1. **Description:**

This specification governs the quality requirements alloy steels rings manufactured by **Ring Rolling Machine** from ingots/ cake supplied by CFFP. The CFFP-cake/ bloom converted at vendor's work will be supplied to our sister units/ customers after final heat treatment, MT/UT testing and finish machining. The material (Cake or Bloom) supplied to vendor is not for sale.

2. **Pre Qualification for the Tender** :

2.1 Only those **indigenous** vendors are eligible to quote who have **Ring Rolling Machine, Vendor is required to furnish the details of Ring Rolling Machine (Type, Make, Year of Manufacture).**

2.2 Who have their own heat treatment facility.

Vendor will confirm the following in tabular form :

		To be filled by vendor
SNo.	Name of Vendor	Name of vendor
01	Year of establishment	MM/YYY
02	Type and make of Ring Rolling Machine	Details of Ring Rolling Machine
03	Maximum height that can be made & weight	Mm & kg
04	Heat Treatment Facility (Yes/No)	Details of Heat Treatment Furnaces

The vendor who have Hammer and Forging Press, but do not have automatic Ring Rolling Machine need not to quote.

The vendor registered with CFFP need not fill the supplier registration form. However companies who are not registered with CFFP will be required to fill the Supplier Registration Form and send it back along with the offer. The form is available at the BHEL Haridwar website (www.bhelhwr.co.in).

Offer of the vendor who will not qualify each clause (2.1 to 2.2) will not be evaluated.

3. **Scope of Supply:**

3.1 **The supplier is to convert the ingots/ cake size to the rings by ring rolling operation, annealing/normalizing/normalizing & tempering and rough machining.** The vendor will quote the ring rolling charges per kg of the Ring. The categories are divided in the following Table-1. Vendor will fill column "Ring Rolling Charges/ Kg" and "Vendor's Remarks". Cake of same heat and same forging will have to be ring rolled & heat treated at same subcontractor for ensuring uniformity of mechanical properties.

Table : 1

S.No.	OD mm (Min)	OD mm (Max.)	Height mm (Max.)	Wt. Range of the Ring (kg)	Ring Rolling Charges / Kg	Vendor's Remarks
01	---	1500	300	Up to 2500 Kg		
02	---	1500	301-400	Up to 2500 Kg		
03	---	1500	401-500	1001 Kg to 3500 Kg		
04	1501	2500	300	1001 Kg to 2500 Kg		
05	1501	2500	301-400	1001 Kg to 3500 Kg		
06	1501	2500	401-500	2501 Kg to 4500 Kg		

It is reiterated that vendor must quote for per kg rate of delivered ring weight and not the cake weight.

Delivery Condition of the item: CFFP supplied cake / bloom / ingot will be return after ring rolling, annealing/normalizing/normalizing & tempering and rough machining.

3.2 The cake weight will be calculated as per the formula given below :

$A = [\{(OD+20)^2 - (ID-20)^2\} X (Ht+20)] / 162196$ Kg

Add Scale lose 10 %

Cake Weight = A X 1.10 Kg

3.3 The vendor will send the dimension report along with the ring.

3.4 Tolerance on Dimensions:

On Outer Diameter : +5, -0

On Inner Diameter : +0, -5

On Height : +5, -0

3.5 Vendor to ensure rings free from surface imperfections, cracks and distortion.

4. **Chemical Composition:**

Actual chemical composition of the item will be intimated to supplier before sending the material for ring rolling operation. However, the chemistry of the cake/ blooms will be within the limits given below (The Grades are mentioned here are only indicative; there will be more grades in the each category of the rings) with minor variations in chemistry. Some indicative grades are given below. There will be other grades and its variations. Actual chemistry will be given with Purchase Order.

