

## Standard Specification for Steel Bars Subject to Restricted End-Quench Hardenability Requirements<sup>1</sup>

This standard is issued under the fixed designation A914/A914M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon  $(\varepsilon)$  indicates an editorial change since the last revision or reapproval.

### 1. Scope\*

- 1.1 This specification covers hot-worked alloy and carbonboron steels designed to attain restricted depth of hardening in the end-quench test. These steel compositions are identified by the suffix letter "RH" added to the conventional grade number.
- 1.2 In general, steels with restricted hardenability (RH steels) will exhibit a hardness range not greater than 5 HRC at the initial position on the end-quench hardenability bar and not greater than 65 % of the hardness range for standard H-band steels (Specification A304) in the inflection region. Generally the restricted hardenability band follows the middle of the corresponding standard H-band. An example of the RH band compared with the H band is given for Grade 4140 in Fig. 1.
- 1.2.1 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.
- 1.3 This specification is expressed in both inch-pound units and SI units. However, the material will be supplied to inch-pound units unless the purchase order specifies the "M" specification designation.

#### 2. Referenced Documents

2.1 ASTM Standards:<sup>2</sup>

A29/A29M Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought

A255 Test Methods for Determining Hardenability of Steel A304 Specification for Carbon and Alloy Steel Bars Subject to End-Quench Hardenability Requirements

E112 Test Methods for Determining Average Grain Size

## 2.2 SAE Standards:<sup>3</sup>

J 406 Methods of Determining Hardenability of Steels

J 1268 Hardenability Bands for Carbon and Alloy H Steels

J 1868 Restricted Hardenability Bands for Selected Alloy Steels

## 3. Terminology

- 3.1 Definitions of Terms Specific to This Standard:
- 3.1.1 *hardenability*—the relative ability of a steel to harden under heat treatment becomes apparent in the degree to which the material hardens when quenched at different cooling rates.
- 3.1.1.1 *Discussion*—Hardenability is measured quantitatively, usually by noting the extent or depth of hardening of a standard size and shape test specimen in a standardized quench. In the end-quench test the depth of hardening is the distance along the specimen from the quenched end to a given hardness.

### 4. Ordering Information

- 4.1 Orders for material under this specification should include the following information, in proper sequence:
  - 4.1.1 Quantity (weight),
  - 4.1.2 Name of material (alloy or carbon-boron steel),
  - 4.1.3 Cross-sectional shape,
  - 4.1.4 Size,
  - 4.1.5 Length,
  - 4.1.6 Grade,
  - 4.1.7 End-quenched hardenability (see Section 9),
  - 4.1.8 Report of heat analysis, if desired (see Section 7),
  - 4.1.9 Special straightness, if required,
  - 4.1.10 ASTM designation and date of issue, and
  - 4.1.11 End use or special requirements.

Note 1—A typical ordering description is as follows: 10 000 lb, alloy bars, round, 4.0-in. diameter by 10 ft, Grade 4140RH, heat analysis required, complete hardenability data required, ASTM AXXX, [AXXXM] dated worm gear.

4.2 The purchaser shall specify the desired grade, including the suffix letters "RH," in accordance with Table 1.

<sup>&</sup>lt;sup>1</sup> This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.15 on Bars.

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<sup>&</sup>lt;sup>2</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>&</sup>lt;sup>3</sup> Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, http://www.sae.org.

