

Enquiry items along with quantities:

It. no.	Size & Item description	Technical requirement	Quantity in kg (Maximum)	Quantity in Nos.- (Minimum bars)
1	230mm dia X 1650 mm LG.	Stainless steel round bars to material specification AA10723 Rev08. Material shall be supplied in forged, rough machined, hardened and tempered condition duly ultrasonically tested as per AA0850118 Rev 01 CAT II. Mechanical properties must be as per of bar dia 60-160 mm mentioned in 11.1 clause of Spec. AA10723. Straightness within 2 mm / meter, minimum impact value required is 10 joule. TC covering all chemical and mechanical properties as per BHEL specification shall be furnished along with the supply. Inspection at source by BHEL or BHEL appointed third party shall be done as per QAP No.: CDE-18-3394 Rev01 only. Final inspection at BHEL, Bhopal	41426	70 Nos.
2	260mm dia X 1950 mm LG.	AA10723. Straightness within 2 mm / meter, minimum impact value required is 10 joule. TC covering all chemical and mechanical properties as per BHEL specification shall be furnished along with the supply. Inspection at source by BHEL or BHEL appointed third party shall be done as per QAP No.: CDE-18-3394 Rev01 only. Final inspection at BHEL, Bhopal	8943	10 Nos.
TOTAL			50369 kg	

Quantity variation as per below:

For item 1 - Supplies quantity are to be restricted between 41426 kg & 33894 kg. - Minimum numbers of 70 bars to be mandatory supplied.

For item 2 - Supplies quantity are to be restricted between 8943 kg & 7317 kg. - Minimum numbers of 10 bars to be mandatory supplied.

Pre-qualification criteria:

Sl. No.	Description of pre-qualification requirement	Vendor's Response	
		Complied (YES/NO)	Supporting Documents required to accept compliance
1	Manufacture of steel Round Bar/ their authorized representative.		Relevant certificate of being manufacturer (For manufacturer not registered with BHEL) / authorization letter with validity form manufacture (for authorized representative). Firm name, contact details, address & email from whom bars intended to be supplied to be furnished.
2	Vendors should have experience of manufacturing, Material Testing & supplying Stainless Steel Round Bar (Martensitic Gr:X17 CrNi 16-2, hardened and tempered as per latest standards EN 10088-3 Gr:X17 Cr Ni 16-2, H&T/ AISI 431, Hot Rolled, H&T/ASTM A276 type 431, H&T, IS 6603 Grade 15 Cr 16Ni 2, Hot Rolled, H&T or Comparable standard as per meeting our Requirement during last 7 years (ending last day of month previous to the one in which NIT is published)		Purchase order and Mill Test certificate. In case of authorized dealer experience documents of there OEM is also considered.
3	Company shall be certified with ISO 9001 or equivalent. In case of authorized representative, Valid ISO certificate of manufacturer is required.		Valid certificate to be submitted.

Note:

- BHEL has right to verify information / confirmation furnished, by asking additional documents, proofs etc.**
- ALL THE ABOVE POINT WISE PRE-QUALIFICATION REQUIREMENT ARE TO BE NECESSARILY ACCEPTED BY THE BIDDERS FOR THEIR OFFERS TO BE CONSIDERED FAILING WHICH OFFERS SHALL BE REJECTED.**

DECLARATION (To be given by Bidder)

GeM Bid No.....

Item Description:

With reference to above reference bid, we M/s..... (Bidder's Name)
confirm/ declare the following.

1. Quoted Make/OEM name -
2. We are OEM or Reseller -
3. Valid Authorization certificate from OEM with OEM's Contact Details attached (In case of reseller) -
Yes / NA
4. We confirm Nil deviation from GeM bid document (NIT).

Note:

1. OEM details such as name, designation, address, e-mail Id and Phone number required to be furnished along with the technical bid. (also refer ATC clause).
2. Commercial Deviation/deviation in delivery shown separately or found hidden in the offer, will not be taken cognizance of.

Signature of Authorized Signatory

Name:

Designation:

Contact No.:

Email:

Stamp / Seal of Firm

Annexure-2

Declaration Regarding MSE Category (to be given by Bidder)

In pursuant to the Public Procurement Policy for MSEs Order, 2012, I/We declare(s) that My/Our firm is(are) falling under the following MSE category and I/we shall submit documentary evidence/ Govt. Certificate etc. (UDYAM certificate) in support of the same along with the techno-commercial offer.