All figure are in %

Grade		C	S	P	Si	Mn	Ni	Cr	Mo	V	Cu	Nb	Al
EN-10222-4 (P355 NH/QH)	Min	---	---	---	0.10	0.90	---	---	---	---	---	---	---
	Max	0.20	0.015	0.025	0.50	1.65	0.30	0.30	0.08	0.10	0.20	0.05	0.06
AA19331 (20C8)	Min	0.15	---	---	0.15	0.60	---	---	---	---	---	---	0.02
	Max	0.25	0.40	0.40	0.35	0.90	0.30	0.30	0.05	0.05	0.25	---	0.05
AA19332 (30C8)	Min	0.25	---	---	0.15	0.60	---	---	---	---	---	---	0.02
	Max	0.35	0.40	0.40	0.35	0.90	0.30	0.30	0.15	0.05	0.25	---	0.05
AA19341 (20C15)	Min	0.16	---	---	0.10	1.30	---	---	---	---	---	---	---
	Max	0.24	0.035	0.035	0.35	1.70	0.30	0.30	0.15	0.05	0.25	---	---
AA19308 (21CrMoV57)	Min	0.17	---	---	---	0.40	---	1.20	0.55	0.20	---	---	---
	Max	0.25	0.020	0.020	0.40	0.80	0.80	1.50	0.80	0.35	---	---	---
HW19386/ (21CrMoNiV4-7)	Min	0.17	---	---	0.15	0.35	0.50	0.90	0.65	0.25	---	---	---
	Max	0.25	0.015	0.015	0.35	0.85	0.80	1.20	0.80	0.35	---	---	0.15
HW19382 (26NiCrMoV11-5)	Min	---	---	---	---	---	2.80	1.40	0.30	---	---	---	---
	Max	0.28	0.015	0.015	0.30	0.40	3.30	1.80	0.45	0.15	---	---	---
HW19390 (X22CrMoV12-1)	Min	0.18	---	---	---	0.40	0.30	11.00	0.80	0.25	---	---	---
	Max	0.24	0.015	0.025	0.50	0.90	0.80	12.50	1.20	0.35	---	---	---

5. **Process:**

Heating For Forging: Due care will be taken in loading the forging in the reheating Furnace. Ingots / cakes/ bloom should be rest on the stands of approx. size 400x400mm which is laid on the reheating furnace. Care should be taken to avoid flame impingement on the ingots / cakes / blooms. The heating rate should be selected in such a way that cracks due to excessive thermal shock will not occur. Sufficient soaking time will be given to ensure uniform temperature is obtained across the cross section of forging. **Heating rate, soaking time and Forging temperature shall be specified.** Overheating and Burning during heating is not acceptable.

6. **Forging and Ring Rolling:**

The upsetting /indenting /Punching must be carried out on hydraulic forging press of sufficient capacity. Ring rolling operation shall be carried out on Continuous Ring Rolling machine. End Temperature of Rolling operation must be reported and shall lie in the range of 1250°C- 900°C or depending on the grade of the ring.

Reduction ratio achieved in each forging operation may also be furnished. Actual dimensions and ovality if any after ring rolling shall be measured and recorded.

7. **Heat Treatment:**

The Rings shall be Normalized/ Normalized and Tempered or Annealed. The Normalizing/ Annealing temperature should be selected to achieve the desired hardness depending upon the grade. The final heat treatment cycle will be given at the time of placement of order. **The**

Heat Treatment must ensure uniform grain refinement to facilitate proper ultrasonic examination. Actual Heat Treatment cycle after ring rolling operation must be reported.

Heat Treatment after ring rolling operation in above mentioned grades are given below:

Grade	Heat Treatment after Ring Rolling
EN-10222-4 (P355 NH/QH) , AA19331 (20C8) , AA19332 (30C8) , AA19341 (20C15)	Normalizing
AA19308 (21CrMoV57), HW19386 (21CrMoNiV4-7) , HW19382 (26NiCrMoV11-5)	Normalized and Tempered
HW19390 (X22CrMoV12-1)	Annealing

8. **Hardness:**

Hardness of each forging shall be measured on minimum of two place 120°C apart on both ends of the ring. The differences between two values for the rings shall not exceed 20 BHN. The hardness of the ring will depend upon the grade.

9. **Inspection:**

i. Heat Treatment charts.
ii. Dimension. The Ring rolling forging must be free from cracks and overlapping.
iii. Random verification of chemistry (spectro analysis) after completion of process will done by CFFP –inspector.
iv. CFFP Reserve the right to witness the process at supplier works.

10. **Marking:**

Before sending the Ring Rolled forging to CFFP following to be punched on each forgings and same will punched/ marked in the Ring before dispatch from the vendor's work.

i. Forge Number
ii. Heat Number
iii. Work Order No.
iv. Item Name

11. **Transportation:**

Vendor will quote **per Kg rate of the delivered ring** including the transportation charges from CFFP to Vendor's works (for cake/ bloom) and from vendor's work to CFFP after the ring rolling of the CFFP-Cake/ bloom.

It is reiterated that vendor must quote for per kg rate of delivered ring weight and not the cake weight.

Prepared By :	Checked By :	Prepared By :
Alok Kumar Singh 23/7/15	23/7	23/7/15
Alok Kumar Singh (Sr Mgr – Forge Shop)	Kamal Singh Rana (AGM – Forge Shop)	Girish Mohan Verma (AGM – Forge Shop)