

NUCLEAR POWER CORPORATION OF INDIA LTD  
(A Government of India Enterprise)

PROJECT : 700 MWe


SPECIFICATION NO. : PC-M-287


REVISION NO.	0	1		
DATE OF REVISION (Months / Year)	July, 2008	Sept. 2009		
TOTAL NO OF PAGES (Including cover sheet)	18+2	18+2		


**Technical Specification For  
Seamless Carbon Steel Pipes and Butt Welding Seamless Fittings  
For Feeders**


USI No. : 33116


Ref: PB-M-48, R-3, Feb., 2001


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R1 Issued : Sept. 2009

Issued By : NPCIL

## REVISION CONTROL SHEET

**DOCUMENT TYPE: SPECIFICATION**

**NO. : PC-M-287 Rev.No. 1**

**TITLE : Technical Specification for Seamless Carbon Steel Pipes  
and Butt Welding Seamless Fittings for Feeders**

REV. NO. & DATE	DESCRIPTION OF REVISION	PREPARED BY	CHECKED BY	REVIEWED BY	APPROVED BY
0 (July' 2008)	Original (pages 18+2)	R.Midha / JKS	T.S.Shetty	T.K.Kandar / G.M.Arora	G.K.Sharma
1 (Sept.' 2009)	100 mm NB feeder pipe, feeder stubs and feeder fittings added in para. 4.1.2 (f) and 4.1.3 (e)	<i>R. Midha</i> 30.9.09 <i>S. Ahmad</i> 30.9.09	<i>R. Shetty</i> 30.9.09	<i>T. K. Kandar</i> 30.9.09 <i>Rajendra Khandu</i> 30.09.09	<i>G. K. Sharma</i> 30.09.09

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**1.0 SCOPE**

This Specification establishes the technical requirements for the material, manufacture, examination, inspection, testing documentation, identification and packaging of seamless carbon steel pipes and butt welding seamless carbon steel fittings for "FEEDERS".

**2.0 CONTENTS**

The requirements of this specification are presented under the following headings:

	<u>Section</u>
Specifications, codes/standards and drawings	3.0
Material and Manufacturing Requirements	4.0
Examination, Inspection and Testing	5.0
Documentation and Identification	6.0
Preservation and Packaging for Shipment	7.0
Technical Information required to be Submitted with Bids	8.0
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**3.0 SPECIFICATIONS, CODES/STANDARDS AND DRAWINGS**

All Specifications, codes/standards and drawings listed below of the issue in effect on the date of the pertinent tendering documents, apply as specified herein. In the event of any conflict between the provisions of this specification and the documents listed below, this specification with the concurrence of Purchaser shall govern.

**3.1 Specifications, Codes/Standards**

ASME	:- Boiler and Pressure Vessel Code
	:- Section II – Part A – Ferrous Material Specifications
	:- Section III – Division-1 Sub-Section NB – Class-I Components
	:- Section V – Non-destructive Examination
ANSI	:- Standards of American National Standards Institutes

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ANSI – B 16.9	:-	Factory made Wrought Steel Butt Welding Fittings
ANSI – B 16.25	:-	Butt Welding of Ends
ANSI – B 16.28	:-	Wrought Steel Butt Welding Short Radius Elbows and Returns
ANSI – B 46.1	:-	Surface Texture
MSS – SP – 25	:-	Standard Marking System for Valves, Fittings, Flanges and Unions
ASTM	:-	Appropriate standards of American Society for Testing and Materials
SA – 333	:-	Specification for Seamless and Welded Steel Pipe for Low Temperature Service
SA - 370	:-	Test Methods and definitions For Mechanical Testing Of Steel products
SA – 420	:-	Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Low Temperature Service
SA – 530	:-	Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe
SE – 709	:-	Standard Guide for Magnetic Particle Examination
SE – 165	:-	Standard Method for Liquid Penetrant Inspection
SE – 213	:-	Standard Method for Ultrasonic Inspection of Metal Pipe and Tubing
ASTM-E-94	:-	Recommended Practice for Radiographic Testing
ASTM – E – 112	:-	Method for Estimating the Average Grain Size of Metals
ASTM-E-381	:-	Method of Macro Etch Testing Products, Inspection and Rating Comprising Steel Bars, Billets, Blooms and Forgings.

