

Enquiry items along with quantities:

It. No.	Size & Item description	Technical requirement	Quantity in kg
1	115 mm dia X 3000 mm – 6000 mm LG	S.S.Bar as per Corporate Standard AA10723 rev08. Straightness within 3 mm/ meter. UT to be Carried out as per BHEL Standard AA0850118 (Acceptance Level-2). TC Covering all Chemical and mechanical properties as per BHEL Specification shall be furnished along with the supply.	13200
2	200 mm dia X 3000 mm – 4000 mm LG	S.S.Bar as per Corporate Standard AA10723 rev08. Straightness within 2mm / meter. UT to be carried out as per BHEL Spec.AA0850118 (Acceptance level-2). The requirement of impact strength is 12 joule min., Elongation to be 10% min., yield strength to be 700 N/ Sq.mm min., and tensile strength to be 900-1050 N/ SQ. mm. rest all properties to be as per BHEL Spec. AA10723 rev08. T.C covering all chemical and mechanical properties as per BHEL Spec. Shall be furnished along with material supply.	33000
TOTAL			46200 kg

Quantity variation as per below:

Item-1 Supplies quantity are to be restricted between 13200 kg & 10800 kg.

Item-2 Supplies quantity are to be restricted between 33000 kg & 27000 kg.

Pre-qualification criteria:

Sl. No.	Description of pre-qualification requirement	Vendor Response	
		Complied (YES/NO)	Supporting Documents required to accept compliance
1	Manufacture of Stainless steel round bar / their authorized representative.		Relevant certificate of being manufacturer / declaration on company letterhead else authorization letter with validity (for authorized representative). Firm name and address, email, contact no. etc. from whom bars intended to be supply to be furnished.
2	Vendors should have experience of manufacturing, Material Testing & supplying STAINLESS STEEL ROUND BAR (Martensitic Gr:x17 CrNi 16-2, HARDENED & 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, Hot rolled, H&T or comparable standard as per 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 relevant documents of there OEM is also considered.
3	Company shall be certified with ISO 9001 or equivalent.		Valid certificate to be submitted. In case of authorized dealer, Valid ISO certificate of OEM is required.

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.**

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:

1. 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**.

2. I hereby declare that our firm qualifies as “**Class-I Local Suppliers**”.

a. The Local Content in the items quoted under this Enquiry is Percent

b. Details of location(s) in India where this value addition shall be done, is/are as follows:

- (a)
- (b)
- (c)

(.....)

For M/s.

(Seal & Sign)

Annexure-1

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

(Vendor's Seal & Sign)

BHARAT HEAVY ELECTRICALS LIMITED, BHOPAL
QA-HYDRO
STANDARD QUALITY ASSURANCE PLAN FOR BAR MATERIAL

QAP NO. : QA/HT/1044 Rev. 00 Dated :- 16.05.2018
SPECIFICATION : AA 10723 Rev. 08 (Stainless Steel Bars- Martensitic Gr: X 17 CrNi 16-2)
SUPPLY CONDITION : upto 100 mm - Hot Rolled ; Hardened & Tempered
Greater than 100 mm - Hot Rolled / Forged ; Hardened & Tempered

1	2	3	4	5	6	7	8	9	10	11	12	
SL. NO.	STAGE	CHARACTERSTIC	METHOD	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	P	V	W	REMARKS	
1	Raw Material	Chemical	Chemical test	1 Sample / Heat	AA 10723 Rev. 08	AA 10723 Rev. 08	Mill Test Certificate	1	2	-	-	
2	Heat Treatment	Hardened & Tempered	Hardened & Tempered	1 Sample / Heat & H.T. Batch	AA 10723 Rev. 08	AA 10723 Rev. 08	H.T. Chart	1	2	-	-	
3	Final Stage	Stamping on test bar for mechanical Testing		Hard Stamp by TPIA	-do-	-do-	-do-	Stage Inspection Report	1	-	2	Test Piece duly stamped by TPIA
		Mechanical Properties	i) Tensile Test	As Specified in AA 10723 Rev. 08	-do-	-do-	-do-	Supplier's Test Certificate	1	-	2	-
			ii) Charpy Impact Test (on 3 samples)	-do-	-do-	-do-	-do-	Supplier's Test Certificate	1	-	2	-
			iii) Yield strength	-do-	-do-	-do-	-do-	Supplier's Test Certificate	1	-	2	-
			iv) % Elongation	-do-	-do-	-do-	-do-	Supplier's Test Certificate	1	-	2	-
		Ultra Sonic Test		As Specified in AA 10723 Rev. 08	100%	AA0850118 Rev. 01	Category II	U.T. report	1	-	2	1) 100% UT to be done by vendor. 2) 15% UT to be witness by TPIA on sample basis
		Chemical Composition		Chemical test	1 sample / Heat	AA 10723 Rev. 08	AA 10723 Rev. 08	Supplier's Test Certificate	1	-	2	-
		Visual Examination		Visual	100%	-do-	Bars shall be free fom surface defects, bends & twists	Supplier's Dimensional Report	1	-	2	-
Dimension & Tolerance		Measurement	100%	-do-	AA 10723 Rev. 08	-do-	1	-	2	-		
4	Dispatch	Identification Marking	Hard Stamping	100%	-do-	-do-	1. Heat No. 2. P.O. No. 3. Spec No. 4. Size 5. Supplier's Name	1	-	2	Identification & marking shall be done on face of each bar & TPIA hard stamp to be done on both face of each bar.	
5	Document submission duly certified by TPIA	1) Mill test certificate (Mechanical & Chemical) 2) Supplier Test certificate (Mechanical & Chemical) 3) Dimensional Inspection report. 4) Heat Treatment chart 5) U.T. Report										

Note : Final Testing of Material will be done at BHEL Bhopal works before clearance of SRV.