Type under MSE	SC Owned	ST Owned	Women Owned	Others (excluding SC/ST & Women Owned)
Micro				
Small				

(√ Tick whichever is applicable)

Note: If the bidder does not furnish the above in the tender, offer shall be processed construing that the bidder is not falling under MSE category.

Signature of Authorized Signatory

Name:

Designation:

Stamp / Seal of Firm

Declaration Regarding Conflict of Interest
(to be given by Bidder)

Conflict of interest would said to have occurred in the tender process and execution of the resultant contract, in case of any of the following situations:

- 1) If its personnel have a close personal, financial, or business relationship with any personnel of BHEL who are directly or indirectly related to the procurement or execution process of the contract, which can affect the decision of BHEL directly or indirectly.
- 2) The bidder (or his allied firm) provided services for the need assessment/ procurement planning of the Tender process in which it is participating.
- 3) Procurement of goods directly from the manufacturers/ suppliers shall be preferred. However, if the OEM/ Principal insists on engaging the services of an agent, such agent shall not be allowed to represent more than one manufacturer/ supplier in the same tender. Moreover, either the agent could bid on behalf of the manufacturer/ supplier or the manufacturer/ supplier could bid directly but not both. In case bids are received from both the manufacturer/ supplier and the agent, bid received from the agent shall be ignored. However, this shall not debar more than one Authorised distributor (with/ or without the OEM). from quoting equipment manufactured by an Original Equipment Manufacturer (OEM) in procurements under a Proprietary Article Certificate.
- 4) A bidder participates in more than one bid in this tender process. Participation in any capacity by a Bidder (including the participation of a Bidder as a partner/ JV member or sub-contractor in another bid or vice-versa) in more than one bid shall result in the disqualification of all bids in which he is a party. However, this does not limit the participation of an entity as a sub-contractor in more than one bid if he is not bidding independently in his own name or as a member of a JV.

I/We declares that I/We have read and understood the above aspects, and confirms that such conflict of interest does not exist and undertakes that I/We will not enter into any illegal or undisclosed agreement or understanding, whether formal or informal with other Bidder(s), in this regard. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to introduce cartelization in the bidding process. In case, I am /We are, found having indulged in above activities, the same will be considered as a violation of the tender conditions, and suitable action shall be taken by BHEL as per extant policies/ guidelines.

Signature of Authorized Signatory

Name:

Designation:

Stamp / Seal of Firm

MAKE IN INDIA format (to be filled by OeMs of the participating bidders)**BHARAT HEAVY ELECTRICALS LIMITED, BHOPAL****MATERIAL MANAGEMENT – STEEL DIVISION**

For this Procurement, Government of India Public Procurement (Preference to Make in India), Order 2017 with its amendments and subsequent Orders issued by the respective nodal ministries shall be applicable even if issued after issue of this NIT but before finalization of contract/PO/WO against this NIT.

*As per the Provisions of this order, please submit a **self-certification complying with the conditions below on company letterhead duly signed by competent authority.***

I, hereby declare on behalf of M/s. that we are participating in the Enquiry No. floated by BHEL, Bhopal (MP), India and shall comply with following:

Public Procurement (Preference to Make in India), Order 2017 *with its amendments* and subsequent Orders issued by the respective nodal ministries shall be applicable even if issued after issue of this NIT but before finalization of contract/PO/WO against this NIT.

- (a) A supplier will be treated as “**Class-I Local Suppliers**”, if the items quoted by bidder have local content equal to or more than 50%.
- (b) ‘**Local Content**’ means the amount of value added in India, which shall be total value of item quoted (excluding net domestic indirect taxes) minus the value of imported content in the item (including all custom duties) as a proportion of the total value, **in percent**.

We hereby certify that the quoted items offered by us against above Enquiry No. is having local content of..... %

Further, to certify that the local content % certified above is in line with definition of Local content given in point no 2 of Public Procurement (Preference to Make in India), Order 2017 dated 19.07.2024 and we qualify as Class —I. (Class-I/ CLASS-II/Non-Local supplier-fill in one which is applicable) local supplier. It is also certified that Repackaging/ Refurbishment/ Rebranding of imported products and the license fees/royalties paid/ technical charges paid out of India are not considered for calculation of local content and there is no such locally-sourced imported items.