### 3.2 Drawings

NPCIL/01006/2235/SK :- Butt welding edge preparation for feeder fittings (for Flat type consumable inserts)

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#### 4.0 MATERIAL AND MANUFACTURING REQUIREMENTS

##### 4.1 Material Requirements

##### 4.1.1 General

All pipes and butt welding fittings shall be new and of high quality carbon steel material and manufacture. All the general requirements, specified herein, regarding material, manufacture, examination, inspection and testing shall be applicable to all pipes and butt welding fittings and shall also be applicable to the starting stock used for the manufacture of butt welding fittings. All pipes and butt welding fittings shall be of 'SEAMLESS' manufacture. They shall have the best workmanship like finish and be made by the best manufacturing practice.

- a) The steel shall be clean, homogeneous and intrinsically tough and shall be produced by recognized "fine Grain melting practice" and shall be fully "killed". The manufacturer shall indicate in the bid the Austenitic grain size guaranteed in the micro structure for their offered products and shall report the grain size actually achieved in the material certificates in the event of an order. Grain size should be 5 or finer.
- b) The steel subjected to vacuum treatment and/or refinement is preferred. The manufacturer shall indicate in the bid the particular type of vacuum treatment and/or refinement method used for Purchasers consideration/evaluation.
- c) The chemical composition shall be in accordance with the particular SA-Material specifications specified herein with the following restrictions on chromium, sulphur, phosphorus and other elements:

Chromium	:	0.20% min. and 0.25% max.
Sulphur	:	0.025% max.
Phosphorus	:	0.025% max.
Aluminium	:	0.04% max
Vanadium	:	0.01% max.
Copper	:	0.30% max.
Cobalt	:	0.02% max.
Nickel	:	0.40% max.
Molybdenum	:	0.10% max.

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- d) All material product forms shall be supplied in the “Normalized” condition, unless otherwise specified herein and shall be delivered in “pickled” condition. All heat treatment and pickling procedures shall be subjected to purchaser’s approval.

Note: - All pipe and pipe fittings shall be pickled to remove loose scale before use for fabrication. (Either at supplier’s shop or at site by the contractor)

- e) In addition to the particular SA – Material specification requirements, the following special or supplementary requirements shall be applicable to pipes and butt welding fittings, where appropriate for the material product forms and as specified herein. However, if any of the following requirements are already called for in the SA – Material specification, then such requirements need not be repeated, provided the scope of testing of the stricter of the two is followed :-

Sl. No	Special/ Supplementary Requirement	Material Product Form	Remarks
1.	Metal Macro Structure / Etching test	Pipes and pipe fittings	Vide 4.1.2(d) and 4.1.3(d)
2.	Grain size evaluation	Pipes and pipe fittings	Vide 4.1.2(d) and 4.1.3(d)
3.	Product Analysis (Modified)	Pipes and pipe fittings	Vide 4.1.2(d) and 4.1.3(d)
4.	Hardness Test	Pipe fittings	Vide 4.1.3(d)
5.	Cold bending (close coiling) test	Pipes	Vide 4.1.2(d) and 5.2 (c)
6.	Flattening test	Pipes	Vide 4.1.2 (d)
7.	Controlled Bore and Wall Thickness	Pipes and pipe fittings	Vide 4.1.2 (f) and 4.1.3 (e)
8.	Hydrostatic Test	Pipes and pipe fittings	Vide 4.1.2 (d) and 4.1.3 (d)
9.	Magnetic Particle Examination	Pipe fittings	Vide 4.1.3 (d)
10.	Liquid Penetrant Examination	Pipe fittings	Only when magnetic particle examination is not feasible. Permitted only with prior approval of Purchaser.
11.	Ultrasonic Examination	Pipes and pipe fittings	Vide 4.3.2 and 5.3
12.	No Repair by Welding	All pipes and pipe fittings	
13.	No bar stock machined products	All pipe fittings	

4.1.2 **Pipes**

- a) All pipes shall be in accordance with SA-333 Grade 6 (modified). They shall also meet the requirements of ASME Section III – NB for Class I components and this specification
- b) Pipes shall be cold drawn, followed by appropriate heat treatment for controlling and achieving the required micro-structure and mechanical properties. The pipes shall be finally bright annealed. All pipes supplied to this specification shall be suitable for cold bending (close coiling) to a minimum mean radius of the lesser of 250 mm or four times the pipe O.D. The manufacturing route and condition of each lot of pipe shall be recorded. Refer Appendix-A for Standard QAP.
- c) Pipes shall be offered in double random lengths, unless otherwise specified in tendering documents. Pipes shall be supplied with square cut ends. Average length of supplied pipes shall be 11 meter with minimum length of 7 meter.
- d) For all pipes, the special/supplementary tests as defined below shall be conducted with satisfactory results.
  - 1) Metal structure/etching test
  - 2) Grain size evaluation (5 or Finer shall be obtained)
  - 3) Product analysis (Modified)
  - 4) Flattening test (as per SA-530)
  - 5) Cold bending (close Coiling) test, [vide 5.2 (c)]. This test shall be conducted on two samples taken from pipes of each size per lot.
  - 6) Hydrostatic test
  - 7) Ultrasonic examination

} These tests shall be conducted on one sample, for each test, taken from each pipe size per lot.

