BHARAT HEAVY ELECTRICALS LIMITED
HEEP HARIDWAR INDIA-PIN 249403
FAX NO: 0091 1334 226462
PHONE NO: 0091 1334 285462

REQUIREMENT OF CHROME MOLYBDENUM STEEL ROUND.

The Heavy Electricals Equipment Plant (HEEP) located in Haridwar, India is one of the major manufacturing plants of Bharat Heavy Electricals Ltd. The core business of HEEP includes design and manufacture of large steam and gas turbines, turbo generators, Defense Items and so on.
Details of items details as below:

SLN	MAT CODE	ITEM DISCREPTION	QUANTITY	UOM	Dly. Schedule (Days)
1	DFPW10500367	CHROME MOLYBDENUM STEEL ROUND N.STD: UNI 7845 SIZE: D= 45 MM DIM.: D GRADE: GR; 25CRMO4	**500**	KG	60
2	DFPW10500375	CHROME MOLYBDENUM STEEL ROUND N.STD: UNI 7845 SIZE: D=63 MM DIM.: D GRADE: GR:25CRMO4	**500**	KG	60
3	DFPW10500383	CHROME MOLYBDENUM STEEL ROUND N.STD: UNI 7845 SIZE: D=100 MM DIM.: D GRADE: GR:25CRMO4	**2000**	KG	60

1. EARLY DELIVERY ACCEPTABLE.

2. QUANTITY TOLERANCE+/- 5% IS ACCEPTABLE.

3. ALL VENDORS TO PROVIDE POINT WISE REPLY/CONFIRMATION ALONG WITH RELEVANT SUPPORTING DOCUMENTS TO EACH AND EVERY POINT OF **PRE-QUALIFICATION REQUIREMENT/PQR** FOR ALL ENQUIRY ITEMS. NONCOMPLIANCE OF THESE MAY LEAD TO REJECTION OF OFFER AS THESE ARE ESSENTIAL CONDITION FOR PARTICIPATING IN TENDER ENQUIRY.

4. KINDLY UPLOAD/ATTACH THE SPECIFICATION DETAILS/ CATALOGUE OF OFFERED ITEMS.

5. KINDLY **SUBMIT TECHNO-COMMERCIAL CHECKLIST** ALONG WITH YOUR OFFER.

6. KINDLY **SUBMIT PQR SHEET WITH SUPPORTING DOCUMENTS** ALONG WITH YOUR OFFER.

7. KINDLY **SUBMIT TECHNICAL PARAMETERS CHECK LIST** ALONG WITH YOUR OFFER.

8. VENDOR TO CONFIRM TO PROVIDE MATERIAL AND DIMENSIONAL TEST CERTIFICATES AS PER ENQUIRY DOCUMENTS ALONG WITH MATERIAL SUPPLY.

9. VENDOR TO CONFIRM TO PROVIDE HEAT TREATMENT AND ULTRASONIC TEST REPORTS OF ROUNDS.

10. VENDOR TO CONFIRM TO PROVIDE CERTIFICATE OF CONFORMANCE.

11. VENDOR TO CONFIRM TO PROVIDE IDENTIFICATION OF ALL ITEMS AND THEIR REPORT ACCORDINGLY.

12. VENDOR TO **SUBMIT MAKE IN INDIA SELF CERTIFICATION** AS PER FORMAT GIVEN ALONG WITH THE ENQUIRY.

Sl.	PQR Requirement	Action	Vendor Response (Yes / No / Enclosed)
1.	Who can either manufacture or supply **25CrMo4** grade Chrome Molybdenum steel Round as per standard UNI 7845.	Vendor to confirm	
2.	Who can carry out Ultrasonic testing as per BHEL specification AA0850118	Vendor to confirm	
3.	Vendor can provide Material Test Certificate (MTC) from NABL accredited Labs/ Government approved Labs /OEM Labs.	Vendor to confirm	

TECHNICAL PARAMETERS CHECK LIST
DATA VALUES TO BE FILLED AND CONFIRMED BY VENDOR

NOTE Vendor to input parameters based on the specification of the quoted item.	

SN.	PARAMETERS	VALUES	SIZE (MM)	UNIT	RESPONSE TYPE		VENDOR RESPONSE
1	MATERIAL DESCRIPTION	CHROME MOLYBDENUM STEEL ROUND	-	-	To confirm	→	
2	MATERIAL CODE	DFPW10500367	D=45MM	-	To confirm	→	
		DFPW10500375	D=63MM		To confirm	→	
		DFPW10500383	D=100MM		To confirm	→	
3	HEAT TREATMENT	HEAT TREATED CONDITION CONFORMING TO UNI-7845 AS PER TABLE-VI.		-	To confirm	→	
4	MATERIAL SPECIFICATION	UNI 7845		-	Specify Spec.	→	
5	MATERIAL GRADE	25CRMO4		-	To confirm	→	
6	SHAPE	ROUND		-	To confirm	→	
7	LENGTH	DFPW10500367	min 3000	MM	Input Value	→	
		DFPW10500375	min 1500	MM			
		DFPW10500383	min 1500	MM			
8	CHEMICAL PROPERTIES	UNI 7845		-	To confirm	→	
9	MECHANICAL PROPERTIES	UNI 7845		-	To confirm	→	
10	ULTRASONIC TESTING	as per BHEL specification AA0850118 and conform to quality level-II		-	To confirm	→	
11.1	CERTIFICATION	MATERIAL TEST CERTIFICATE (MTC) from NABL accredited/ Govt. approved Lab or OEM Labs		Y	confirm to supply	→	
11.2	CERTIFICATION	ULTRASONIC TEST REPORT		Y	confirm to supply	→	
11.3	CERTIFICATION	Certificate of Conformance / Compliance (COC)		Y	confirm to supply	→	
12	VENDOR REMARKS						

TECHNO-COMMERCIAL CHECKLIST

SL. NO.	TERMS & CONDITION	VENDOR CONFIRMATION /REMARKS / REPLY
	TENDER DETAILS	
1	BIDDER NAME	
2	GEM BID NO	
	QUALITY & TECHNICAL REQUIREMENTS	
3	ATTACHED FOLLOWING DOCUMENTS DULY FILLED, SIGNED & STAMPED ALONG WITH OFFER: • PQR SHEET ALONG WITH SUPPORTING DOCUMENTS • TECHNO-COMMERCIAL CHECKLIST • TECHNICAL PARAMETERS CHECK LIST	
4	VENDOR TO CONFIRM TO PROVIDE MATERIAL AND DIMENSIONAL TEST CERTIFICATES AS PER ENQUIRY DOCUMENTS ALONG WITH MATERIAL SUPPLY	
5	VENDOR TO CONFIRM TO PROVIDE HEAT TREATMENT AND ULTRASONIC TEST REPORTS OF ROUNDS	
6	VENDOR TO CONFIRM TO PROVIDE CERTIFICATE OF CONFORMANCE ALONG WITH DISPATCH.	
7	VENDOR TO CONFIRM TO PROVIDE IDENTIFICATION OF ALL ITEMS AND THEIR REPORT ACCORDINGLY	
	COMMERICAL REMARKS	
8	ITEM IS TO BE SUPPLIED AS PER ITEM DESCRIPTION/ SPECIFICATION/DRAWING.	
9	SUBMIT **MAKE IN INDIA SELF CERTIFICATION** AS PER FORMAT GIVEN ALONG WITH THE ENQUIRY	
10	KINDLY UPLOAD/ATTACH THE SPECIFICATION DETAILS/ CATALOGUE OF OFFERED ITEMS. (If applicable)	
11	**BREACH OF CONTRACT CLAUSE:**. IN CASE OF BREACH OF CONTRACT, WHEREVER THE VALUE OF SECURITY INSTRUMENTS LIKE PERFORMANCE BANK GUARANTEE AVAILABLE WITH BHEL AGAINST THE SAID CONTRACT IS ATLEAST 10% OF THE CONTRACT VALUE, THE SAME BE ENCASHED. IN CASE THE VALUE OF THE SECURITY INSTRUMENTS AVAILABLE IS LESS THAN 10% OF THE CONTRACT VALUE, THE BALANCE AMOUNT BE RECOVERED FROM OTHER FINANCIAL REMEDIES (I.E. AVAILABLE BILLS OF THE CONTRACTOR, RETENTION AMOUNT, ETC. WITH BHEL) OR LEGAL REMEDIES BE PURSUED.	
12	**ACTION AGAINST BIDDERS / VENDOR / SUPPLIER / CONTRACTOR IN CASE OF DEFAULT:** IN ORDER TO PROTECT THE COMMERCIAL INTERESTS OF BHEL, BHEL SHALL TAKE ACTION AGAINST SUPPLIES / CONTRACTORS BY WAY OF SUSPENSION OF BUSINESS DEALINGS, WHO EITHER FAIL TO PERFORM OR ARE IN DEFAULT WITHOUT ANY REASONABLE CAUSE, CAUSE LOSS OF BUSINESS/ MONEY/ REPUTATION, INDULGE IN MALPRACTICES, CHEATING, BRIBERY, FRAUD OR ANY OTHER MISCONDUCT OR FORMATION OF CARTELS SO AS TO INFLUENCE THE BIDDING PROCESS OR INFLUENCE THE PRICE ETC. SUSPENSION OF BUSINESS DEALINGS COULD BE IN THE FORM OF “HOLD” OR “BANNING” A SUPPLIER/ CONTRACTOR OR A BIDDER AND SHALL BE AS PER “GUIDELINES FOR SUSPENSION OF BUSINESS DEALINGS WITH SUPPLIERS/ CONTRACTORS” AVAILABLE AT BHEL’S WEBSITE “https://www.bhel.com/guidelines-suspension-business-dealings-supplierscontractors”	
13	REST GENERAL TERMS AND CONDITIONS AS PER GeM	

MAKE IN INDIA SELF CERTIFICATION

As per Government Public procurement order no. P-45021/2/2017-BE-II dt.15.06.2017 & P45021/2/2017-PP(BE-II) dated 28.05.2018,29.5.2019, 04.6.2020 and amendment dated 16.09.2020, it is hereby certifying that we

…… …… (supplier name) are ……......(Class-I/Class-II) local supplier and will meet the requirement of minimum local content of ……... (50%/20%) as defined in public procurement order dated 04.6.2020 for material against Enquiry no. ……. Details of location at which local value addition will be made is as follows: -

……

……..……

……

We also understand, false declarations will be in breach of the code of integrity under Rule 175(1)(i)(h) of the General Financial Rules for which a bidder or its successors can be debarred for up to two years as per Rule 151 (iii) of the general financial rules along with such other actions as may be permissible under law.

Note:

As per office order P-45021/102/2019-BE-II-Part (1) (E-50310) Dated 04/03/2021, Bidders can't claim itself as "Class-I local supplier/Class-II local suppliers" by claiming the service such as transportation, insurance, installation, commissioning, training & after sales service support like AMC/CMC etc. as local value addition. Bidder offering imported product will fall under the category of Non-Local supplier.

	Special quench and tempering carbon or alloy steel for finished products obtained from hot rolled bar and coil Quality, Requirements and Tests Together with UNI 7874 and UNI 8787 supersedes UNI 5332	UNI 7845

This standard agrees in part with ISO recommendation 683, parts I to VIII and EURONORM 83 (see parts explanations).

1. Scope and application

This standard covers special quench and tempering carbon or alloy steel for finished products obtained from hot rolled bar and coil.

Attention is drawn to the primary importance of the mass effect 1) of the quench and tempering heat treatment1) and its ripercussions on the mechanical properties of the finished product which vary in relation to size.

Mechanical properties indicated in Table II refer to inspection requirements (heat treatment, shape and size of test bar) which may differ from those of the finished part.