The above declaration does not include services such as transportation, insurance, installation, commissioning, training and after sales service support like AME/CMC etc. as local value addition. We also understand, false declarations will be in breach of the Code of Integrity under Rule 175(1) (i) (h) of the General Finance Rules for which a bidder or its successors can be debarred for up to two years as per Rule 151 (iii) of the General Finance Rules along with such other actions as may be permissible under law.

We further confirm that details of location(s) in India at which the local value addition is made will be at

- a.
- b.

I hereby declare that the details furnished above are true and correct to the best of my knowledge and belief and I undertake to inform you of any changes therein, immediately. In case any of the above information is found to be false or untrue or misleading or misrepresenting, I am aware that I may be held liable for it.

(.....)

For M/s.

(Seal & Sign)



Heat Exchanger Group

BHEL Bhopal

STANDARD QUALITY ASSURANCE PLAN
(SQAP)

QAP No.

CDE-18-3394

Revision No.

01

Date of Issue

18.05.2018

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ITEM

STAINLESS STEEL BAR TO AA-10723
(Hot Rolled – Hardened & Tempered)

S.No.	Components & Operations	Characteristics	Category	Type / Method of Check	Quantum of check	Reference Document	Acceptance Norms	Format of Records	Agency			Remarks
									1	2	3	
1	2	3	4	5	6	7	8	9	10			11
1.0	IN PROCESS INSPECTION											
1.1	MATERIAL INSPECTION											
a.	Verification of Co-related Mill Test Certificates - MTCs.	<ul style="list-style-type: none">Chemical composition (Product Analysis)Mechanical Properties	Major	Visual	100%	BHEL Specification AA-10723 Rev.08	BHEL Specification AA-10723 Rev.08	MTC	R	R	-	<ul style="list-style-type: none">Hold point of BHEL-IASee Note-b, c & d
b.	Surface Finish	Physical	Minor	Visual	100%	----	-----	IR	P	W	-	Bar should be free from any injurious defects.
a.	Dimensional check	Measurement of Diameter, Length, straightness.	Major	I+Visual	100%	BHEL Specification AA-10723 Rev.08	BHEL Specification AA-10723 Rev.08	IR	P	W	-	
1.2	CHECKING OF FOLLOWING PARAMETERS											
a.	Heat Treatment (in case MTC is silent on the same)	Checking of HT data / Chart	Critical	Visual	100 %	BHEL Specification AA-10723 Rev.08	BHEL Specification AA-10723 Rev.08	IR	P	R	-	<ul style="list-style-type: none">Calibrated HT furnace need to be used. BHEL-IA to ensure the same while inspection.
b.	Ultrasonic Examination	NDT to ensure absence of any volumetric defects	Major	I + Visual	100 %	BHEL Spec. AA-0850118	Cat-2 of BHEL Spec. AA-0850118	IR	P	W	-	<ul style="list-style-type: none">Calibrated UT meter to be used.UT to be done by ASNT / ASNT Level-II person in UT only.10% of the offered quantity to be witnessed by BHEL-IA.
c.	Impact test (in case MTC is silent on the same)	Toughness of material	Major	I + Visual	100%	BHEL Specification AA-10723 Rev.08	BHEL Specification AA-10723 Rev.08	IR	P	W	-	See Note- b & d also.
d.	Documentation	Verification of Quality Documents .	Minor	Visual	100%	BHEL Specification AA-10723 Rev.08	BHEL Specification AA-10723 Rev.08	Three (03) sets of all the above documents.	P	R	-	<ul style="list-style-type: none">Out of three sets, minimum one set shall be in original format.See Note-a

S.K. BISWAS
 S.D. GOPAL
 CDE



Heat Exchanger Group

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ITEM

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									1	2	3	
1	2	3	4	5	6	7	8	9	10			11

Approval does not relieve supplier from meeting our requirements as per the drawing / specification.

Note :