1 = Manufacturer / Trader
2 = BHEL / BHEL's TPIA


Asst. Engg.
ASHOK SHARMA
व. अभियंता (व. इं. टी.) / Sr. Engineer (W.T.)
परिचालन-जल दरवाजा / Quality Control
बी.एच.ई.एल., भोपाल / BHEL, BHOPAL


H.T.E

16/05/18
शिवेन्द्र कुमार/Shivendra Kumar
व. प्रबंधक/Sr. Manager
व. विभाग/H.T.E. DIVISION
बी.एच.ई.एल., भोपाल/BHEL, Bhopal

WTM

16/5/18
MAHENDRA SONI
व. प्रबंधक (उत्पादन) ज. ए. वि. प्रभाग
Dy. Manager (Production) WTM Division
बी.एच.ई.एल., भोपाल / BHEL, BHOPAL

	CORPORATE PURCHASE SPECIFICATION			AA 107 23	
				Rev. No. 08	
				PAGE 1 OF 4	
STAINLESS STEEL BARS (MARTENSITIC), Gr: X17CrNi 16-2, H & T					
<p>1.0 GENERAL :</p> <p>This specification governs the quality requirements of Stainless Steel Bars (Martensitic), Hardened and Tempered.</p>					
<p>2.0 APPLICATION :</p> <p>For general engineering purposes involving stresses under corrosive conditions.</p>					
<p>3.0 CONDITION OF DELIVERY :</p> <p>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.</p>					
<p>4.0 COMPLIANCE WITH NATIONAL STANDARDS :</p> <p>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</p>					
<p>5.0 DIMENSIONS AND TOLERANCES :</p>					
<p>5.1 Sizes: The bars shall be supplied to the dimensions specified in BHEL order.</p>					
<p>5.1.1 Length:</p> <p>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.</p> <p>Forged bars shall be supplied in lengths of 1.5 to 3 metres.</p>					
<p>5.2 Tolerances:</p>					
<p>5.2.1 Hot rolled bars:</p> <p>The bars shall not vary from specified diameter or distance across flats by more than $\pm 2\frac{1}{2}$ %.</p>					
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

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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

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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:

Ruling 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.

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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
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AMENDMENT - NOTIFICATION

AA 085 01 18 REV.No. 01

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AA 085 01 18:ULTRASONIC TESTING CLASSIFICATION AND ACCEPTANCE STANDARDS FOR STEEL FORGINGS, BILLETS AND BLOOMS

1.0 PAGE 1 OF 6; Cl 1.0 SCOPE:

Last sentence of the para is modified as follows:

"This standard does not apply to austenitic steel forgings for which AA 085 01 19 may be referred to."

2.0 Cl 3.2 Sensitivity:

Title of the left hand column of the table is modified as "Frequency, MHz" in place of Frequency range, MHz.

3.0 PAGE 2 OF 6; Cl 5.0 COUPLANT:

Last line is modified as "or water shall be used."

4.0 Cl 6.1: Eight line is modified as follows:

"shall not exceed 150mm/second. The following techniques"

Please see instructions on the reverse.

Ref:	Amd. No.	Approved	Issued	Date	Cum. Sr. No.
Cl:10.2.4 of MOM	01	WG-NDT	CORP. R&D	15.1.96	A 1822

INSTRUCTIONS

**Changes to be incorporated in the controlled copies
for "AMENDMENT -- NOTIFICATION".**

- a) The "AMD. No." of this "Amendment Notification" shall be recorded against the sheet / clause, being amended, on the margin.
- b) This, "Amendment Notification" shall be filed over the concerned preface sheet of the Specification / or first sheet of the standard or over the previous Amendment, if any.





CORPORATE STANDARD

AA 085 01 18

REV.No. 01

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**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.

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 range, MHz	Min.No. of full screen back echoes
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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.

Revision: CL.9.4 OF MOM OF WG(NDT)			Approved: INTERPLANT STANDARDIZATION COMMITTEE - (WG-NDT)		
Rev.No. 01	Amd.No.	Reaffirmed	Prepared CFFP	Issued CORP. R&D	Dt. of 1st issue Jan '80
Dt. Jan '95	Dt.	Year:	HARDWAR		

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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 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, water, glycerine or cellulose paste 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 100 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 can not 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.



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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 mid point 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:

<u>Category</u>	<u>Unacceptable defects</u>
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.
2	<ul style="list-style-type: none"> (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	<ul style="list-style-type: none"> (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	<ul style="list-style-type: none"> (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%.



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- (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:

- (a) Adjust the depth range of the equipment to the required depth.
- (b) 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.
- (c) 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.
- (d) 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).
- (e) 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.

- (f) Note the equivalent flow size curve passing through the above point. Multiply the reduced flow dimension (S) of the curve by the probe diameter to give the equivalent flow size in millimetres.

ANNEXURE - A
KRAUTKRAMER'S DGS DIAGRAM