} This test shall be conducted on each pipe at both ends.

} The test/examination shall be conducted on each pipe.
- e) No repair by welding shall be permitted on the pipes.
- f) The pipe / header stubs supplied to this specification shall be of special dimensions with controlled bore diameter and wall thickness.

Nominal size	Special ID for Feeder Pipe/ Header Stub (mm)	Wall Thickness of Feeder Pipe	Special Thickness for Feeder Stubs (mm) on reactor headers
100 mm NB	87.00 ± 0.50	10.0 <sup>+0.60/-0.00</sup>	13.50 <sup>+1.0/-0.0</sup>
80 mm NB	73.65 ± 0.45	8.50 <sup>+0.60/-0.00</sup>	11.0 <sup>+1.0/-0.0</sup>
65 mm NB	59.00 ± 0.40	7.40 <sup>+0.60/-0.00</sup>	10.0 <sup>+1.0/-0.0</sup>
50 mm NB	49.25 ± 0.30	6.75 <sup>+0.60/-0.00</sup>	9.0 <sup>+1.0/-0.0</sup>

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#### 4.1.3 Butt Welding Pipe Fittings

- a) All butt welding fittings shall be in accordance with SA-420 Gr.WPL-6 (modified). They shall also meet the requirements of ASME Section III – NB for Class-I components and this Specification. The fittings shall be rated equivalent in strength (pressure rating) to pipes of same size and wall thickness. This shall be established and certified as described in NB-3649 and NB-3612.
- b) Butt welding fittings shall be forged or formed to the finished shape and size by hot working. The hot working shall be done in such a way as to cause metal flow in directions most favorable for resisting the stresses encountered in service and as to achieve completely wrought structure. Forging for pipe fittings shall be done in number of stages. Fittings manufactured by hot working and/or cold forming processes shall be appropriately heat treated for controlling and achieving the required micro structure and mechanical properties. Fittings shall be finally annealed or normalized. The manufacturing route and condition of each lot of fittings shall be recorded. Refer Appendix-B for Standard QAP.
- c) Fittings shall not be manufactured by machining only from bar stock.
- d) For all fittings, the special / supplementary tests as defined below shall be conducted with satisfactory results.

1)	Metal structure/etching test	}	These tests shall be conducted on one sample, for each test, taken from each size of fittings per lot.
2)	Grain size evaluation (5 or finer shall be obtained)		
3)	Product analysis		
4)	Hardness test Fittings shall have maximum hardness of 197 HB.		
5)	Hydrostatic test	}	The test shall be conducted on 2 samples for each size of fittings per lot. Hydro pressure shall be 174 Kg/cm <sup>2</sup> (g)
6)	Ultrasonic examination	}	To be carried out on all fittings. [Refer Note 5.3.1(b)]
7)	Magnetic particle examination		
8)	Dimension Check	}	See Note given below.
9)	Thickness gauging by ultrasonic		
10)	Proof test	}	The test shall be conducted on one fitting from each nominal size. Pressure shall be 770 Kg/cm <sup>2</sup> (g)

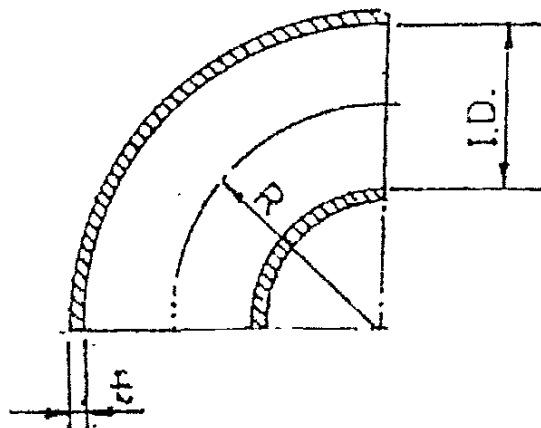
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Note: - Ultrasonic Thickness Gauging: - In addition to thickness measurement by conventional methods, ultrasonic thickness gauging shall be carried out (in grid pattern) on pipe fittings from each lot on random basis. For elbows the extent of examination shall be minimum 10 % and for other fittings it shall be minimum 2%. If results are found to be unacceptable, the thickness gauging shall be extended on 100% of fittings.