- (a) All the inspection report & test certificates shall be part of the final QA Document duly signed and stamped by BHEL-IA. Quantity of set = Three (03) Nos. All reports shall be arranged in sequential manner as per this QAP with proper index sheet at top and same to be submitted to BHEL along-with the supply only. Later submission of these reports are not at all acceptable. BHEL-IA to ensure it while giving final dispatch clearance.
- (b) In the absence of original correlated MTC, material to be tested to ensure both chemical & mechanical properties at Govt. Approved Lab / BHEL TSD / manufacturer's lab having calibrated instruments (duly approved by NABL / NABL appointed agency). Sample for check test shall be drawn in consultation with BHEL-IA from each heat & production lot.
In presence of original co-related MTC : No testing is required, record of the same duly endorsed by BHEL-IA with respect to original one to be furnished. *In case of spectrometer for chemical testing, calibration by vendor in presence of BHEL-IA using master calibration blocks (as furnished by OEM) is also acceptable.*
- (c) Chemical composition shall comply as specified in Para-9.0 of BHEL-Specification AA-10723 Rev.08 only.
- (d) For mechanical properties, refer Para-11.1 of BHEL-Specification AA-10723 Rev.08. Above 160mm, tensile, yield and elongation value shall be taken same as that of up-to 160mm diameter bar except impact test at room temperature (which need to be ensured as 10 Joules – average of 03 ISO-V Samples).
- (e) All other technical requirements as specified in Spec. AA-10723 Rev.08 need to be ensured.

LEGEND: 1: Supplier, 2: BHEL IA, 3: Customer; P-Perform, W-Witness, R-Record review, MTC : Mill test Certificates, IR : Inspection report, IA : Inspection Agency, I : Instrument to be used for check.

Prepared by :

Sarvesh Asthana
Draughtsman - CDE
30

Reviewed by :

Santosh Mahato
Dy. Manager (D) CDE

Approved by :

S.K. Biswas.
Sr. Dy. General Manager (D) CDE



CORPORATE PURCHASE SPECIFICATION

AA 107 23

Rev. No. 08

PAGE 1 OF 4

STAINLESS STEEL BARS (MARTENSITIC), Gr: X17CrNi 16-2, H & T

1.0 GENERAL :

This specification governs the quality requirements of Stainless Steel Bars (Martensitic), Hardened and Tempered.

2.0 APPLICATION :

For general engineering purposes involving stresses under corrosive conditions.

3.0 CONDITION OF DELIVERY :

Hot rolled, hardened and tempered.

For size above 100 mm, forgings in H&T condition are also acceptable.

Bars shall be supplied in the descaled condition.

The ends of bars shall be square and true.

The bars shall be supplied in straight lengths.

4.0 COMPLIANCE WITH NATIONAL STANDARDS :

The material shall comply with the requirements of the following National standard and also meet the requirements of this specification.

EN 10088-3, Gr. X 17 Cr Ni 16 - 2: General Purpose Semi-finished Products, Bars, Rods and Sections

5.0 DIMENSIONS AND TOLERANCES :

5.1 Sizes: The bars shall be supplied to the dimensions specified in BHEL order.

5.1.1 Length:

Unless otherwise specified, hot rolled bars shall be supplied in 3 to 6 metres lengths or in multiples with maximum of 10 per cent, shorts down to 1 metre.

Forged bars shall be supplied in lengths of 1.5 to 3 metres.

5.2 Tolerances:

5.2.1 Hot rolled bars:

The bars shall not vary from specified diameter or distance across flats by more than $\pm 2\frac{1}{2}$ %.

Revisions:

Cl. 31.2.0 of MOM of MRC-S&GPS

APPROVED:

**INTERPLANT MATERIAL RATIONALISATION
COMMITTEE-MRC (S&GPS)**

Rev. No. 08

Amd.No.

Reaffirmed

Prepared

Issued

Dt. of 1st Issue

Dt:19.3.2008

Dt :

Year: 2013

BHOPAL

Corp. R&D

MAY, 1978

**5.2.2 Forged bars:**

The tolerance on the forged bars shall be as follows:

<u>Diameter, mm</u>	<u>Tolerance, mm</u>
50 to 125	+ 6.0
125 to 175	+ 8.0
175 ---	+ 12.5

Note: (FOR HOT ROLLED & FORGED BARS)

Insignificant surface defects in the form of dent and ripple marks are permissible provided their depth does not exceed half the tolerances on each size.

6.0 MANUFACTURE :

Process used for the manufacture of the bars is left to the discretion of the manufacturer. Bars shall be manufactured from fully killed steel. Sufficient reduction and discard shall be made from each ingot to ensure freedom from pipe, harmful segregation and other defects.

7.0 HEAT TREATMENT :

Following heat treatment cycles are suggested.

- 1) Hardening at : 980-1030°C followed by oil quenching.
- 2) Double tempering at : 640-680°C followed by 590-620°C.

Details of actual heat treatment cycles followed shall be specified in the test certificate.

8.0 FREEDOM FROM DEFECTS:

The bars shall be free from internal and surface defects. Bars shall be free from twists and bends.