- 4.3 Band limits are shown graphically and as tabulations in Figs. 2-23, inclusive. For specification purposes, one must use tabulated values of Rockwell hardness (HRC) as a function of distance from the quenched end of the hardenability bar, either in inch-pound units (sixteenths of an inch) or in SI units (millimetres). Values below 20 HRC are not specified because such values are not accurate.
- 4.3.1 Band limits shown graphically are so depicted for convenience in estimating the hardness values at various intermediate locations on the end quench test bar for quick comparisons of the various RH grades. The values of "Approximate Diameter of Rounds with Same As-Quenched Hardness" shown above each RH-band, were selected from ranges appearing in Fig. 7 of SAE J 406. The RH-bands are presented graphically, with distances from the quenched end in both inch-pound units and also SI units.
- 4.4 For specification purposes, RH-band steels shall exhibit hardness within the minimum and maximum HRC range specified at the J1 (J1.5-mm) position and shall meet one additional minimum and one additional maximum value. In this specification, the two additional hardness values shall represent the approximate hardness for 50 % martensite for the minimum and maximum specified carbon content, respectively (except where hardenability is too high; then the two additional hardness control values shall be five HRC points below the maximum hardness value specified at the J1 (J1.5-mm) position).
- 4.4.1 In general, these points define the critical locations of the Jominy hardenability band for purposes of characterizing heat treatment response. The four specification points are circled in the tables of hardness versus Jominy distance and on the RH-bands. For all other Jominy positions, a tolerance of two points HRC is permitted for a maximum consecutive <sup>3</sup>/<sub>16</sub>-in. or 5-mm Jominy distance on the restricted hardenability band.
- 4.4.2 For example, referring to Fig. 9, a hardenability test bar of a steel meeting the requirements for 4140RH must exhibit a hardness at J1 not less than 54 HRC, nor more than 59 HRC. At J12, the test bar must exhibit hardness not less than 43 HRC, but the maximum hardness can be as high as 52 HRC (or even 54 HRC if the region of the test bar is chosen as the exception). At J20, the bar must exhibit hardness not greater than 47 HRC, but the minimum hardness can be as low as 37 HRC (or as low as 35 HRC if this region of the test bar is chosen as the exception).
- 4.4.3 A similar example, referring to Fig. 9, for 4140RH with distances from the quenched end in millimetres would limit hardness at J1.5 mm to not less than 54 HRC nor more than 59 HRC. At J20 mm, the test bar must exhibit hardness not less than 42 HRC. At J30 mm, the test bar must exhibit hardness not greater than 48 HRC.

#### 5. Manufacture

5.1 *Melting Practice*—The steel shall be made by one or more of the following primary processes: basic-oxygen or electric furnace. The primary melting may incorporate separate degassing or ladle refining and may be followed by secondary melting using electroslag remelting or vacuum arc remelting.

Where secondary melting is employed, the heat shall be defined as all the ingots remelted from a single primary heat.

5.2 *Slow Cooling*—Immediately after hot working, the bars shall be allowed to cool when necessary to a temperature below the critical range under suitable conditions, to prevent injury by too rapid cooling.

### 6. General Requirements

6.1 Material furnished under this specification shall conform to the applicable requirements of the current edition of Specification A29/A29M, unless otherwise provided for in this specification.

### 7. Chemical Requirements

7.1 The heat analysis shall conform to the requirements as to chemical composition prescribed in Table 1 for the grade specified by the purchaser.

### 8. Grain Size Requirements

- 8.1 The steel shall have an austenitic grain size of five to eight. The grain structure shall be considered satisfactory when a minimum of 70 % of the rated grains are within the specified size limits.
- 8.2 Hardenability values specified are based on fine-grain steels and are not applicable to coarse-grain steel.

### 9. End-Quench Hardenability Requirements

- 9.1 The end-quench hardenability shall conform to the requirements specified on the purchase order.
- 9.2 Hardenability values shall be specified in accordance with the applicable values in Figs. 2-23, inclusive, for the grade specified.

### 10. Test Specimens

- 10.1 *Number and Location*—The number and location of test specimens shall be in accordance with the manufacturer's standard practice and shall adequately represent the hardenability of each heat.
- 10.2 *Thermal Treatment*—All forged and rolled hardenability test specimens must be normalized prior to testing. Cast specimens need not be normalized.

#### 11. Test Methods

- 11.1 Grain Size—Test Methods E112.
- 11.2 End-Quench Hardenability—Test Method A255.

#### 12. Certification and Reports of Testing

- 12.1 The hardenability shall be reported by listing hardness values at the following distances from the quenched end of the test specimen:
- 12.1.1 For inch-pound units (J distance in sixteenths of an inch): 1 through 16 sixteenths, then 18, 20, 22, 24, 28, and 32 sixteenths of an inch.
- 12.1.2 For SI units (J distance in millimetres): 1.5, 3, 5, 7, 9, 11, 13, 15, 20, 25, 30, 35, 40, 45, and 50 mm.