This standard does not apply to products intended for special applications for which separate standards exist (eg. Surface heat treating steels)

2 Definitions and grading:-
For definition and grading of steels see Std. UNI EU 20.
For definition and grading of steel products by shape and size see Std. UNI 7272.

3 Material

3.1. Steel making process and product manufacturing process

3.1.1. All steels covered herein must be killed.

3.1.2. Except as agreed at the time of ordering, the steel making process2) and the product manufacturing process2) are left to the discretion of the producer. However, the purchaser is entitled to receive information on the steel making process used on demand. Special processes such as degassing, vacuum melting or remelting, should be agreed upon at the time of ordering3).

3.1.4. Except as otherwise agreed at the time of ordering, the amount of hot reduction, intended as the ratio of average cross-section of the useful length of ingot or semifinished product to the crosssection of the finished product, shall be such as to ensure a metallurgically correct reduction.

3.2. Chemical analysis

3.2.1. Ladle analysis

3.2.1.1 Ladle analysis shall be in line with the requirements of Table I for each steel quality.

3.2.1.2. Mechanical properties and Jominy hardenability values which, depending on types of steel supply (see paragraph 5.3 and Table VII) are mandatory for inspection purposes, are given in Tables II and IV respectively.

For supply types 3 to 3e small deviations in ladle analysis relative to those of Table I shall be permissible provided their mechanical property requirements of Table II are met. For supply types 2 to 2e, 4 to 4e and 5, deviation form requirements shall only be possible upon agreement between purchaser and supplier at the time of ordering.

1) For definition of mass effect and quench and tempering effect see Std. UNI 3354.

2) For definition of steel formulation process and manufacturing process see Std. UN) 5447.
3) i.e.: end user, purchaser and steel supplier, manufacturer and control body and/or documentation organization

Table - Steel quality and chemical analysis (heat analysis)

(cont.)

Class	Steel grade	% Chemical analysis								
		C	Mn	Si	P max.	S max.	Cr	Ni	Mo	V
Non alloy	**C25**	0,22 ÷ 0,29	0,40 ÷ 0,80	0,15 ÷ 0,40	0,035	0,035	–	–	–	–
	C30•	0,27 ÷ 0,34	0,50 ÷ 0,80	0,15 ÷ 0,40	0,035	0,035	–	–	–	–
	C35	0,32 ÷ 0,39	0,50 ÷ 0,80	0,15 ÷ 0,40	0,035	0,035	–	–	–	–
	C40++•	0,37 ÷ 0,44	0,50 ÷ 0,80	0,15 ÷ 0,40	0,035	0,035	–	–	–	–
	C45++	0,42 ÷ 0,50	0,50 ÷ 0,80	0,15 ÷ 0,40	0,035	0,035	–	–	–	–
	C50++•	0,47 ÷ 0,55	0,60 ÷ 0,90	0,15 ÷ 0,40	0,035	0,035	–	–	–	–
	C55	0,52 ÷ 0,60	0,60 ÷ 0,90	0,15 ÷ 0,40	0,035	0,035	–	–	–	–
	C60	0,57 ÷ 0,65	0,60 ÷ 0,90	0,15 ÷ 0,40	0,035	0,035	–	–	–	–
Cr alloy	**41Cr4**	0,38 ÷ 0,45	0,50 ÷ 0,80	0,15 ÷ 0,40	0,035	0,035	0,90 ÷ 1,20	–	–	
Cr-Mn alloy	**36CrMn5++•**	0,33 ÷ 0,40	0,80 ÷ 1,10	0,15 ÷ 0,40	0,035	0,035	1,00 ÷ 1,30	–	–	–
Cr-V alloy	**50CrV4**	0,47 ÷ 0,55	0,70 ÷ 1,10	0,15 ÷ 0,40	0,035	0,035	0,80 ÷ 1,20	–	–	0,10 ÷ 0,20
Cr-Mo alloy	**25CrMo4**	0,22 ÷ 0,29	0,50 ÷ 0,80	0,15 ÷ 0,40	0,035	0,035	0,90 ÷ 1,20	–	0,15 ÷ 0,25	–
	30CrMo4•	0,27 ÷ 0,34	0,40 ÷ 0,70	0,15 ÷ 0,40	0,035	0,035	0,80 ÷ 1,10	–	0,15 ÷ 0,25	–
	35CrMo4++	0,32 ÷ 0,39	0,60 ÷ 0,90	0,15 ÷ 0,40	0,035	0,035	0,90 ÷ 1,20	–	0,15 ÷ 0,25	–
	42CrMo4++	0,38 ÷ 0,45	0,60 ÷ 0,90	0,15 ÷ 0,40	0,035	0,035	0,90 ÷ 1,20	–	0,15 ÷ 0,25	
Ni-Cr-Mo alloy	**40NiCrMo2**	0,37 ÷ 0,44	0,70 ÷ 1,00	0,15 ÷ 0,40	0,035	0,035	0,40 ÷ 0,60	0,40 ÷ 0,70	0,15 ÷ 0,25	–
	39NiCrMo3++	0,35 ÷ 0,43	0,50 ÷ 0,80	0,15 ÷ 0,40	0,035	0,035	0,60 ÷ 1,00	0,70 ÷ 1,00	0,15 ÷ 0,25	–
	40NiCrMo7•	0,37 ÷ 0,44	0,50 ÷ 0,80	0,15 ÷ 0,40	0,035	0,035	0,60 ÷ 0,90	1,60 ÷ 1,90	0,20 ÷ 0,30	–
	30NiCrMo12 •	0,28 ÷ 0,35	0,50 ÷ 0,80	0,15 ÷ 0,40	0,035	0,035	0,60 ÷ 1,00	2,60 ÷ 3,20	0,30 ÷ 0,50	–
	34NiCrMo16	0,31 ÷ 0,38	0,30 ÷ 0,60	0,15 ÷ 0,40	0,035	0,035	1,60 ÷ 2,00	3,70 ÷ 4,20	0,25 ÷ 0,45	–

* Other elements not indicated in the table shall not be deliberately introduced in the steel, except for those intended for heat preparation. All possible precautions shall be adopted to prevent the addition of such elements deriving from scrap and other raw materials used during preparation. However, residual elements may be present provided that hardenability requirements and mechanical properties indicated are met and that intended use is not adversely affected.

** May be supplied on request with added lead (0.15 to 0.30%) or controlled sulphur (0.020 to 0.035%) for high speed machining applications.
May be supplied on request with a higher content of molybdenum (0.60%) and possibly with the addition of vanadium.

• Steels not covered by EURONORM 83.

3.2 Check Analysis

For supply types 1, 1C and 1e a check analysis may be agreed at the time of ordering. The Table below lists permissible deviations between check analysis and ladle analysis indicated in Table-1.

Element	Required limit %	Permissible deviation ♦● %
C	up to 0,55	± 0,02
	over 0,55 up to 0,65	± 0,03
Mn	up to 1,00	± 0,04
	over 1,00 up to 1,10	± 0,06
Si	up to 0,40	± 0,03
P o S	up to 0,035	+ 0,005
Cr	fino a 1,30	± 0,05
Ni	up to 1,00	± 0,03
	over 1,00 up to 2,00	± 0,05
	over 2,00 up to 4,20	± 0,07
Mo	up to 0,30	± 0,03
	over 0,30 up to 0,50	± 0,04
V	up to 0,20	± 0,02

♦ Values indicated apply only to diameters ≤ 160 mm; for larger diameters permissible deviations shall be agreed of the time of ordering.

● For a given heat permissible deviation of any element in check analysis may be either above max. or below min. specified in table 1, but never both.

Table II - Mechanical properties for quench and tempered bar (see para. 3.3)

Steel grade	Test bar diam. mm over	up to	Tensile test: UTS R N/mm²	UTS R kgf/mm²	Proof stress $R_{p\,0.2}$ min. N/mm²	Proof stress $R_{p\,0.2}$ min. kgf/mm²	Elongation A min. %	Impact strength KCU min. J
C35		16	540÷690	55÷70	360	37	19	37,5
	16	40	490÷640	50÷65	305	31	21	37,5
	40	100	–	–	–	–	–	–
	100	160	–	–	–	–	–	–
	160	250	–	–	–	–	–	–
C40		16	640÷780	65÷80	440	45	17	35
	16	40	590÷740	60÷75	370	38	19	35
	40	100	540÷690	55÷70	325	33	20	30
	100	160	–	–	–	–	–	–
	160	250	–	–	–	–	–	–
C55		16	670÷810	68÷83	470	48	16	30
	16	40	610÷760	62÷77	390	40	18	27,5
	40	100	570÷720	58÷73	355	36	19	25
	100	160	–	–	–	–	–	–
	160	250	–	–	–	–	–	–
C60		16	700÷840	71÷86	490	50	15	25
	16	40	640÷780	65÷80	420	43	17	25
	40	100	590÷740	60÷75	370	38	18	20
	100	160	–	–	–	–	–	–
	160	250	–	–	–	–	–	–
41Cr4		16	730÷870	74÷89	510	52	14	20
	16	40	690÷830	70÷85	460	47	15	17,5
	40	100	640÷780	65÷80	410	42	16	15
	100	160	–	–	–	–	–	–
	160	250	–	–	–	–	–	–
36CrMn5		16	760÷900	77÷92	540	55	13	17,5
	16	40	740÷880	75÷90	500	51	14	15
	40	100	690÷830	70÷85	440	45	15	–
	100	160	–	–	–	–	–	–
	160	250	–	–	–	–	–	–
		16	790÷940	81÷96	560	57	12	–
	16	40	760÷900	77÷92	510	52	13	–
	40	100	710÷850	72÷87	430	44	14	–
	100	160	–	–	–	–	–	–
	160	250	–	–	–	–	–	–
		16	830÷980	85÷100	590	60	11	–
	16	40	780÷930	80÷95	530	54	12	–
	40	100	740÷880	75÷90	450	46	13	–
	100	160	–	–	–	–	–	–
	160	250	–	–	–	–	–	–
		16	930÷1 130	95÷115	735	75	11	25
	16	40	830÷980	85÷100	635	65	12	25
	40	100	740÷880	75÷90	540	55	14	25
	100	160	–	–	–	–	–	–
	160	250	–	–	–	–	–	–
		16	880÷1 080	90÷110	685	70	12	25
	16	40	780÷930	80÷95	590	60	13	25
	40	100	740÷880	75÷90	540	55	14	25
	100	160	–	–	–	–	–	–
	160	250	–	–	–	–	–	–

(cont.)

cont'd.