- e) The fittings supplied to this specification shall comply with the requirements of ANSI-B-16.28 / B-16.9 for the corresponding nominal size fittings excepting that their bores and wall thickness shall meet the special requirements as given below:

Nominal size	Special ID for elbows at ends & concentric reducer(mm)	Special ID for elbow along the length (mm)	Special Wall Thickness, t		Bend Radius * R	
			Concentric Reducers (mm)	Elbows (mm)	LR (mm)	SR (mm)
100 mm NB	87.00 ± 0.50	87.00 ± 0.50	10.00 <sup>+0.60/-0.00</sup>	10.00 <sup>+0.60/-0.00</sup>	152.4	--
80 mm NB	73.65 ± 0.45	73.65 ± 0.45	8.50 <sup>+0.60/-0.00</sup>	8.50 <sup>+0.60/-0.00</sup>	114.3	--
65 mm NB	59.00 ± 0.40	59.00 ± 1.0	7.40 <sup>+0.60/-0.00</sup>	9.50 <sup>+0.6/-0.00</sup>	95.25	63.50
50 mm NB	49.25 ± 0.30	49.25 ± 0.8	6.75 <sup>+0.60/-0.00</sup>	8.70 <sup>+0.5/-0.00</sup>	76.20	50.80

\* Refer Sketch below:



- f) The fittings shall have circular, uniform and smooth bores. This shall be demonstrated by means of longitudinal and transverse sectioning on a representative fitting of each size and wall thickness, produced by the same production process/method for the bulk order fittings. The butt weld edge preparations shall be as per drawing no: NPCIL/01006/2235/SK suitable for Flat type consumable inserts.

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- g) Ovality, concentricity, other tolerances (except ID and wall thickness) shall be as given in ANSI B16.28 and B16.9 for pipe fittings.
- h) No repair by welding shall be permitted on the fittings.
- i) Ball passage test shall be carried out on all the elbows. The size of the ball shall be worked out by the manufacturer considering the dimensional requirement and after establishing the procedure obtain NPCIL approval.

#### **4.2 Surface Finish and End Preparation**

- 4.2.1 The surfaces of pipes and pipe fittings shall be smooth and even, and shall be prepared as required for the examination, inspection and tests called for in para-5.0 – Examination, Inspection and testing.
- 4.2.2 Butt welding ends of pipe fittings shall be prepared in accordance with Drawing No. NPCIL/01006/2235/SK for Butt Welding Edge Preparation for feeder fittings for Flat type consumable inserts. Other requirements for edge preparation shall be as per ANSI B 16.25.

#### **4.3 Repair of Pipes and Fittings**

- 4.3.1 All the surface of pipes and fittings shall be smooth and all surface, defects revealed by visual or non-destructive examinations shall be removed as required by ASME Section III NB – 2538 excepting that repair by welding shall not be permitted.
- 4.3.2 Pipes and pipe fittings containing sub surface defects which are greater than 5% of the wall thickness, as revealed by the volumetric examination such as ultrasonic / radiographic examination, are not acceptable and shall be rejected.
- 4.3.3 Repairs by thermal process shall not be performed and all local repairs shall be by mechanical means only, viz. grinding and machining and shall be smoothly blended into the surrounding surface. Removal of any defects, surface or sub surface, shall not reduce the remaining local defect free wall thickness under the repair areas to less than the specified minimum wall thickness in Para 4.1.2(f) & 4.1.3 (e). All repaired areas shall be re-examined by magnetic particle and the volumetric examination by which the defect was detected, to ensure complete removal of the defect. Acceptance of repaired geometrics shall be at the discretion of the Purchaser.
- 4.3.4 However, repair by local grinding / machining shall not be permitted in such portions of any fitting, if it impairs the integrity or reinforcement of such fittings (e.g. high stress/stress concentration areas).

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## 5.0 EXAMINATION, INSPECTION AND TESTING

### 5.1 General

The manufacturer shall be responsible to provide and perform all the in-process and final examination, inspection and testing specified herein. The examination, inspection and testing shall be programmed and conducted in a manner satisfactory to the Purchaser and hence the examination, inspection and testing programme and procedures shall be subjected to the prior approval of the purchaser.

