.0MPa for outside diameters 4" and above. Pressure shall be held for not less than 10s, during which leakage shall not occurred to steel pipe. The water used for hydrostatic testing shall contain less than 50ppm chlorides. Records made by automatic hydrostatic recorder shall be available.

7.3. Nondestructive Test

100% NDT shall be carried out to all pipes. For seamless pipe, NDT operations and acceptance criteria shall comply with Table 7.3-1. For welded pipe, NDT operations and acceptance criteria shall meet the requirement shown in Table 7.3-2.

Table 7.3-1 NDT Operations and Acceptance Criteria for Seamless Pipe

NDT Operation	Specification	Specific Requirements	Acceptance Criteria
UT for longitudinal and transverse imperfections	ISO 10893-10	Notch shall be on both internal and external surface	U2/C
UT for laminar imperfections	ISO 10893-8	Reference standard shall be flat-bottomed round recess	1) Max. individual imperfection: ● Area 500mm^2; 2) Mini. Imperfection size: ● Area: 150mm^2; ● Length:15mm; ● Width: 8mm; 3) Max. population density: ● 10 (per 500 mm x 500mm square)
UT of wall thickness	ISO 10893-12	/	As per ISO 10893-12
UT for laminar imperfections at pipe ends	ISO 10893-8	Tested band shall be a minimum of 50 mm and shall overlap automatic tested pipe body area by a minimum of 25mm. Reference standard shall be a flat-bottomed round recess	No trigger/ alarm
Liquid penetrant testing of bevel faces	ISO 10893-4	/	No linear indications

Table 7.3-2 NDT Operations and Acceptance Criteria for Welded Pipe

NDT Operation	Specification	Specific Requirements	Acceptance Criteria
UT for longitudinal and transverse imperfections in the weld seam	ISO 10893-11	Notch shall be on both internal and external surface	U3
UT for laminar imperfections in the pipe body (Note-1)	ISO 10893-9	Edge band shall be 25 mm from final plate/ strip edge. Reference standard shall be a flat-bottomed round recess.	U1
UT for laminar imperfections at pipe ends	ISO 10893-8	Tested band shall be a minimum of 50 mm and shall overlap automatic tested pipe body area by a minimum of 25mm. Reference standard shall be a flat-bottomed round recess	No trigger/ alarm
Testing of the weld seam at pipe ends not covered by automatic testing: manual UT or RT	ISO 10893-11/ ISO 10893-6	Notch shall be on both internal and external surface. Film radiographic techniques using fine-grain type film and lead intensifying screens.	U3 As per ISO 10893-6
UT for laminar imperfections in the plate/strip edges adjacent to the weld (Note-2)	ISO 10893-8	Reference standard shall be a flat-bottomed round recess	4) Max. individual imperfection: ● Area 500mm^2; 5) Mini. Imperfection size: ● Area: 150mm^2; ● Length:15mm; ● Width: 8mm; 6) Max. population density: ● 10 (per 500 mm x 500mm square)

NDT Operation	Specification	Specific Requirements	Acceptance Criteria
Liquid penetrant testing of bevel faces	ISO 10893-4	/	No linear indications

Notes:

1) The test may be performed on the strip prior to forming into pipe with a minimum coverage of 25%.
2) The test may be performed on the strip edges in accordance with ISO 10893-9 prior to forming into pipe.

Such pipes shall be rejected if the test signal was produced by imperfections that cannot be identified or was produced by cracks or crack-like imperfections. Any repaired pipe by welding shall be not accepted.

The pipe bevel face shall be free of laminations and inclusions.

Blind area without inspection is not allowed for each pipe.

The MANUFACTURER shall produce the ultrasonic procedures (automatic and manual) he intends to use, including the equipment capabilities, the reference standards for calibration of sensitivity, and the acceptance criteria. These procedures shall be submitted at bid stage and shall be subject to qualification tests prior to production start.

All personal undertaking NDT activities shall be certificated in accordance with ISO 11484.