Steel grade	Test bar diam. mm over	up to	Tensile test: UTS R N/mm²	UTS R kgf/mm²	Proof stress $R_{p\,0.2}$ min. N/mm²	Proof stress $R_{p\,0.2}$ min. kgf/mm²	Elongation A min. %	Impact strength KCU min. J
50CrV4		16	030 1 230	105 125	835	85	10	20
	16	40	930 1 130	95 115	735	75	11	20
	40	100	880 1 080	90 110	685	70	12	20
	100	160	—	—	—	—	—	—
	160	250	—	—	—	—	—	—
25CrMo4		16	830 1 030	85 105	635	65	13	35
	16	40	780 930	80 95	590	60	13	35
	40	100	690 830	70 85	440	45	14	35
	100	160	—	—	—	—	—	—
	160	250	—	—	—	—	—	—
30CrMo4		16	880 1 080	90 110	685	70	12	32,5
	16	40	830 1 030	85 105	635	65	12	32,5
	40	100	740 880	75 90	520	53	13	30
	100	160	690 830	70 85	420	43	15	30
	160	250	—	—	—	—	—	—
35CrMo4		16	930 1 130	95 115	735	75	11	30
	16	40	880 1 080	90 110	665	68	11	30
	40	100	780 930	80 95	560	57	12	30
	100	160	740 880	75 90	510	52	14	30
	160	250	690 830	70 85	460	47	14	30
42CrMo4		16	1 030 1 230	105 125	835	85	10	25
	16	40	930 1 130	95 115	735	75	10	25
	40	100	830 1 030	85 105	635	65	11	25
	100	160	780 930	80 95	560	57	13	25
	160	250	740 880	75 90	510	52	13	25
40NiCrMo2		16	1 030 1 230	105 125	835	85	10	25
	16	40	930 1 130	95 115	735	75	11	30
	40	100	830 980	85 100	635	65	12	30
	100	160	740 880	75 90	540	55	13	30
	160	250	—	—	—	—	—	—
39NiCrMo3		16	980 1 180	100 120	785	80	11	30
	16	40	930 1 130	95 115	735	75	11	30
	40	100	880 1 080	90 110	685	70	12	30
	100	160	830 980	85 100	635	65	12	30
	160	250	740 880	75 90	540	55	13	30
40NiCrMo7		16	1 030 1 230	105 125	835	85	11	30
	16	40	980 1 180	100 120	785	80	11	30
	40	100	930 1 130	95 115	735	75	12	30
	100	160	850 1 030	87 105	665	68	13	30
	160	250	780 980	80 100	635	65	12	30
30NiCrMo12		16	980 1 180	100 120	785	80	14	40
	16	40	980 1 180	100 120	785	80	14	40
	40	100	930 1 130	95 115	735	75	13	37,5
	100	160	880 1 030	90 105	685	70	14	35
	160	250	880 1 030	90 105	685	70	14	35
34NiCrMo16*		16	1 230 1 420	125 145	1 030	105	9	20
	16	40	1 230 1 420	125 145	1 030	105	9	20
	40	100	1 130 1 320	115 135	930	95	10	25
	100	160	1 080 1 270	110 130	880	90	10	25
	160	250	980 1 180	100 120	785	80	11	25

* Mechanical properties for 11 mm dia. quenched and stress relieved steel bar:

$R_{p\,0.2}$ = 1 275 N/mm² (130 kgf/mm²); R = 1 720 1 960 N/mm² (175 200 kgf/mm²); A = 7%; KCU = 15 J.

(cont.)

T le Mechanical properties or 00 mm normalized ee ba (for ormation y'

(cont

Stee grade	ensile				
	UTS *R*		Yi ength		Elongation *A* min. %
	N/mm²	kgf/mm²			
C 25	410÷520	42÷53	235	24	
C 30	460÷610	47÷62	255	**26**	23
C 35	490÷640	50÷65	275	**28**	
	570÷720	58÷73	325	33	
	590÷740	60÷75	335	**34**	7
50	630÷780	64÷80	355	**36**	16
55	660÷830	67÷85	360	**37**	
60	880	90	380		

Table IV - Hardenability ratings (Jominy) (cont.)

Distance from quenched end of specimen mm	Steel																							
	41Cr4		36CrMn5		50CrV4		25CrMo4		30CrMo4		35CrMo4		42CrMo4		40NiCrMo2		39NiCrMo3		40NiCrMo7		30NiCrMo12		34NiCrMo16	
	Rockwell hardness *HRC*																							
	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.	min.	max.
	53	61	50	58	57	65	44	52	46	56	49	58	53	61	53	60	52	60	52	60	51	57	50	57
3	52	61	49	58	56	65	42	52	45	55	49	58	53	61	53	60	51	60	52	60	50,5	56,5	49	56
	50	60	48	57	56	64	38	51	42	53	48	57	52	61	52	60	50	59	52	60	50	56	48	56
7	47	59	47	56	54	64	35	50	38	51	45	56	51	60	50	59	49	58	52	60	50	56	48	56
9	44	58	44	55	52	63	32	48	35	49	42	55	50	60	47	58	48	58	52	60	49,5	55,5	48	56
11	40	56	41	54	51	63	30	46	30	47	39	54	48	59	42	57	46	57	52	60	49,5	55,5	48	55
13	37	54	39	54	50	62	28	43	28	45	36	53	45	59	38	55	44	57	52	60	49	55,5	48	55
15	35	52	37	53	47	61	26	41	26	42	34	52	43	58	35	54	43	56	52	60	49	55,5	47	55
20	30	46	34	50	42	60	23	37	24	39	30	48	38	56	30	48	39	55	51	59	48,5	55	47	55
25	27	42	32	48	39	58	21	35	23	37	28	45	35	53	28	43	36	52	50	58	48	55	47	55
30	25	40	31	46	37	57	20	33	21	35	27	43	34	51	26	41	34	51	49	58	48	55	47	55
35	23	38	30	45	36	55	–	32	20	33	26	41	33	48	25	39	33	49	48	58	47,5	55	47	55
40	22	37	29	44	35	54	–	31	–	32	25	40	32	47	24	38	32	48	47	57	47,5	55	47	55
45	21	36	28	43	34	53	–	31	–	31	24	40	32	46	24	38	31	46	45	56	47	55	47	55
50	20	35	27	43	33	53	–	31	–	31	24	39	32	45	23	37	30	45	44	56	47	55	47	55

Note These values, to be confirmed by further testing, are to be considered representative of the steel quality and are applicable preferably to austenitic grain size 5 or finer as per UNI 3245.

3.3 Mechanical properties

For supply types 3 to 3e, 4 to 4e and 5 the values of mechanical properties after quench and tempering given in Table II deriving from longitudinal specimens4), conforming to Figure 1, apply. Such values are guaranteed.

3.3.1 For supply types 3, 3c and 3e the values of mechanical properties as per Table II taken from a test specimen obtained from 16 mm diameter reference test bar machined from a test piece taken from a product after hot forging to 25 mm diameter apply. The 16 mm diameter test bar is subsequently quenched and tempered as per procedure indicated in Table VI for each type of steel. The supplier may, except for the cases agreed upon at the time of ordering, machine the 16 mm diameter test bar directly from the sample product cutting from the position indicated in Figure1 and then quench and temper.

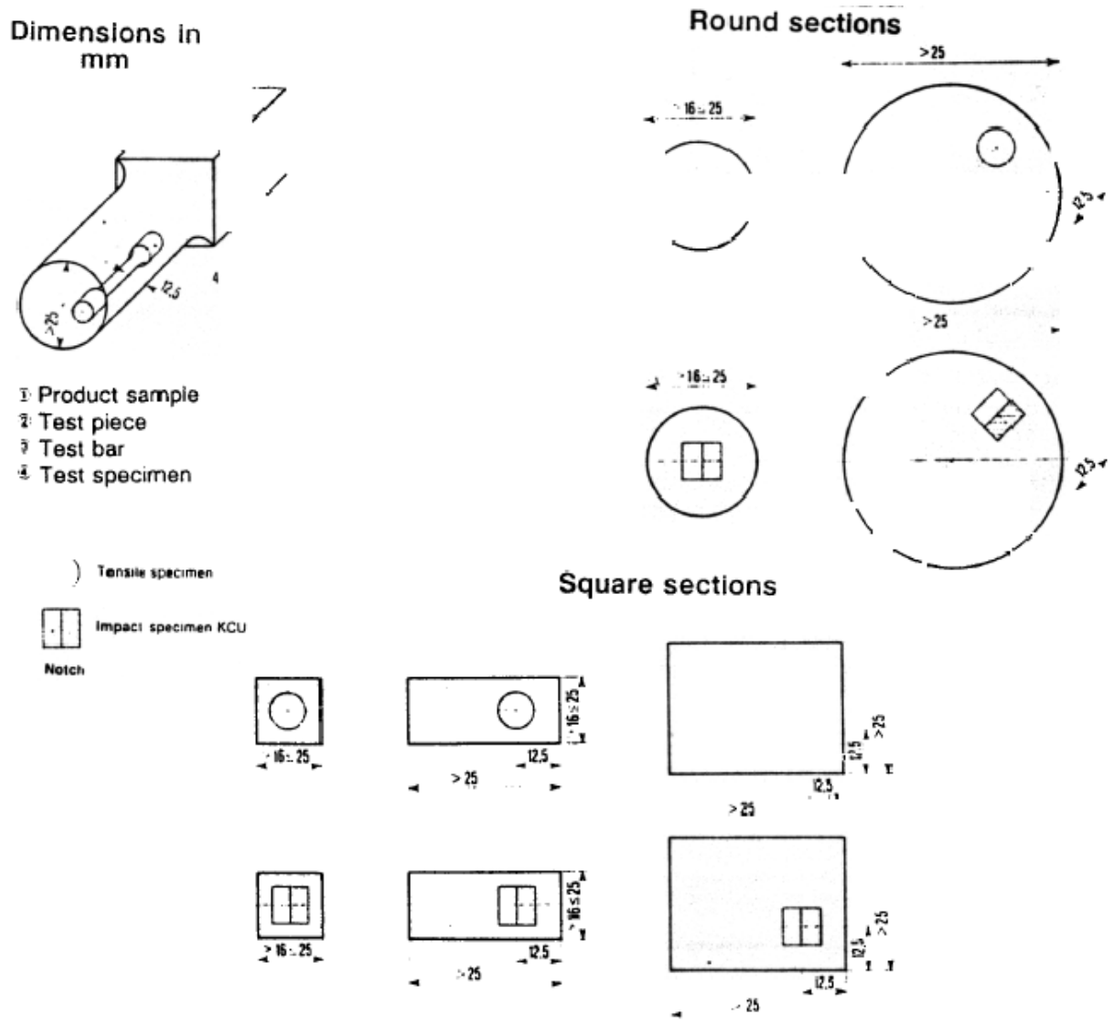
3.3.2 For supply types 4, 4c and 4e the values of mechanical properties indicated in Table II taken from test specimen obtained from test bar (see Figure 1) corresponding to the critical section (see note in Table VII) to be defined at the time of ordering derived by hot forging of a sample product to specified diameter or size apply. Test bar is subsequently quenched and tempered as per Table VI for each steel type.

3.3.3

Test bar may also be obtained, except for arbitration cases, directly from sample product by machining and subsequent quench and tempering.

3.3.3 For supply type 5 the values of mechanical properties indicated in Table II taken from test specimens obtained by machining as per Figure 1, directly from a quenched and tempered sample product at supply size apply.

3.3.4 As in the case of carbon steels mechanical properties in quenched and tempered conditions involve a thin surface layer only, Table III lists the values of such requirements in a normalized condition for information only (see paragraph 5.2.2.1).



3.4. Brinell hardness

For supply types 1c, 1e, 2c, 2e, 3c, 3e, 4c and 4e Table V lists Brine" hardness values to be observed in order to obtain the mechanical and structural properties best suited to machining or cold formability.

Table V -Brinell hardness values for soft annealing, spheroidizing and structure-oriented annealing within specified hardness bands

Steel grade	Soft annealing	Spheroidizing	Structure-oriented annealing
	HB Hardness		HB Hardness
	max.	max.	
C25	190	147	123÷174
C30	200	155	139 180
C35	210	161	143÷197
C40	220	179	155÷210
C45	235	188	163÷217
C50	245	200	
C55	250	215	
C60	260	217	
41Cr4	230	195	
36CrMn5	230	195	170÷215
50CrV4	250	240	
25CrMo4	210	180	–
30CrMo4	220	185	170÷215
35CrMo4	235	190	180÷225
42CrMo4	245	195	185÷240
40NiCrMo2	235	195	
39NiCrMo3	240	220	
40NiCrMo7	250	230	–
30NiCrMo12	260	–	–
34NiCrMo16	275	–	–

• Generally lamellar ferrite and pearlite

Note -In as hot rolled conditIon no Brinell hardness value is guaranteed; however. prior to agreement at time of ordering between purchaser and supplier max. hardness values may be specified.