The Purchaser or his authorized, agency shall have access to the Manufacturer's or their sub-contractors premises at all reasonable times and to the extent necessary to assess compliance with the provisions of the said programme and this specification. Examination, inspection and test reports shall be submitted by the Manufacturer to the Purchaser.

### 5.2 Material Inspection and Tests

- a) All the materials shall be inspected / tested with satisfactory results and accepted in full compliance with the applicable SA – Material specification and in addition with this specification. The material shall be tested in its final finished and heat treated condition at delivery.
- b) The pipes and pipe fittings shall be impact tested and shall comply with the impact test requirements of the applicable SA – Material Specification.
- c) Cold Bend Tests for Pipes

Two pipe sample lengths selected from each size per lot shall be cold bent through 135° around a cylindrical or contoured mandrel to produce pipe bends of mean radius equal to lesser of 250 mm or 4 (four) times the pipe O.D. Suitable flexible bore mandrels or approved filler material shall be used to maintain the section circularity of the pipe bends. After bending, the external surfaces of each test bend shall be inspected and shall be found free from cracks, laminations and other defects. Further the external surfaces of each test bend shall be examined by liquid penetrant method and shall be free from any indications. Similarly internal surfaces of the bend shall be inspected after sectioning and liquid penetrant examination carried out. After the successful completion of these inspection and examination, the bend specimens shall be forwarded to the Purchaser for his review and reference purposes.

If the test bends reveal any cracks, laminations or other defects on inspection or any unacceptable indications on liquid penetrant examination, the lot of pipes from which these test bends were made shall be rejected.

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- d) Documents in the form of Certified Material Inspection / Test reports and Mill Certificates that the required tests have been carried out at the sources shall be furnished by the Manufacturer to the Purchaser.

### 5.3 Non-destructive Examination of Pipes and Fittings

#### 5.3.1 Examination of Pipes and Pipe – Stock

- a) Pipes of all sizes shall be examined for both “Longitudinal and Transverse” discontinuities by Ultrasonic examination by scanning with beam directed successively in two opposite circumferential directions and two opposite longitudinal directions. The examination shall be carried out in accordance with ASME Section III NB-2550.
- b) In case of such pipe fittings which cannot be satisfactorily examined by ultrasonic method, their starting pipe stock material shall be ultrasonically examined as in (a) above. This aspect shall be checked, established prior to taking up manufacturing of pipe fittings and needs approval of purchasers. In addition to ultrasonic inspection, 5% (Min.5 Nos.) fittings of lot of each size shall be radiographed to detect any flaws.

#### 5.3.2 Examination of Pipe Fittings

- a) Each pipe fitting shall be ultrasonically examined completely to cover its entire volume.
- b) If it is not possible to cover the entire volume in the finished form the starting stock or semi-finished material, shaped nearest to the final form shall be ultrasonically examined completely and subsequently the finished product shall be ultrasonically examined to the maximum extent possible. Further, if the purchaser deems it necessary the Manufacturer shall examine by radiographic method, to Purchaser’s satisfaction, such portion of the finished product which cannot be either ultrasonically examined meaningfully or examined to the required ultrasonic examination acceptance standards.

The bidder shall describe in detail the stages and extent of volumetric examination in his quotation for Purchaser’s evaluation.

- c) Each pipe fitting shall be examined by magnetic particle method. This examination shall cover completely all the external surfaces and accessible internal surfaces. The examination shall be repeated with magnetization applied successively in two mutually perpendicular directions over the surfaces. When magnetic particle examination cannot be meaningfully carried out over an entire or part of a fitting liquid penetrant examination may be carried out in such cases with prior approval of the Purchaser.

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- d) The Ultrasonic, Radiographic Magnetic Particle and Liquid Penetrant Examinations shall be in accordance with ASME Section III – NB-2550. The ultrasonic examination acceptance standards for the starting stock or semi-finished material shall be same as called for the corresponding finished product thickness.
- e) Ultrasonic thickness gauging for elbows to be done as per approved procedure.

#### 5.4 **Additional Examination, Inspection and Testing Requirements**

- 5.4.1 All examination, inspection and testing procedures shall be submitted to Purchaser for approval and only after the approval of such procedures work shall commence.
- 5.4.2 All chemicals and fluids such as cleaning agents, penetrants, developers and water used for hydrostatic testing and paints used for marking shall preferably be free from halogen and sulphur. However, in no case more than 25 ppm of halogen and sulphur shall be permitted. For hydro testing, the potable quality water is acceptable. Examination materials, chemicals, fluids, or any other material used for examination, inspection and tests shall be removed from the product to achieve a clean-dry surface.
- 5.4.3 Fittings shall be demagnetized immediately after magnetic particle examination.
- 5.4.4 In addition to the above examination, inspection and tests, the finish of all surfaces of all pipes and fittings shall be inspected visually as required by the basic SA – Material Specifications. This shall include the use of boroscope, dental mirrors or any other devices where necessary.