8. DIMENSION AND WEIGHT REQUIREMENTS

8.1. Diameter Tolerance

Variation in outside diameter shall comply with requirements of Table 8.1-1.

Table 8.1-1 Permissible Variations in Outside Diameter

NPS Designator inch	Permissible Variations in Outside Diameter	
	Over (mm)	Under (mm)
$_{1/8}$-1$_{1/2}$	0.4	0.8
Over 1$_{1/2}$ to 4	0.8	0.8
Over 4 to 8	1.6	0.8

NPS Designator inch	Permissible Variations in Outside Diameter	
	Over (mm)	Under (mm)
Over 8 to 18	2.4	0.8
Over 18 to 26	3.2	0.8
Over 26 to 34	4.0	0.8
Over 34 to 48	4.8	0.8

8.2. Out-of-roundness

The pipe out-of-roundness shall be determined at three locations equidistant along the pipe body.

The out-of-roundness (i.e. the difference between the major and minor outside diameters) measured at the same plane over four axes at 45° intervals shall not exceed 1% of the nominal outside diameter.

8.3. Wall Thickness Tolerance

The minimum wall thickness at any point shall not more than 10% under the nominal wall thickness specified, and the maximum wall thickness at any point shall not exceed 15% above the nominal wall thickness specified.

8.4. Length of Supply

The length of pipe shall be 11.5m ± 0.5m. It is not allowed to adopt circumferential weld to connect pipes. All pipe lengths shall be recorded.

8.5. Straightness

The finished pipe shall be reasonably straight. All pipes shall be randomly checked for straight line shall not exceed 1.5mm/m.

8.6. Pipe Ends

The end of pipes should be processed to be sloping joint (bevelled edge for welding). To measure as the benchmark of vertical line of axis of steel pipes, for the equal wall thickness

welding steel joint, the degree of sloping joint should be 30°~35°. The width of root face is 1.6mm ± 0.8mm, and all burrs at the ends of the pipe shall be removed.

When inner surface is fabricating or burnishing, measure of inner cone angle shall be as the benchmark of axis of steel pipes. The angle of the internal taper should be no more than 7°.

The out-of-squareness shall not exceed the following values:

- 1mm for NPS≤8;
- 0.005×QD with the maximum of 1.6mm for NPS>8.

8.7. Delivered Weight

Steel pipes shall be delivered according to theoretical weight, and the deviation between practical weight and theoretical weight must be controlled within - 3.5%~+10% for NPS 12 or smaller, and -5%~+10% for larger than NPS12.

9. INSPECTION FREQUENCY

The inspection frequency of relevant tests shall comply with the Table 9.0-1, as follows:

Table 9.0-1 Inspection Frequency

Type of inspection	Frequency of inspection	Maximum quantities of lot
Product analysis	Two pipes from each lot.	The lot shall include all pipe of the same size and heat, heat treated in the same furnace at the same temperature, time at heat, and furnace speed or all pipes of same size and heat, hot formed and quenched in the same production run. a) NPS<2: 400; b) 2≤NPS≤5: 200; c) NPS≥6: 100
Tensile test	Each first-day-production test pipe and one pipe each lot respectively. (a set of three test pieces from each test Pipe)	
Impact test		
Metallographic Examination		
Pitting Corrosion Resistance Test		
Intergranular Corrosion Test		
Hardness test	Each first-day-production test pipe and two pipes from each lot.	
Flattening Test	5% of the lot, but in no case less than two lengths of pipe.	
Ferrite/Austenite	Each end of each first-day-production test pipe	

Type of inspection	Frequency of inspection	Maximum quantities of lot
Ratio	and one pipe each lot respectively. (a set of two pieces)	
Visual inspection	Each pipe	
NDT	Each pipe	
Hydrostatic test	Each pipe	

10. PICKLING AND PASSIVATION

All DSS pipes shall carry out pickling and passivation and shall be free of scale and contaminating iron particles. When DSS pipes are bright annealed, pickling is not necessary.