3.5 Jominy hardenability

For supply types 2a to 2e, with guaranteed Jominy hardenability, Rockwell C hardness values from Table IV or scatter bands indicated In Figure 2 to 13 shall apply.
Quench temperature of Jominy test specimen shall be as indicated in Table VI for each steeltype.
Jominy hardenability guarantee applies to alloy steels only. The test results shall always be expressed as per Std. UNI 3150.

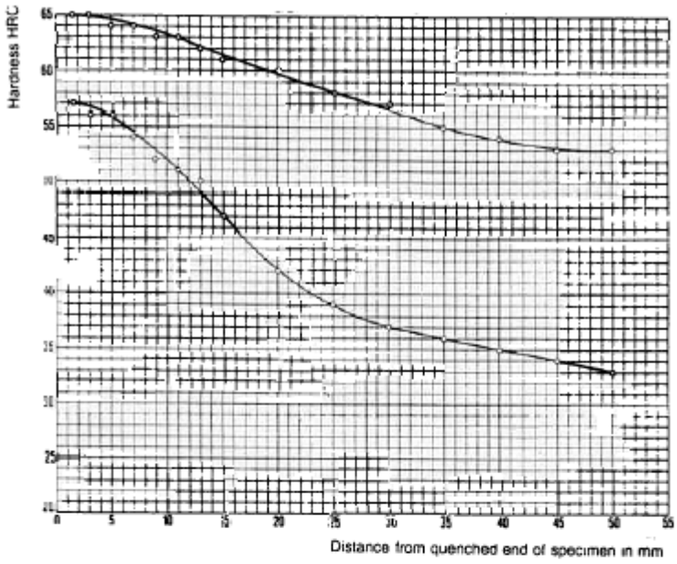


Fig. 4 - Jominy hardenability for steel 50CrV4

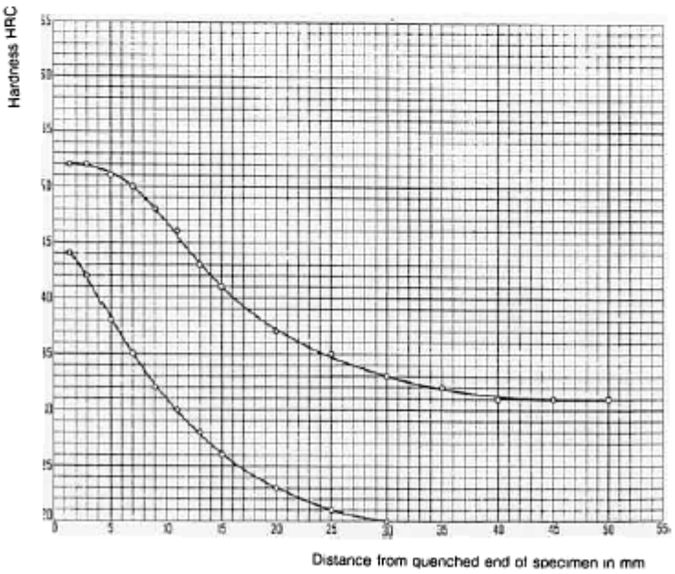


Fig. 5 - Jominy hardenability for steel 25CrMo4

(cont.)