#### 6.0 **DOCUMENTATION AND IDENTIFICATION**

##### 6.1 **Documentation**

All manufacturing Procedures, Examination/Inspection/Testing programme and procedures, after approval by Purchaser as called for in this Specification, shall form part of documentation. Various Examination, Inspection and Testing data/results obtained their evaluation and disposition etc, shall be properly documented and certified by the Manufacturer. The final documentation, before issue, shall be countersigned by the Purchaser or his Authorized Agency. At least 6 (six) sets of such final documentation shall be supplied to the Purchaser.

##### 6.2 **Identification**

- a) Pipes shall be marked in accordance with SA – 530 and the applicable SA-Material Specification. Marking shall be done on both the ends of pipes.

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- b) All fittings shall be marked in accordance with MSS-SP-25 and the applicable SA – Material Specification.
- c) In addition, all pipes and fittings shall be identified with this specification no. (PC-M-287) and the lot reference number.
- d) Marking shall be by vibro-tool or electro-etching only.
- e) To indicate that the materials have undergone non-destructive examinations an additional material identification shall be painted on each piece as described below:
  - i) Pipes : A continuous longitudinal white strip
  - ii) Fittings : A continuous white strip on the major dimensions but not extending over the machined end preparation.

#### 7.0 PRESERVATION AND PACKAGING FOR SHIPMENT

- 7.1 The Manufacturer shall not ship the materials without obtaining the clearance for shipment by the Purchaser or his Authorized Agency.
- 7.2 The supplier shall be responsible for preparing, preserving and packing the materials supplied to this specification, to protect them against corrosion and damage of any kind during shipment to the destination and also during storage at site. Protective measures shall be adequate to prevent corrosion in transit and in storage at the destination for a period of about 48 months in a tropical climate.
- 7.3 All material shall be cleaned and coated with removable preservative to prevent corrosion. Pipe fittings shall be packaged to protect their weld edge preparations. Pipe ends shall be sealed by water proof plastic end caps. All material shall be packed in weather proof wooden boxes in such a way that materials will not undergo any damage or rusting during shipment, handling and site storage. The packaging shall be subjected to the inspection and approval of Purchaser or his Authorized Representative.
- 7.4 All pipes shall be in bundles with each pipe ends closed, machine strapped at 3 places and box packed

#### 8.0 TECHNICAL INFORMATION REQUIRED TO BE SUBMITTED WITH BIDS

- 1) Catalogue, technical literature indicating product range, manufacturing and testing facilities available at bidder works.
- 2) Confirmation to the effect that the specifications have been clearly understood by the bidder.

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- 3) Confirmation to the extent that the material shall be supplied completely in accordance with technical specifications. In case of any deviations from technical specifications, the fact should be clearly brought out giving cross reference to the Para no., section no. of this specification.
- 4) Complete manufacturing sequence with details of the process at each stage. Indicate clearly the method for manufacturing ID controlled pipe fittings.
- 5) Raw material proposed to be used for manufacturing of each type item. i.e. material specification, size, thickness of raw material to be used for manufacturing pipes and pipe fittings.
- 6) Indicate specifically :
  - i) Type of vacuum treatment or refinement method used.
  - ii) Meeting additional chemistry control requirements
  - iii) Forging ratio for making pipe fittings.
  - iv) Availability of pickling facility.
- 7) Vendor shall indicate the activities to be carried out in house and furnish the details of sub vendors for manufacturing / inspection activities.