9.0 CHEMICAL COMPOSITION :

The melt analysis of steel and the permissible variation in the composition of the material from the melt analysis shall be as follows :

Element	Melt analysis, percent		Permissible variation, percent,
	min.	max.	
Carbon	0.12	0.22	+ 0.01
Silicon	--	1.00	+ 0.05
Manganese	--	1.50	+ 0.03
Nickel	1.50	2.50	+ 0.07
Chromium	15.00	17.00	± 0.20
Sulphur	--	0.030	+ 0.005
Phosphorus	--	0.040	+ 0.005



CORPORATE PURCHASE SPECIFICATION

AA 107 23

Rev. No. 08

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Note: Elements not listed in this table shall not be intentionally added to the steel without the agreement of the purchaser except for finishing the cast. All appropriate precautions are to be taken to avoid the addition of such elements from scrap and other materials used in production which would impair mechanical properties and the suitability of the steel.

10.0 TEST SAMPLES :

The test samples shall be selected as per EN 10088-3.

11.0 MECHANICAL PROPERTIES :

11.1 Tensile and impact:

The test samples when heat treated and tested in longitudinal direction in accordance with IS : 1608 or any other reputed equivalent International Standard shall show the following properties:

Rulling section, mm	Tensile strength, N/mm ²	Yield strength, min. N/mm ²	Percent Elongation, min	Impact Strength* at Room Temp.
Upto 60mm (Inclusive)	900-1050	700	12	20
Above 60 mm to 160 mm	900-1050	700	10	15

* (Average of 3 ISO-V samples in Joules).

The above properties are valid for ruling section upto and including 160 mm. The mechanical properties required for sizes above 160 mm shall be as per mutual agreement between BHEL and manufacturer.

12.0 ULTRASONIC TEST:

12.1 Each bar above 100 mm shall be tested ultrasonically in accordance with BHEL standard AA 085 01 18 to ensure freedom from internal defects. The norms of acceptance shall be as per category 2 of the above standard.

12.2 Optional tests:

If specified in order, each bar > 40 to 100mm shall be tested ultrasonically in accordance with BHEL standard AA 085 01 18 to ensure freedom from internal defects and the norms of acceptance shall be as per category 2.

**13.0 TEST CERTIFICATES :**

Three copies of test certificates shall be supplied, unless otherwise stated in the order. In addition, the supplier shall ensure to enclose one copy of the test certificate along with their despatch documents to facilitate quick clearance of the material. The test certificate shall bear the following information:

BHEL References :

AA 10723 Rev. No.08: Stainless Steel Bars, Gr.X17CrNi 16-2 – H&T.
BHEL Order No.

Supplier's References :

Name
Identification No.
Melt No.

Details of heat treatment followed.

Result of Tests:

Dimensional inspection.
Results of chemical analysis, mechanical tests and ultrasonic test called for in this specification.

14.0 PACKING AND MARKING:

The material shall be suitably packed in bundles-Hessian wrapped-to prevent sagging and damage during transit.

Each bar/flat 50 mm in diameter/width across flats shall be stamped with 'AA 107 23', melt No., BHEL order No., at one end or on the end face.

Bars/flat upto and including 50 mm in diameter/width across flats shall be bundled together and tied with wire at 3 to 4 places along the length of the bars.

A metal label shall be securely attached to each bundle and shall bear the following information

AA107 23: Stainless steel bars Gr: X17CrNi 16-2, H&T
BHEL Order No.
Consignment/Identification No.
Melt No.
Size and Weight.
Supplier's Name.

15.0 REFERRED STANDARDS (Latest Publications Including Amendments):

1. EN 10088-3

2. IS 1608

3. AA 085 01 18



CORPORATE STANDARD

AA0850118

Rev. No.01

PAGE 1 of 5

ULTRASONIC TESTING, CLASSIFICATION AND ACCEPTANCE STANDARDS FOR STEEL FORGINGS, BILLETS AND BLOOMS

1.0 SCOPE:

This standard deals with the ultrasonic testing of steel forgings, billets and blooms. The procedure covers pulse echo direct contact manual ultrasonic flaw detection technique. This standard does not apply to austenitic steel forgings for which AA0850119 may be referred to.

2.0 PERSONNEL REQUIREMENT:

Personnel performing non-destructive examination and evaluation shall be qualified to the recommended practice SNT - TC - 1A or any other recognised practice.