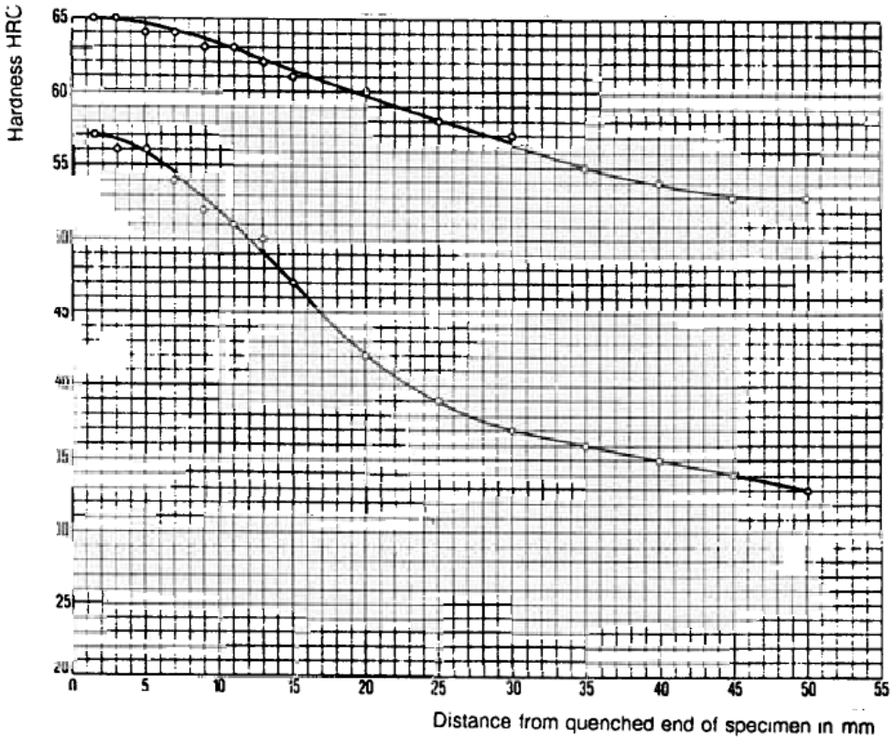


Fig. 4 - Jominy hardenability for steel 50CrV4

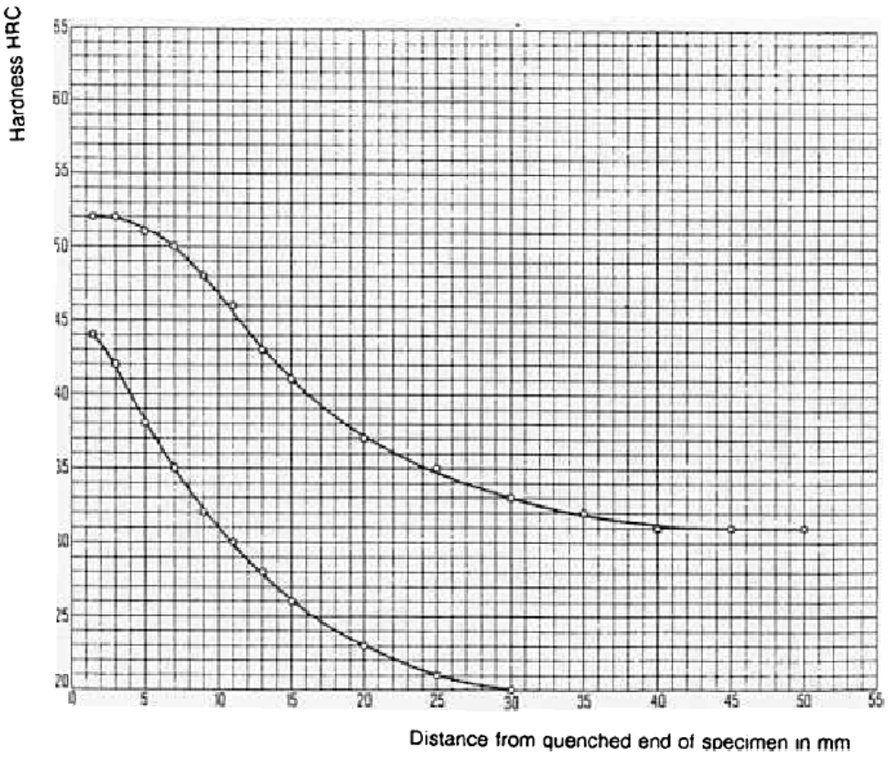


Fig. 5 - Jominy hardenability for steel 25CrMo4

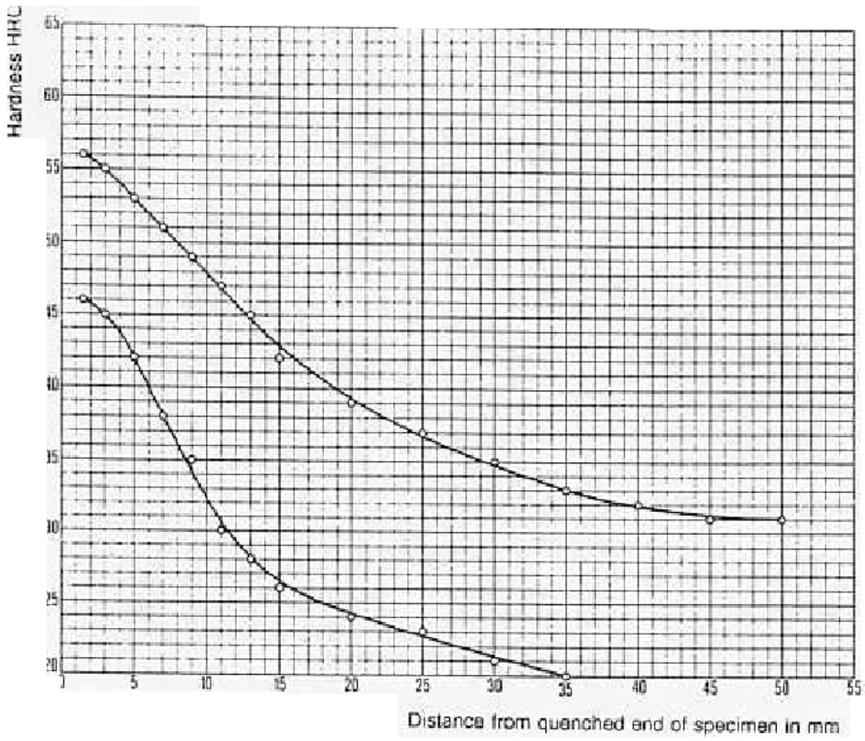


Fig. 6 - Jominy hardenability for steel 30CrMo4

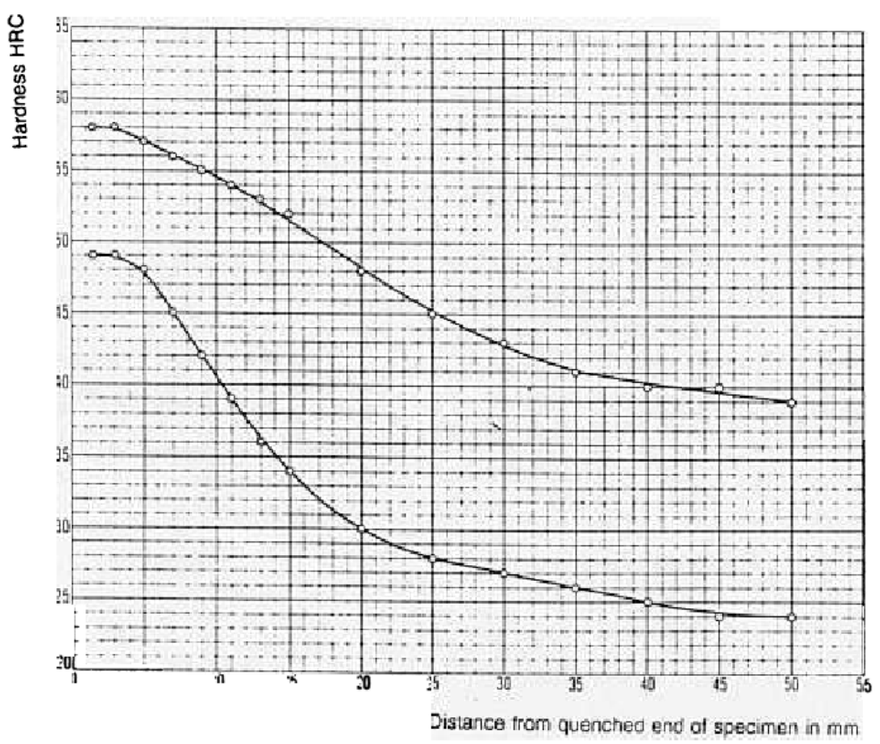


Fig. 7 - Jominy hardenability for steel 35CrMo4

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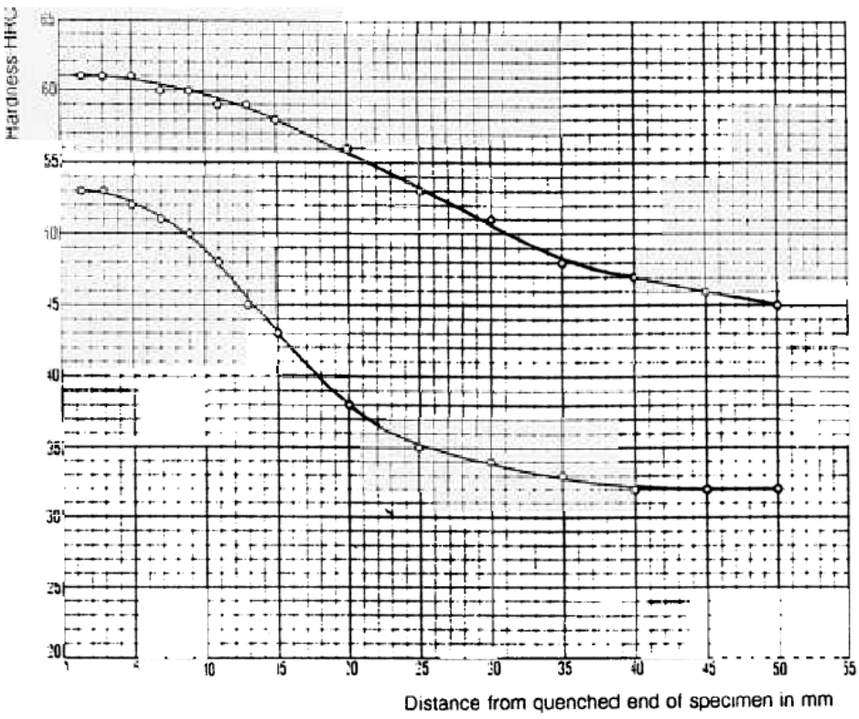

Fig. 8 - Jominy hardenability for steel 42CrMo4

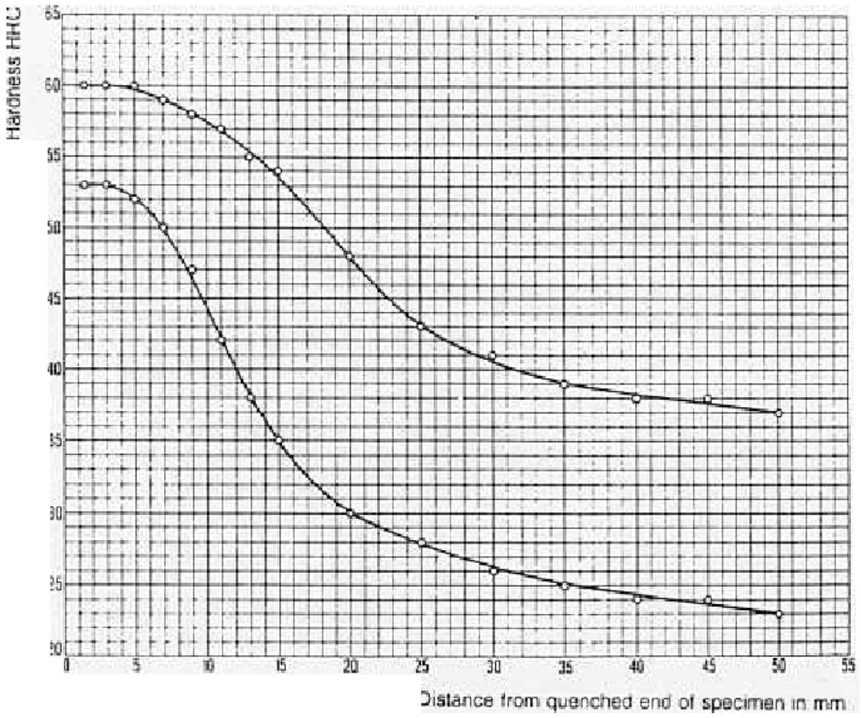

Fig. 9 - Jominy hardenability for steel 40NiCrMo2

(cont.)

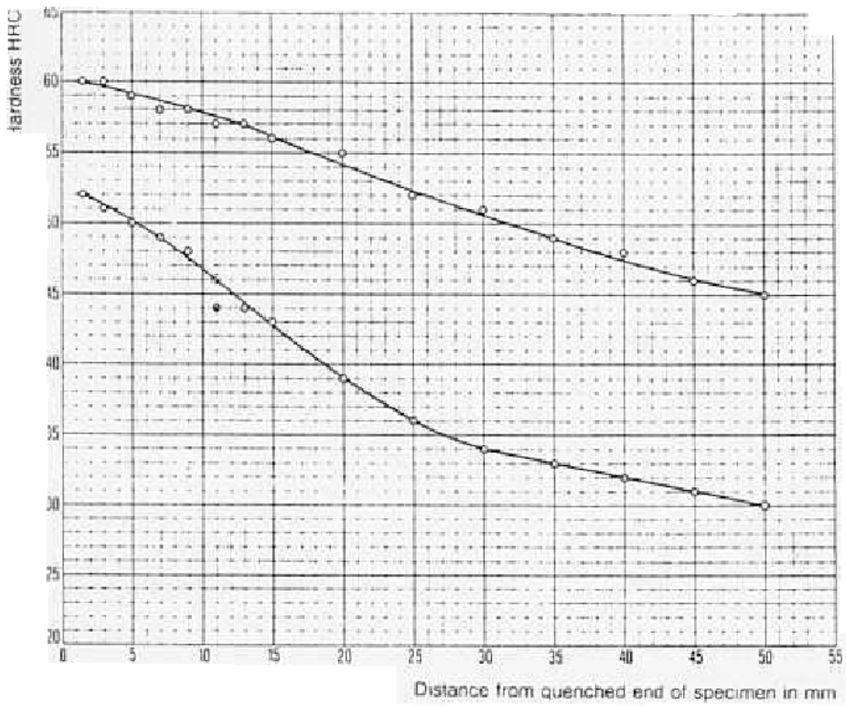

Fig. 10 - Jominy hardenability for steel 39NiCrMo3

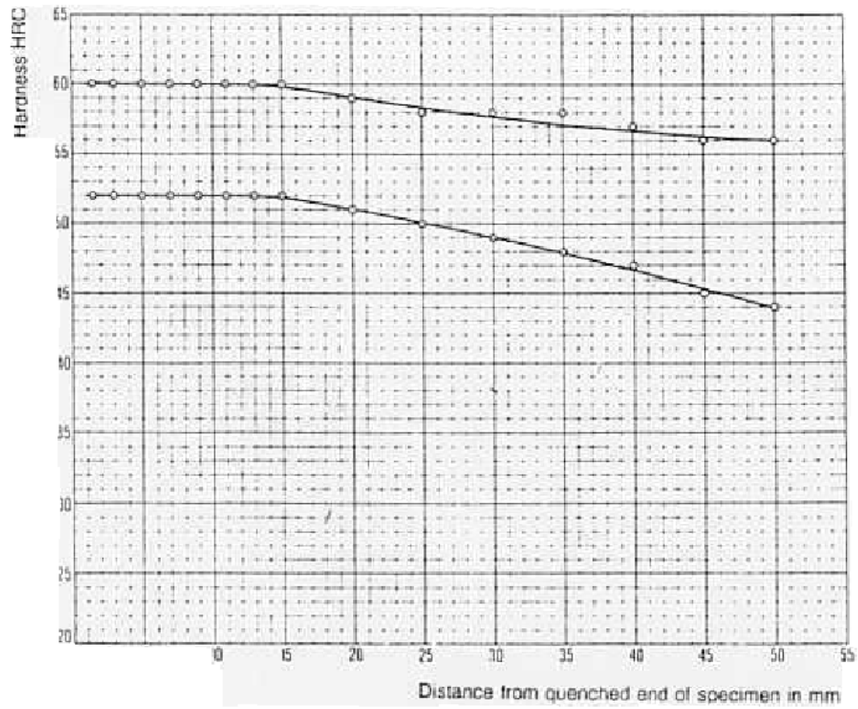

Fig. 1 - Jominy hardenability for steel 40NiCrMo7

(cont.)

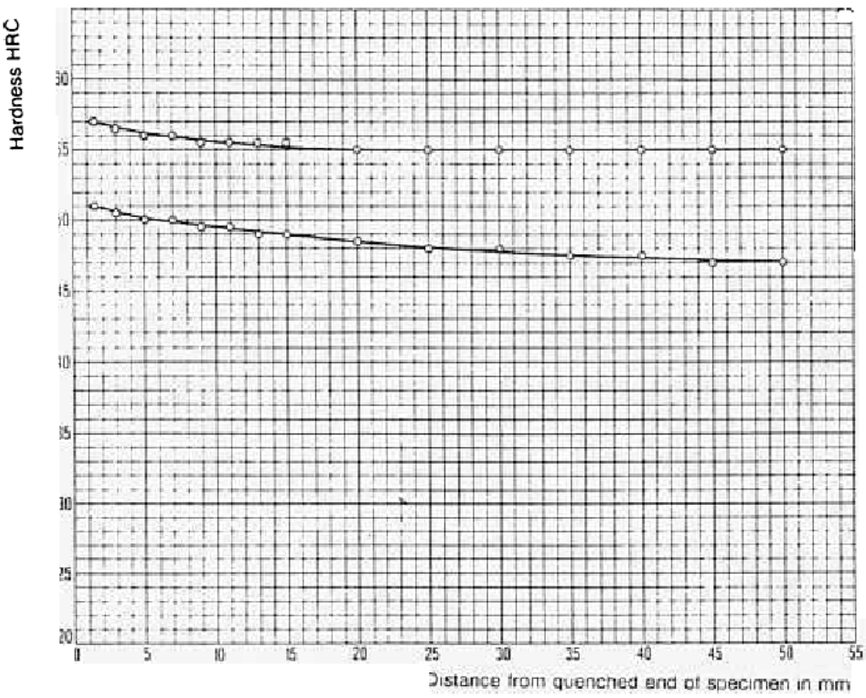

Fig. 12 - Jominy hardenability for steel 30NiCrMo12

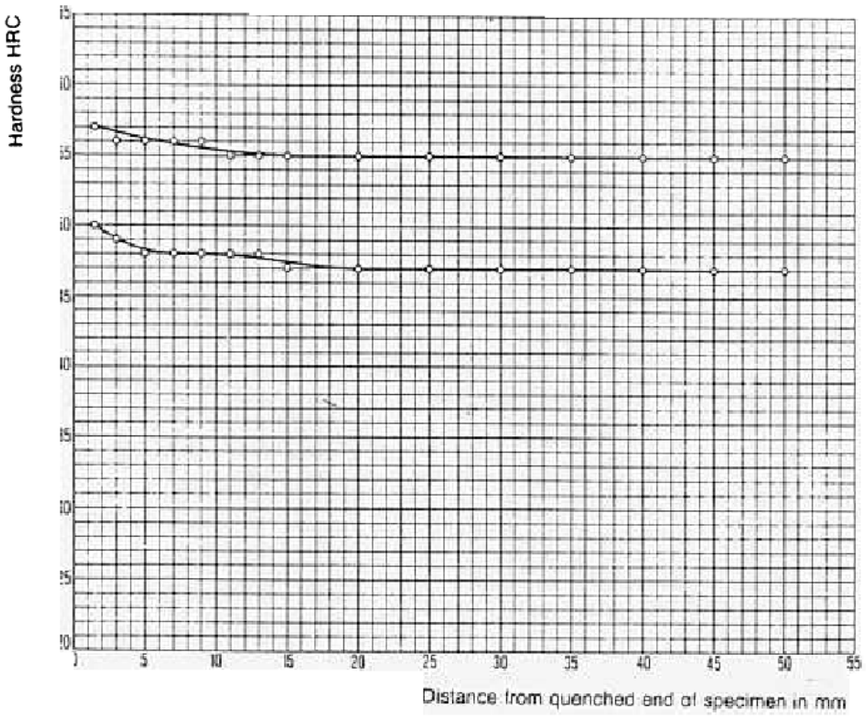

Fig. 13 - Jominy hardenability for steel 34NiCrMo16

(cont.