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**APPENDIX – A: STANDARD QUALITY ASSURANCE PLAN FOR PIPES**

Sl. No	OPERATION	NPC'S INSPECTION			SAMPLE	INSPECTION
		A	B	C		
1.	Heat Analysis	√			One sample per heat	Checking of test certificates- Heat no. grade, Fine grain melting practice and fully killed. See restrictions of Para 4.1.1 (c)
2.	Heat Treatment	√	√		All pipes must be heat treated	H.T. by normalizing. Checking of time temperature chart.
3.	Product Analysis	√			As per material spec ( min. One sample from each size per each lot)	Checking of test certificates see restrictions of Para 4.1.1(c)
4.	Tensile Test	√		√	On 5% of the pipes from lot ( min. two per lot)	Witness the test operation
5.	Impact test	√		√	As per material spec.	Witness the test operation
6.	Grain Size	√		√	One sample from each size per lot	Checking
7.	Flattening Test	√		√	Test shall be made from both ends of each pipe.	Witness the test operation
8.	Cold bending test & Liquid penetrant test	√		√	Two samples taken from pipes of each size per lot	Witness the test operation
9.	Metal Macro Structure / Etching test	√			One sample from each size per lot	Also check that no seam and no repair by welding
10.	Ultrasonic Examination	√	√	√	Refer Para 5.3.1	Witness the test operation.
11.	LP Examination	√	√	√	On re-worked areas only	Witness the test operation.
12.	Hydrostatic Test	√	√	√	Each pipe shall be tested at 174 kg/cm <sup>2</sup> (g)	Witness for pressure integrity and leak tightness
13.	Dimension check	√		√	Each pipe	Check for double random length, controlled bore, ends, wall thickness, straightness
14.	Visual Inspection test		√		10% random checking – surface quality, cleaning	Inside/outside of pipes to ensure absence of mill scale, degreased condition and dryness.
15.	Marking, color coding	√			Each pipe shall be marked	Checking as per Para 6.2
16.	Document / test certificate verification	√			All certificates must be checked.	Checking
17.	Preservation and Packing	√			All pipes must be suitably packed	Checking as per Para 7.0
18.	Issue of Third Party Inspection Certificate and Shipping Release Note.	√		√		

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**APPENDIX – B: STANDARD QUALITY ASSURANCE PLAN FOR PIPE FITTINGS**

Sl. No	OPERATION	NPC'S INSPECTION			SAMPLE	INSPECTION
		A	B	C		
1.	Inspection of pipes	√		√	All pipes	Co-relation with mill T.C., heat no. and grade, surface quality, dimensional check
2.	Heat Analysis	√		√	One sample per heat	Checking of test certificates. See restrictions of Para 4.1.1 (c)
3.	Ultrasonic test on starting stock / pipe	√	√	√	Only when UTE on final product is not feasible (As per Para 5.3.1(b))	Prior approval required. Witness the test operation
4.	Forming	√		√	One sample from each lot of fittings per size and wall thickness	Longitudinal and transverse sectioning
5.	Heat Treatment	√	√		All pipe fittings must be heat treated	Checking of time temperature chart and temp. monitoring
6.	Product Analysis	√			As per material spec. ( min. one sample from each size per each lot)	Checking of test certificates see restrictions of Para 4.1.1(c)
7.	Tensile Test	√		√	One sample from each size of fitting per each lot ( min. as per material spec.)	Witness the test operation
8.	Grain Size	√		√	One sample per size per lot	Checking of Test Certificates
9.	Impact test	√		√	As per material spec.	Witness the test operation
10.	Hardness Test	√		√	One sample from each size of fitting per each lot	Witness the test operation
11.	Proof test	√		√	One sample from each nominal size of fitting	Witness the test operation
12.	Etching test	√			One sample from each size per lot	Checking of seamless.
13.	Micro Structure test	√			One sample from each size per lot	Checking
14.	Radiographic examination	√	√	√	Required on 5 % qty ( minimum 5 nos. fittings of each size), when UTE is carried out on starting pipe stock material	See Para 5.3.1 (b). Checking radiographs
15.	Ultrasonic test	√	√	√	As per Para 5.3.2	Witness the test operation
16.	Magnetic Particle Examination ( LPE if permitted)	√	√	√	Each fitting shall be tested	Witness the test operation
17.	Dimension Test	√		√	Each fitting	
18.	Ultrasonic Thickness gauging	√	√	√	Fitting thickness gauging in grid pattern. Para 4.1.3 (d)	Witness the test operation
19.	Hydrostatic Test at 174 kg/cm <sup>2</sup> (g)	√	√	√	On two samples from each size of fittings per each lot	Witness for pressure integrity and leak tightness
20.	Proof test	√		√	One fitting from each nominal size.	Pressure shall be 770 Kg/cm <sup>2</sup> (g)
21.	Ball passing test for elbows	√		√	100% elbows	Witness the test operation for circularity, ovality
22.	Visual Inspection test		√		10% random checking – surface quality, cleaning	Inside/outside of fittings to ensure absence of mill scale, degreased condition and dryness.