11. MANUFACTURING AND SUPERVISION

During the period of pipe manufacturing, purchaser is entitled to assign inspector to the plant for pipe inspection and acceptance, and is entitled to reject pipe which fails to meet requirements.

If necessary, representative assigned by purchaser shall perform spot-check for production to guarantee consistency with standard and this agreement.

MANUFACTURER of pipe shall allow representative assigned by purchaser to perform inspection and spot-check to test record and test specimen during the period of pipe manufacturing.

12. TEMPORARY PROTECTIVE MEASURES

The outside surface of steel pipe is without any coating and lubricating. All pipes external shall be wrapped with a thin polythene sheet or other efficient methods approved by COMPANY. Pipe end shall be equipped with pipe end protector. Steel pipe size shall be identified piece by piece according to practical dimension.

13. STORAGE AND TRANSFORATION

During manufacture, storage, and transportation, the pipe shall not contact with loose carbon steel (e.g. swarf, filling etc.). Nylon sling or rubber-coated hooks/support etc. shall be used for all handing operation.

The pipe shall be segregated from other materials during storage and supported during stacking to avoid deformation.

MANUFACTURER shall be responsible for the protection of steel pipe during storage. MANUFACTURER shall be subject to regulation of steel pipe storage specified by purchaser during bidding.

The pipe packaging and loading for shipment shall be performed according to the procedures of Practices ASTM A700, and all pipes shall not travel as deck cargo.

14. DOCUMENTATION

The MANUFACTURER shall provide the COMPANY at the bid stage with a technical specification giving full details of all the characteristics of the proposed steel, the steel-making process, the billet manufacturing process and the inspection procedures.

The MANUFACTURER's specification shall include the following minimum information:

- Experience of this product in similar oil field (more than 2 years);
- Steel-making process;
- Pipe manufacture process;
- Special treatments for controlling residual elements and segregations;
- Nominal weight of each heat;
- Heat treatment process of pipe (including temperature, soaking time and cooling medium, etc.);
- Aimed chemical analysis, together with minimum and maximum working limits (ladle and check) selected for the order;
- Visual inspection;
- NDT procedures;
- Dimensional inspections with frequencies of execution.

Unless otherwise specified by COMPANY, the following information shall also be included in MANUFACTURER's specification:

- Name of pipe MANUFACTURER and Mill;

- Unit length of pipes offered, if different from that stated;
- Location of paint stenciling (on inside or outside of pipe);
- Pipe supply track record as well as histograms of chemical and mechanical test results from previous orders of the same pipe grade;
- At MANUFACTURER's option, any other technical information related to the proposed pipe supply;
- Description of the proposed pipe end protectors (if any);

The MANUFACTURER's deviations/qualifications to present specifications. Where no deviations are stated in the bid, the potential MANUFACTURER shall be considered as fully accepting the requirements of present specification.

MANUFACTURER shall submit final documents when delivery, including:

- Production analysis report;
- Tensile test report;
- Impact test report;
- Hardness test report;
- Flattening test report;
- Metallographic test report;
- Pitting corrosion resistance test;
- Ferrite/Austenite ratio test report;
- NDT report;
- Factory hydrostatic test report;
- Product quality certificate;

Compilation of all concessions/deviations, if any, granted by COMPANY.

The report shall be approved and signed by the Inspector who attended the tests.

15. MARKING

Each length of pipe shall be legibly marked related information at least, as follows:

- MANUFACTURER's name or brand
- ASTM standard No.
- Material grade
- Heat No.
- Batch number
- Pipe size (outside diameter & nominal wall thickness)
- Pipe length

Making shall begin approximately 300mm from the end of each length pipe. Other required information shall be according to ASTM A999/A999M.

16. OTHERS

After manufacture procedure is determined, the MANUFACTURER shall provide pipe samples in advance to the purchaser for weld process performance test.