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Table VI - Temperatures for forging and quench and tempering reference test bars and for Jominy test

(cont.)

Steel grade	Forging °C	Quench and tempering			Jominy test specimen •• quenching temperature ± 5 °C
		Quenching * °C	Quenching medium **	Tempering • °C	
C25	1 100–900	860÷880	water	550÷650	–
C30	1 100–850	850÷870	water	550÷650	–
C35	1 100–850	840÷860	water	550÷650	–
C40	1 100–850	830÷850	water	550÷650	–
C45	1 100–850	820÷840	water	550÷650	–
C50	1 050–850	830÷850	oil	550÷650	–
C55	1 050–850	825÷845	oil	550÷650	–
C60	1 050–850	820÷840	oil	550÷650	–
41Cr4	1 050÷850	840÷860	oil	550÷650	850
36CrMn5	1 050÷850	840÷860	oil	550÷650	850
50CrV4	1 050÷850	830÷870	oil	550÷650	850
25CrMo4	1 050÷850	850÷870	oil	550÷650	860
30CrMo4	1 050÷850	840÷860	oil	550÷650	850
35CrMo4	1 050÷850	840÷860	oil	550÷650	850
42CrMo4	1 050÷850	830÷850	oil	550÷650	840
40NiCrMo2	1 050÷850	830÷850	oil	550÷650	850
39NiCrMo3	1 050÷850	830÷850	oil	550÷650	850
40NiCrMo7	1 050÷850	830÷850	oil	550÷650	850
30NiCrMo12	1 050÷850	820÷840	oil	550÷650	825
34NiCrMo16	1 050÷850	810÷830	oil	550÷650	825

* Soaking time shall be sufficient to permit full steel structure transformation throughout test bar mass, but in no case under 30 minutes.

** Water temperature to be 15° to 30°C, oil temperature to be 15° to 60°C.

• Tempering time: Minimum 1 h. Temperature shall be selected from the range indicated to obtain properties specified in Table III.

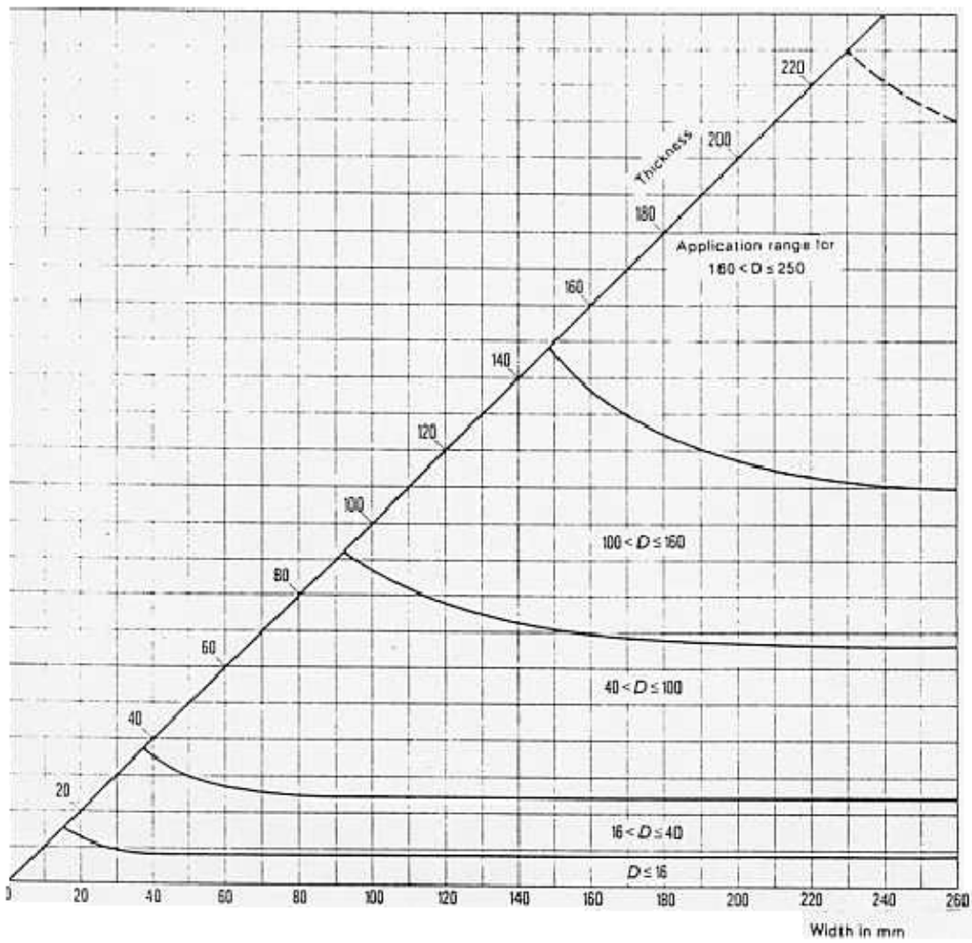
•• Jominy test specimen shall be normalized prior to testing.

Table VIa - Soft annealing and normalizing temperatures

Steel grade	Soft annealing °C	Normalizing °C
C25	650÷700	870÷900
C30	650÷700	860÷890
C35	650÷700	860÷890
C40	650÷700	840÷870
C45	650÷700	840÷870
C50	650÷700	840÷870
C55	650÷700	830÷860
C60	650÷700	820÷850
41Cr4	680÷720	850÷880
36CrMn5	680÷720	860÷890
50CrV4	680÷720	850÷880
25CrMo4	680÷720	860÷890
30CrMo4	680÷720	860÷890
35CrMo4	680÷720	850÷880
42CrMo4	680÷720	850÷880
40NiCrMo2	640÷680	850÷880
39NiCrMo3	640÷680	850÷880
40NiCrMo7	640÷680	850÷880
30NiCrMo12	640÷680	840÷870
34NiCrMo16	640÷680	830÷860

(cont.)

Fig. 14 -Diagram for conversion of rectangular cross-sections in round cross-sections covering quench and temper condition (equivalent diameter D)



Example of application:
For a flat product 80 mm thick by 150 mm wide, consider the mechanical properties indicated in Table II for diameter range 100 to 160 mm.

4. Dimensions and tolerances

4.1. For dimensions and tolerances of hot rolled finished products see:

- for hot rolled round products, bar and coil Std. UNI 7620;
- for hot rolled square bar Std. UNI 6013;
- for hot rolled flat bars Std. UNI 6014;
- for hot rolled hexagonal bar and coil Std. UNI 7061.
-

For tolerances of scalped and sized or ground round bar see Std. UNI 5945.
For hot rolled finished products in other shapes, tolerpnces shall be defined at the time of ordering by agreement between supplier and purchaser.

5.0 Supply terms

5.1. General

For general supply terms covering steel products see Std. UNI 5447.

5.2 Supply conditions

5.2.1. Normal supply condition

Products covered herein are usually supplied as hot rolled.

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Table VII - Supply types

(cont.)

Requirements for	Supply type												
		1c	1e	2	2c	2e	3	3c	3e	4	4c	4e	5
Chemical analysis	x	x	x	x	x	x	x	x	x	x	x	x	x
Hardness as normalized or soft annealed or spheroidized	–	x	–	–	x	–	–	x	–	–	x	–	–
Hardness as annealed to obtain a structure to within a given hardness range	–	–	x	–	–	x	–	–	x	–	–	x	–
Hardenability (Jominy)	–	–	–	x	x	x	–	–	–	–	–	–	–
Mechanical properties of:													
Quench and hardened test bar dia 16 mm	–	–	–	–	–	–	x	x	x	–	–	–	–
Critical quench and tempered section*	–	–	–	–	–	–	–	–	–	x	x	x	–
Quench and hardened product in supply size	–	–	–	–	–	–	–	–	–	–	–	–	x

* One of the major factors in selecting steel quality is to know whether the mechanical properties requested can be obtained with part shape and size at the time of heat treating. The most significant section in this respect is defined as "critical section" and shall always be expressed as the diameter of a round bar of equivalent behaviour when heat treated (see Fig. 14).

5.2.2. Special supply conditions

5.2.2.1. Upon agreement at the time of ordering, products may be supplied in the following special conditions:

a) Special heat treatment

- Soft annealed to guarantee maximum hardness (see Table V)
- Spheriodized (see Table V)
- Annealed to obtain a particular structure and hardness range (see Table V)
- Normalized (carbon steels only) (see Table III)
- Quenched and tempered
-

b) Special surface conditioning

- Cleaned
- Mechanically cleaned (bar products only)
- Scalped and scalped and sized (round bar products only)
- Ground (round bar products only)

The purchaser should state the use for which products are intended, e.g.

- Products intended for hand-forging or hot die-forging
- Products for upsetting or cold extrusion
- Products for machining
- Products for cold drawing.

5.3 Supply types

5.3.1. Products shall be ordered in one supply type as per Table VII to be stated at the time of ordering Products covered herein shall be supplied in separate heats.

5.4 Surface defects

5.5

5.4.1. The surface of hot rolled product supplied as rolled, cleaned or mechanically cleaned may be affected by defects the severity of which varies depending on the manufacturing process.

For round, hexagonal and flat products there are three classes of permissible defects5) based on defect depth (see Table VIII). The purchaser shall therefore specify upon ordering the selected class depending on intended use of the

Table VIII - Permissible depth of surface defects

Class	Diam of width across flats mm	Permissible defect depth *
A	up to 30	≤ 1% with 0,1 mm minimum
	over 30 up to 100	≤ 1% with 0,6 mm maximum
B	over 100 up to 150	≤ 1.6 mm
C	up to 16 excluded	≤ 4% with 0,5 mm maximum
	from 16 to 50 excluded	≤ 3% with 1 mm maximum
	from 50 to 100 excluded	≤ 2% with 1,5 mm maximum
	from 100 to 150 excluded	≤ 1,5% with 2,25 mm maximum
* Depth of defects is expressed as percent of nominal diameter or width across flats.		

(cont.)

5) By defect depth is meant the distance at right angles to product surface from bottom of defect and said surface. Normally this depth is measured through filing or grinding.

material. The class is to be selected taking into account also chemica! analysis, shape of part and quenching medium.

5.4.1.2. For class of defects 8, unless otherwise specified at the time of ordering, if the depth of the 1L defects in round bars is greater than indicated above, a repair by grinding or mechanical deseaming shall be permissible providing the resulting surface is smooth, adequately blending with the surrounding surface and no deeper than 4% of nominal diameter and total width not greater than one quarter of the circumference. The portion of surface where the depth of repair is within the minus dimension or deviation permitted on diameter shall not be considered as repaired portion.

5.4.1.3. For finished products of other sizes or other shapes tolerated surface defects depth shall be agreed at the time of ordering depending on intended use.

The surface of products supplied scalped, scalped and cold finished and ground shall be free fromdefects.

5.4.3. In case of dispute. defect depth shall be assessed through microscopic testing on a transverse section of product sample at 100 X.