3.0 EQUIPMENT CHARACTERISTICS:

3.1. Frequency range:

The ultrasonic equipment shall be suitable for operating at frequencies within the range of 0.5 to 6 MHz.

3.2. Sensitivity:

The sensitivity of the equipment shall be tested to ensure that the number of full screen back wall echo is not less than that given below, when the appropriate probe is placed on the metalised surface of plastic insert of the Indian Standard reference block (IS:4904)/IIW block.

Frequency MHz	Min. No. of full screen back echoes
1	5
2	4
4 to 6	2

3.3. Resolution:

The resolution of the equipment and probe combined shall be such as to show separately indications of the three grooves in the IIW- VI block.

4.0 SURFACE CONDITION:

The test surface shall be free from loose scales, rust and such other extraneous material that would interfere with the ultrasonic energy transmission. In case of machined surface, it is desirable to have a surface finish of 6.25 microns or better. A gramophone record type

Revisions:
Clause.9.4 & 10.2.4 of MOM of WG-NDT

APPROVED:
INTER PLANT STANDARDISATION
COMMITTEE - WG(NDT)

Rev. No.01	Amd. No.01	Reaffirmed	Prepared	Issued	Dt. of 1 st Issue
Dt:02-01-1995	Dt: 15-01-1996	Year:	10HEEP, Haridwar	Corp. R&D	Jan 1980

CORPORATE STANDARD



of finish and tear produced by machining tools shall be avoided since these give rise to spurious echoes and cause probe wear.

5.0 COUPLANT:

To ensure adequate transmission of ultrasonic energy between the probe and the test object, a suitable couplant having good wetting characteristics such as oil, grease, glycerine or water shall be used.

6.0 TESTING TECHNIQUE:

6.1. Selection of testing technique shall be made after giving due consideration to the method of manufacture and shape of the object tested. Testing technique should be such that each and every part of the object volume is scanned at least once. Successive scans shall overlap a minimum of 15% of the probe width. Uniform contact shall be maintained between probe and object and scanning speed shall not exceed 150 mm/ second. The following techniques are considered to be minimum for providing adequate coverage.

6.2. Scanning Scheme (Solid And Hollow Forgings):

Complete length of the forging shall be scanned radially from sides/cylindrical surface through 360° using longitudinal wave probe. Whenever practicable the forging shall be scanned in axial direction also. Hollow forgings, and when necessary, solid forgings also shall be scanned using appropriate shear wave probes to detect axial and radial cracks. Hollow forgings are the forgings made hollow on the press by punching or ring rolling operation.

6.3. **Solid Rectangular Forgings, Billets and Blooms:** Complete length of the object shall be scanned from two adjacent faces and whenever practicable one end face using longitudinal wave probe.

6.4. Radial cracks on round sections which cannot be detected by normal testing method may be subjected to other crack detection methods such as MPI.

7.0 SCANNING:

7.1. Probes and Frequency:

Overall scanning shall be done using 2 MHz nominal, 20-25 mm diameter probes except when large grain size and path length make it necessary to use a lower frequency. Smaller probes may be used when necessary. However, for forgings intended for backing material for white metal lined bearings, the examination shall be carried out by 4 MHz probes.

7.2. Time Base Calibration:

The time base shall be calibrated using a calibration block or a known dimension of forging under examination.

7.3. Sensitivity:

7.3.1. When Calibrated Attenuator is Not Available:

Reference sensitivity of equipment shall be set such that the maximum acceptable defect equivalent flat bottomed hole in the test block is equal to 75% of the full screen height. Testing shall be carried out at the highest sensitivity possible.

7.3.2. When Calibrated Attenuator is Available:

The sensitivity of the equipment during scanning shall be set 6 dB more than the sensitivity required to give a full screen height echo from the maximum acceptable size of defect.

Note: The above sensitivity level adjustment is purely for scanning purposes. Once a defect is encountered, the sensitivity shall be brought down to estimate the size of defect for evaluation of the material under test.

8.0 ESTIMATION OF FLAW SIZE:

8.1. Large Size Flaws:

The size of large flaws can be estimated by moving the probe in all directions and plotting the midpoint of the probe when echo falls to 50 percent or 6 dB.

8.2. Small Size Flaws:

8.2.1. When Calibrated Attenuator is Not Available:

8.2.1.1. The size of the flaw may be estimated by comparing with the echoes of the flat bottomed holes at appropriate depths in a test block of ultrasonically similar material.