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23.	Marking and color coding	√			Each fitting shall be marked	Checking
24.	Document / test certificate verification	√			All certificates must be checked.	Checking
25.	Preservation and Packing	√			All fittings must be suitably packed	Checking
26.	Issue of Third Party Inspection Certificate and Shipping Release Note.	√				

Legends:- A = Checking of Test Report  
 B = Checking of material or equipment  
 C = Witnessing of Operation (customer hold point)

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**Notes:-**

1. The lot number, heat number, coil number, mill test certificate number and its quantity shall be identified at raw material stage for ladle analysis, check test analysis and for product analysis. Random samples for various testing as required by QAP and code / material specification shall be drawn by QA representative and stamped.
2. Original test certificate of raw materials shall be required for review at the time of First Stage Inspection.
3. Manufacturer should use starting stock of pipe of sufficiently higher thickness for making pipe fittings to meet thickness reduction during process of bending, forming, scale removal, grinding (for removal of surface defects if found during visual / MPE / UTE) marking, etc. Manufacturer shall satisfy this aspect to the purchaser's representative before taking up the work.
4. The material test laboratory shall be approved by NPCIL.
5. The heat treatment furnaces shall be in good condition and shall have temperature recorder and checked for calibration by NPCIL QA / Third party QA and the related certificate shall be submitted. The validity of calibration shall not be more than 6 months. The agency for heat treatment shall be approved by NPCIL.
6. The loading and unloading of items in the furnace may be witnessed by NPCIL QA / Third party representative. Heat treatment chart shall be submitted for review.
7. All items shall be identified to avoid mixing and proper identification during inspection and examination.
8. Vendor shall carry out 100 % dimensional check on all pipe fittings.
9. All items shall be visually examined for any imperfections and defects.
10. All NDE examinations (UTE, MPE, LPE, Eddy current testing, radiography, etc.) shall be carried out as per NPCIL approved procedures. The selection of appropriate technique(s) / method(s) shall be approved by NPCIL. Work shall be taken up after approval of procedures.
11. NPCIL QA representative / Third party shall witness 100 % UT examination, 100 % magnetic particle examination and 100 % liquid penetrant examination
12. On removal of surface defects after MPE / LPE (particularly on class-I components) thickness checking shall be carried out by ultrasonic gauging. The UT instrument shall have reference master thickness gauge of required contour and capable of measuring the least count accuracy as required.
13. Suitable Go - NO GO gauges and fixtures may be used for dimensional inspection. Threads shall be examined by plug and ring gauges. These gauges shall have proper certification for accuracy.
14. Material traceability report (indicating material, size, item description, lot no., heat no., NDE report nos., check test certificate, vendor's final certificate no., etc.) shall be submitted.

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15. Color coding, bin card and proper tagging along with entry in proper registers shall be maintained to identify the location of material at any point during manufacturing and to avoid mixing of materials.
16. All items shall be stamped by vendor's name / monogram apart from item description, size, serial no., class, material code, rating, grade, etc. and meeting MSS-SP-25 and NPCIL specification. The fittings confirming to NPCIL specification shall be color coded as mentioned in specification.
17. The history docket containing all test certificates, inspection reports, approved procedures, QAPs along with shipping release shall be submitted in properly bound document, duly signed by NPCIL QA / Third party Inspection agency, along with soft copy on CD.
18. In case, manufacturer intends to use " On line " UTE or eddy current examination or hydro test facility, the required system details shall be submitted for approval for on line witnessing and extent of witnessing.
19. Calibrated instruments shall be used for inspection, examination and testing.
20. Non destructive examinations shall be carried out by personnel qualified to level-I of ASNT/ISNT and evaluated by ASNT/ ISNT level-II.
21. The portion at the end of pipe which is not examined by Ultrasonic Examination is to be discarded.
22. The visual examination and dimensional check shall cover outer diameter, wall thickness, workmanship, root face, end beveling, end squareness, outer and inner surface finish, out of roundness, straightness, dents on inside / outside surfaces, length, weight, marking, color coding, stamping, stenciling, processing / rolling marks on internal surface, etc.
23. After repair by grinding on parent material up to minimum wall thickness, the repaired area should be blended smoothly to the surrounding surface.
24. Check and ensure consistency and repeatability of detection in ultrasonic examination.
25. The drawing for all non-standard pipe fittings (like branched outlet fittings, lateral tees, etc for which the dimensions are not given in ANSI standards) shall be submitted for NPCIL approval.
26. QA representative shall stamp the inspected items.
27. Vendor shall submit guarantee certificate.