5.5 Internal defects

The adoption of appropriate methods for detecting any internal defects and any guarantee of freedom from or extent of permissible defects as well as the rules for interpretation of indications and methods, shall be the subject of special agreement at the time of ordering.

5.6 Heat treatments

Table VI summarizes the temperatures for quench and tempering test bars of individual steels within the scope of inspection testing, as well as the temperatures for the Jominy hardenability test.

6.0 Inspection

6.1. General

For all finished products covered herein the parties may agree to carry out inspection as per paragraph 5 of Std. UNI 5447.

6.2. Inspection unit

Finished products must be inspected by heat and, where the product is supplied as quenched and tempered (supply type 5) by heat treated lots and groups of the same diameter.

6.3 Chemical analysis

If agreed at the time of ordering ladle analysis is submitted to the purchaser. Where, for supply types 1, 1 c and 1 e, purchaser requires a check analysis, the minimum requirement is one check per heat. For the check analysis the deviations indicated in Table la from the limits required in Table I shall apply.

6.4 Brinell hardness and mechanical properties

The number of test pieces required for hardness testing (supply types 1c, 1e, 2c, 2e, 3c, 3e, 4c and 4e) and for mechanical properties on specimen cut from quenched and tempered test bar (supply types 3, 3c, 3e, 4, 4c and 4e) is indicated in Table IX.

Where products are supplied quenched and tempered (supply type 5) for inspection of guaranteed values the following conditions apply:

- If quench and tempering was carried out using batch equipment take one test piece per heat, heat treated lot and group of the same diameter.

- If quench and tempering was carried out on continuous equipment take one test piece for each 25 ton or residual portion for carbon steels and a test piece every 15 ton or residual portion for alloy steels, with a minimum of one test piece per heat or per group of the same diameter.

(cont.....)

6.5 Jominy hardenability

One test piece per heat is required to inspect Rockwell C values guaranteed by a Jominy test (supply types 2, 2c and 2e).

6.6 Cutting and preparation of samples, test pieces test bars and test specimens

6.6.1. Chips for check analysis shall be cut evenly on the entire section of the product. Where this is not practicable or possible. chips shall be cut in a suitable area which shall be representative of the entire section.

6.6.2 Test specimens for tensile and impact tests shall be cut longitudinally. For supply types 3, 3c and 3e test specimens shall be obtained from a round test bar having diameter 16 mm, quenched and tempered as indicated in Table VI.

For supply types 4, 4c and 4e test specimens shall be taken as indicated in Figure 1 from a test bar having diameter equal to the critical section, quenched and tempered as indicated in Table VI
(for rectangular cross-section products see diagram in Figure 14).

For supply type 5, test specimens shall be taken as indicated in Figure 1, directly from the finished product in the quenched and tempered condition.

6.6.3. Details concerning the cutting of test specimens for hardness test covering products supplied on the basis of supply types 1 c, 1 e, 2c, 2e, 3c, 3e, 4c and 4e shall be agreed upon at the time ofordering. Where possible hardness shall be tested at mid radius of a product cross-section.

6.6.4. For the Jominy test, test specimens shall be cut as per Std. UNI 3150. Subject to specificagreement, the test specimen may be machined from the initial section of the product in which case the position from which it is taken shall be agreed.

6.6.5. Sampling for chemical analysis shall be as per Std. UNI 6453. Cutting and preparation of test specimens to assess mechanical and fabrication properties shall be governed by Std. UNI 551.

6.7 Inspection for surface defects, internal defects and dimensional tolerances

For inspection of surface defects (and repair thereof), internal defects and dimensional tolerances, see paragraphs 5.4.1,5.4.1.1 and 5.5, Std. UNI 5447.

6.8 Complementary tests

If the test results do not conform to requirements complementary testing may be carried out as directed below:-

6.8.1 Complementary check analysis shall be carried out as per paragraph 7.3, Std. UNI 5447.

6.8.2 Complementary mechanical tests shall be carried out as per paragraph 6.3, Std. UNI 5447.

6.8.3 Supplies not entirely conforming to the requirements for surface inspection and dimensional check may be submitted for reinspection after elimination of non-conforming parts.

6.9 Additional tests

Any other specific quality requirements and other inspection tests (e.g. non-metallic inclusions, etc.) may be agreed at the time of ordering.
Results to be obtained and test procedures for additional testing shall be the subject of special agreement.

7. Test procedure

7.1 Check analysis shall be carried out as per the relevant UNI standards on individual elements to bemonitored.

7.2 Tensile test shall be carried out as per Std. UNI 556.

(cant.....)

7.3 Impact test KCU shall be carried out as per Std. UNI 4431.
Unless otherwise specified at the time of ordering, impact strength shall be determined on a single test specimen.
In case of dispute the impact strength value to be considered shall be the average of three results obtained on test specimens cut at equal distance from the surface, next to one another, or where this is not possible, one after the other from the same test bar.

7.4 Jominy test shall be carried out as per Std. UNI 3150.
Quenching temperatures shall be as indicated in Table VI.

7.5 Brinell and Rockwell hardness tests shall be carried out as per Std. UNI 560 and Std. UNI 562.

8.0 Designation

For conventional steel designation see Std. UNI EU 27.
Example of designation for round hot rolled bar, diameter 30 mm, steel 40NiCrMo2, surface defects class C, supplied quenched and tempered, supply type 4C:

Tondo 30 UNI 7620 -40NiCrMo2 -Cia sse C bonificato 4C UNI 7845

9.0 Material identification

9.1. Marking

Suitable marking of all products or part thereof with indication of steel quality, heat number, andpossibly, a name or trade mark of producer may be agreed at the time of ordering.
For small diameter products (normally below 40 mm) marking may be substituted with labeling of individual bundles.

9.2 Labeling

Where products are supplied in bundles, each bundle shall be identified with one or more indelible labels carrying the following information:

- Name of mill
- Steel quality
- Size
- Heat number
- Lot identification
- Marking (e.g.: purchase number, confirmation number, card, etc.).

10. Documents

When requested at the time of ordering one only of the following documents, as envisaged by Std. UNI 5447, shall be issued for products covered in this Standard.

a) Order without inspection
- Certificate of conformity with order
- Certificate of origin
- Inspection certificate

b) Order with inspection
- Inspection certificate
- Inspection report.

11. Disputes

Std For the settlement of any dispute and consequences thereof. see paragraph A Std. UNI 5447.

Symbols - Metallic material tests: R, RpO,2, A, KCU, see Std. UNI 552; HB, see Std. UNI 560; HRC, see . UNI 562.

CHIARIMENTI

La presente norma UNI rispetto alle corrispondenti ISO/R 683 Parti I a VIII contempla le seguenti modifiche principali:

- sono state riassunte in una unica norma le parti I a VIII della ISO/R 683 divise per gruppi omogenei di acciai da bonifica, prevedendo quindi un'unica descrizione delle prescrizioni qualitative e delle prove degli acciai;
- una diversa stesura redazionale;
- ritocchi nella composizione chimica degli acciai, con l'aggiunta di tipi di produzione nazionale e con l'esclusione di alcuni non significativi.
  La raccomandazione ISO prevede 14 tipi di acciai da bonifica, mentre la norma UNI ne prevede 20; in particolare la raccomandazione ISO non prevede gli acciai 36CrMn5, 50CrV4, 30CrMo4 e 30NiCrMo12;
- una stesura più completa e dettagliata delle condizioni di fornitura, sullo stato normale e particolare di fornitura dei prodotti;
- riporta un prospetto che prevede il numero dei saggi da prelevare nella massa dell'unità di collaudo.

La presente norma UNI rispetto alla corrispondente EURONORM 83 contempla le seguenti modifiche principali:

- una stesura più completa e dettagliata in particolare delle condizioni di fornitura, sullo stato normale e particolare di fornitura dei prodotti;
- ritocchi nella composizione chimica degli acciai con l'aggiunta di tipi di produzione nazionale e con l'esclusione di alcuni non significativi.
  L'EURONORM prevede 22 tipi di acciai e la norma UNI ne prevede 20; in particolare l'EURONORM non prevede gli acciai C30, C40, C50, 36CrMn5, 30CrMo4, 40NiCrMo7 e 30NiCrMo12;
- riporta un prospetto con i valori di durezza Brinnel allo stato di ricottura di addolcimento, di ricottura di coalescenza e di ricottura per l'ottenimento di una determinata struttura in un intervallo determinato di durezza;
- sono riportate le temperature della ricottura di addolcimento;
- prevede un prospetto che riporta la profondità tollerata dei difetti superficiali.

Prodotti finiti laminati a caldo in barre e rotoli di acciaio non legato o legato speciale da bonifica

Qualità, prescrizioni e prove

(UNI 7845)

Studio del progetto — **8ª Sottocommissione "Laminati in barre e rotoli di acciai legati o non legati destinati a trattamento termico" della Commissione Tecnica dell'UNSIDER** (Ente italiano di unificazione siderurgica, federato all'UNI — Milano, via Torino, 44), riunioni dell'1 dic. 1967, 18 giu., 13 nov. 1970, 13 dic. 1971, 22 feb. 1973, 15 mag., 12 giu., 17 lug. e 28 ott. 1975.

Esame ed approvazione — **Commissione Tecnica dell'UNSIDER**, riunione del 16 giu. 1976.

Esame finale ed approvazione — **Gruppo settoriale I "Metalli e correlati" della Commissione Centrale Tecnica dell'UNI**, riunione del 20 gen. 1977. **Commissione Centrale Tecnica dell'UNI**, riunione del 15 mar. 1977.

Ratifica — **Presidente dell'UNI**, delibera del 6 nov. 1978.

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 AA 085 01 19 may be referred to. (01)

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.

(01)

Frequency ~~range~~, 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.

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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 or water, ~~glycerine or cellulose paste~~ shall be used. (01)

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. (01)

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.

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.

CORPORATE STANDARD

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	(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	(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:

(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.