8.2.1.2. The size of the flaw may also be estimated by moving probe successively in all the four directions at right angles to each other and plotting the midpoint of the probe when echo height falls to 50% or 6 dB. Due allowance shall also be made for beam spread, depth and orientation of flaw and diameter of the forging if the scanning is done from the curved surface.

8.2.2. When Calibrated Attenuator is Provided With The Equipment:

The size of the flaw (smaller than the beam spread) can be estimated accurately in millimetres of equivalent circular flaw with the help of Krautkramer's DGS (Distance – Gain – Size) diagram. Method of estimating flaw size using a DGS diagram is given in Annexure - A.

9.0 CLASSIFICATION OF FORGINGS, BILLETS AND BLOOMS:

9.1. Forgings, billets and blooms are classified into the following five categories depending upon the defect size admissibility for the purpose of ultrasonic testing:

Category	Unacceptable defects
1	<ul style="list-style-type: none"> i) Cracks, flakes, seams & laps. ii) Defects giving indication larger than that from a 2 mm diameter equivalent flaw. iii) Groups of defects with maximum indication less than that from a 2 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 70%. iv) Defects giving indications of 1 to 2 mm diameter equivalent flaw separated by a distance less than four times the size of the larger of the adjacent flaws.

CORPORATE STANDARD



Category	Unacceptable defects
2	i) Cracks, flakes, seams & laps. ii) Defects giving indication larger than that from a 4 mm diameter equivalent flaw. iii) Groups of defects with maximum indication less than that from a 4 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 50%. iv) Defects giving indications of 2 to 4 mm diameter equivalent flaw separated by a distance less than four times the size of the larger of the adjacent flaws.
3	i) Cracks, flakes, seams & laps. ii) Defects giving indication larger than that from a 6 mm diameter equivalent flaw. iii) Groups of defects with maximum indication less than that from a 6 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 40%. iv) Defects giving indications of 3 to 6 mm diameter equivalent flaw separated by a distance less than four times the size of the larger of the adjacent flaws.
4	i) Cracks, flakes, seams & laps. ii) Defects giving indication larger than that from a 10 mm diameter equivalent flaw. iii) Groups of defects with maximum indication less than that from a 10 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 20%. iv) Defects giving indications of 5 to 10 mm diameter equivalent flaw separated by a distance less than four times the size of the larger of the adjacent flaws.
5	i) Cracks, flakes, seams & laps. ii) Defects giving indication larger than that from a 15 mm diameter equivalent flaw. iii) Groups of defects with maximum indication less than that from a 15 mm diameter equivalent flaw which cannot be separated at testing sensitivity if the back echo is reduced to less than 10%.

Note: Loss of back wall echo not attributable to the presence of defects or geometry and exceeding the limits mentioned in item (iii) of each category of unacceptable defects shall be a cause for rejection.

ANNEXURE - A

The equivalent flaw size curves of the DGS diagram is prepared by plotting the amplitude in decibels from a series of circular reflectors with increasing distance from the probe in water and so the graph incorporates only the loss in water. When it is found that the attenuation in the material under test is more (this can be checked using back echo curve of DGS diagram), this shall be taken into account while calculating the flaw size. Corrections will not be required for majority of heat treated forgings when tested with 2-4 MHz probes.

A step by step method of estimating flaw size using universal DGS diagram is given below:

- Adjust the depth range of the equipment to the required depth.
- Adjust the back echo to 70% of screen height from a defect free area parallel wall of the material under test or ultrasonically similar test block and note the dB value (A) on the calibrated gain control.

- Mark on the back echo curve of the diagram, the back wall of the distance in terms of near field in millimetres in the case of universal DGS diagram.
- Move the probe to the defective area and get the maximum defect echo. Read off the flaw depth. Increase the gain with the calibrated gain control until echo height reaches 70% of screen height. Note the attenuator reading in dB (B).
- Calculate the gain (G) in dB by subtracting 'A' from 'B'. Count off the gain 'G' downwards from the marked point on the back echo curve, and then move horizontally to intersect the vertical line from the base line corresponding to the flaw depth 'D' in terms of near field in the case of universal diagram.
- Note the equivalent flaw size curve passing through the above point. Multiply the reduced flaw dimension (S) of the curve by the probe diameter to give the equivalent flaw size in millimetres.

ANNXXURE - A

KRAUTKRAMER'S DGS DIAGRAM