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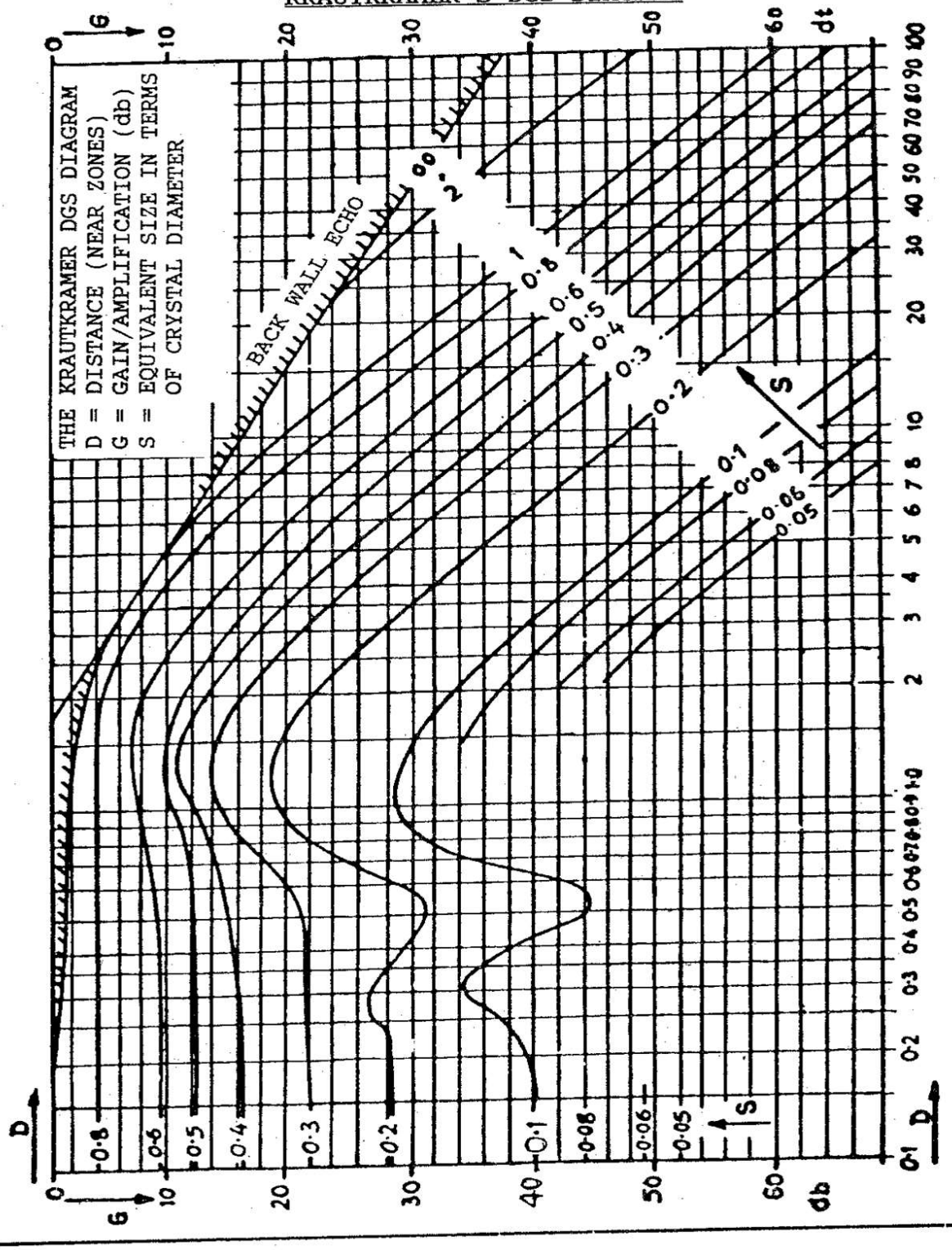
(f) Note the equivalent flaw size curve passing through the above point. Multiply the reduced flaw dimension (S) of the curve by the probe diameter to give the equivalent flaw size in millimetres.

ANNEXURE - A

KRAUTKRAMER'S DGS DIAGRAM



1. ALL VENDORS TO PROVIDE POINT WISE REPLY/CONFIRMATION ALONG WITH RELEVANT SUPPORTING DOCUMENTS TO EACH AND EVERY POINT OF **PRE-QUALIFICATION REQUIREMENT/PQR** FOR ALL ENQUIRY ITEMS. NONCOMPLIANCE OF THESE MAY LEAD TO REJECTION OF OFFER AS THESE ARE ESSENTIAL CONDITION FOR PARTICIPATING IN TENDER ENQUIRY.

2. QUANTITY TOLERANCE+/- 5% IS ACCEPTABLE.

3. ALL VENDORS TO PROVIDE POINT WISE REPLY/CONFIRMATION ALONG WITH RELEVANT SUPPORTING DOCUMENTS TO EACH AND EVERY POINT OF **PRE-QUALIFICATION REQUIREMENT/PQR** FOR ALL ENQUIRY ITEMS. NONCOMPLIANCE OF THESE MAY LEAD TO REJECTION OF OFFER AS THESE ARE ESSENTIAL CONDITION FOR PARTICIPATING IN TENDER ENQUIRY.

4. KINDLY UPLOAD/ATTACH THE SPECIFICATION DETAILS/ CATALOGUE OF OFFERED ITEMS.

5. KINDLY **SUBMIT TECHNO-COMMERCIAL CHECKLIST** ALONG WITH YOUR OFFER.

6. KINDLY **SUBMIT PQR SHEET WITH SUPPORTING DOCUMENTS** ALONG WITH YOUR OFFER.

7. KINDLY **SUBMIT TECHNICAL PARAMETERS CHECK LIST** ALONG WITH YOUR OFFER.

8. VENDOR TO CONFIRM TO PROVIDE MATERIAL AND DIMENSIONAL TEST CERTIFICATES AS PER ENQUIRY DOCUMENTS ALONG WITH MATERIAL SUPPLY.

9. VENDOR TO CONFIRM TO PROVIDE HEAT TREATMENT AND ULTRASONIC TEST REPORTS OF ROUNDS.

10. VENDOR TO CONFIRM TO PROVIDE CERTIFICATE OF CONFORMANCE.

11. VENDOR TO CONFIRM TO PROVIDE IDENTIFICATION OF ALL ITEMS AND THEIR REPORT ACCORDINGLY.

12. VENDOR TO **SUBMIT MAKE IN INDIA SELF CERTIFICATION** AS PER FORMAT GIVEN ALONG WITH THE ENQUIRY.

13. MSE/MII: THE SUPPLIER NEEDS TO SUBMIT/UPDATE MSE/MII CREDENTIALS ON GEM PORTAL DURING PROFILE UPDATION/ OFFER SUBMISSION STAGE. THE MSE DATA SUBMITTED IS CROSS VERIFIED BY GEM WITH GOVT. OF INDIA UDYAM/NSIC DATABASE THROUGH API INTEGRATION ON REAL TIME BASIS AND FOR MII, A SELF DECLARATION IS BEING GIVEN AND AUTHENTICATED BY AADHAR OTP. IF THE SELLER FAILS TO CLAIM MSE/MII PROVISION ON GEM PORTAL AT PROFILE UPDATION/BID SUBMISSION STAGE, THE SAID SELLER WILL BECOME INELIGIBLE FOR GETTING THE MSE/MII BENEFITS FOR THAT BID AUTOMATICLLY. THE VENDOR CAN ALWAYS CONTACT THE GEM HELPDESK, IN CASE OF ANY ISSUES.

14. THE PRICE QUOTE BY BIDDER SHOULD BE INCLUSIVE OF GST & SHOULD BE ON BHEL HEEP HARIDWAR STORES BASIS.

15. BIDDER'S OFFER IS LIABLE TO BE REJECTED IF THEY DON'T UPLOAD ANY OF THE CERTIFICATES / DOCUMENTS SOUGHT IN THE BID DOCUMENT, ATC AND CORRIGENDUM IF ANY.

16. **BREACH OF CONTRACT CLAUSE:**

    IN CASE OF BREACH OF CONTRACT, WHEREVER THE VALUE OF SECURITY INSTRUMENTS LIKE PERFORMANCE BANK GUARANTEE AVAILABLE WITH BHEL AGAINST THE SAID CONTRACT IS ATLEAST 10% OF THE CONTRACT VALUE, THE SAME BE ENCASHED. IN CASE THE VALUE OF THE SECURITY INSTRUMENTS AVAILABLE IS LESS THAN 10% OF THE CONTRACT VALUE, THE BALANCE AMOUNT BE RECOVERED FROM OTHER FINANCIAL REMEDIES (I.E. AVAILABLE BILLS OF THE CONTRACTOR, RETENTION AMOUNT, ETC. WITH BHEL) OR LEGAL REMEDIES BE PURSUED.

17. **ACTION AGAINST BIDDERS / VENDOR / SUPPLIER / CONTRACTOR IN CASE OF DEFAULT:**

IN ORDER TO PROTECT THE COMMERCIAL INTERESTS OF BHEL, BHEL SHALL TAKE ACTION AGAINST SUPPLIES / CONTRACTORS BY WAY OF SUSPENSION OF BUSINESS DEALINGS, WHO EITHER FAIL TO PERFORM OR ARE IN DEFAULT WITHOUT ANY REASONABLE CAUSE, CAUSE LOSS OF BUSINESS/ MONEY/ REPUTATION, INDULGE IN MALPRACTICES, CHEATING, BRIBERY, FRAUD OR ANY OTHER MISCONDUCT OR FORMATION OF CARTELS SO AS TO INFLUENCE THE BIDDING PROCESS OR INFLUENCE THE PRICE ETC. SUSPENSION OF BUSINESS DEALINGS COULD BE IN THE FORM OF "HOLD" OR "BANNING" A SUPPLIER/ CONTRACTOR OR A BIDDER AND SHALL BE AS PER "GUIDELINES FOR SUSPENSION OF BUSINESS DEALINGS WITH SUPPLIERS/ CONTRACTORS" AVAILABLE AT BHEL'S WEBSITE https://www.bhel.com/guidelines-suspension-business-dealings-supplierscontractors

18. BIDDERS ARE ADVISED TO CHECK APPLICABLE GST ON THEIR OWN BEFORE QUOTING. BUYER WILL NOT TAKE ANY RESPONSIBILITY IN THIS REGARDS. GST REIMBURSEMENT WILL BE AS PER ACTUALS OR AS PER APPLICABLE RATES (WHICHEVER IS LOWER), SUBJECT TO THE MAXIMUM OF QUOTED GST %.

19. BIDDER SHALL SUBMIT THE FOLLOWING DOCUMENTS ALONG WITH THEIR BID FOR VENDOR CODE CREATION:

    A. COPY OF PAN CARD **B.** COPY OF GSTIN **C.** COPY OF MSE CERIFICATE

20. DEDICATED /TOLL FREE TELEPHONE NO. FOR SERVICE SUPPORT: BIDDER/OEM MUST HAVE DEDICATED/TOLL FREE TELEPHONE NO. FOR SERVICE SUPPORT.

21. DATA SHEET OF THE PRODUCT(S) OFFERED IN THE BID, ARE TO BE UPLOADED ALONG WITH THE BID DOCUMENTS. BUYERS CAN MATCH AND VERIFY THE DATA SHEET WITH THE PRODUCT SPECIFICATIONS OFFERED. IN CASE OF ANY UNEXPLAINED MISMATCH OF TECHNICAL PARAMETERS, THE BID IS LIABLE FOR REJECTION.

22. SCOPE OF SUPPLY (BID PRICE TO INCLUDE ALL COST COMPONENTS): ONLY SUPPLY OF GOODS.

23. PRODUCTS SUPPLIED SHALL BE NONTOXIC AND HARMLESS TO HEALTH. IN THE CASE OF TOXIC MATERIALS, MATERIAL SAFETY DATA SHEET MAY BE FURNISHED ALONG WITH THE MATERIAL.

24. WHILE GENERATING INVOICE IN GEM PORTAL, THE SELLER MUST UPLOAD SCANNED COPY OF GST INVOICE AND THE SCREENSHOT OF GST PORTAL CONFIRMING PAYMENT OF GST.

25. **PAYMENT TERMS SHALL BE AS PER FOLLOWINGS:**

a) **FOR NON-MSES BIDDER:** 100% payment along with taxes, freight & insurance will be made after receipt and acceptance of material and within 90 days from the date of invoice subject to submission of non-discrepant documents within 15 days of supply as per terms and conditions of Purchase Order (THIS IS IN SUPERSESSION OF 10 DAYS' TIME AS PROVIDED IN CLAUSE 12 OF GEM GTC).

b) **FOR MSES BIDDER:** For MSEs (covered under MSME Act) which are registered and periodically renewed with BHEL, the payment will be made within 45 days or as prescribed in the relevant act. Benefits of MSE (such as EMD Waiver, Tender fee exemption, Price preference, Payment preference etc.) will be given only to those MSE Vendors who are manufacturers of offered items against the NIT. No MSE benefits shall be provided to Agents / Stockists /Dealers / Traders etc. for the items offered but not manufactured by themselves."

c) **FOR MEDIUM ENTERPRISES:** 100% payment along with taxes, freight & insurance will be made after receipt and acceptance of material and within 60 days from the date of invoice subject to submission of non-discrepant documents within 15 days of supply as per terms and conditions of Purchase Order.

d) Please note that vendor to adhere to the payment terms as per above. No deviation in payment terms shall be accepted. Vendor to submit their offer accordingly.