## 13. Keywords

## 13.1 bars; restricted hardenability

### TABLE 1 Chemical Requirements of Restricted Hardenability Steels

Note 1—Phosphorus and sulfur in electric-furnace steel is 0.025 %, max.

Note 2—Small quantities of certain elements are present in alloy steels that are not specified or required. These elements are considered as incidental and may be present to the following maximum amounts: copper, 0.35 %; nickel, 0.25 %; chromium, 0.20 %; molybdenum, 0.06 %.

Note 3—Chemical ranges and limits shown in this table are subject to the permissible variation for product analysis shown in Specification A29/A29M.

Grade			Chemical Co	mposition, %		
Designation	Carbon	Manganese	Silicon	Nickel	Chromium	Molybdenum
15B21RH <sup>A</sup>	0.17-0.22	0.80-1.10	0.15-0.35			
15B35RH <sup>A</sup>	0.33-0.38	0.80-1.10	0.15-0.35			
3310RH	0.08-0.13	0.40-0.60	0.15-0.35	3.25-3.75	1.40-1.75	
4027RH	0.25-0.30	0.70-0.90	0.15-0.35			0.20-0.30
4118RH	0.18-0.23	0.70-0.90	0.15-0.35		0.40-0.60	0.08-0.15
4120RH	0.18-0.23	0.90-1.20	0.15-0.35		0.40-0.60	0.13-0.20
4130RH	0.28-0.33	0.40-0.60	0.15-0.35		0.80-1.10	0.15-0.25
4140RH	0.38-0.43	0.75-1.00	0.15-0.35		0.80-1.10	0.15-0.25
4145RH	0.43-0.48	0.75-1.00	0.15-0.35		0.80-1.10	0.15-0.25
4161RH	0.56-0.64	0.75-1.00	0.15-0.35		0.70-0.90	0.25-0.35
4320RH	0.17-0.22	0.45-0.65	0.15-0.35	1.65-2.00	0.40-0.60	0.20-0.30
4620RH	0.17-0.22	0.45-0.65	0.15-0.35	1.65-2.00		0.20-0.30
4820RH	0.18-0.23	0.50-0.70	0.15-0.35	3.25-3.75		0.20-0.30
50B40RH <sup>A</sup>	0.38-0.43	0.75-1.00	0.15-0.35		0.40-0.60	
5130RH	0.28-0.33	0.70-0.90	0.15-0.35		0.80-1.10	
5140RH	0.38-0.43	0.70-0.90	0.15-0.35		0.70-0.90	
5160RH	0.56-0.64	0.75-1.00	0.15-0.35		0.70-0.90	
8620RH	0.18-0.23	0.70-0.90	0.15-0.35	0.40-0.70	0.40-0.60	0.15-0.25
8622RH	0.20-0.25	0.70-0.90	0.15-0.35	0.40-0.70	0.40-0.60	0.15-0.25
8720RH	0.18-0.23	0.70-0.90	0.15-0.35	0.40-0.70	0.40-0.60	0.20-0.30
8822RH	0.20-0.25	0.75-1.00	0.15-0.35	0.40-0.70	0.40-0.60	0.30-0.40
9310RH	0.08-0.13	0.45-0.65	0.15-0.35	3.00-3.50	1.00-1.40	0.08-0.15

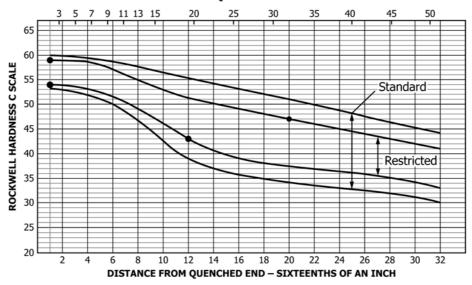
A These steels can be expected to have 0.0005 to 0.003 % boron.

## **HARDENABILITY BAND**

4140 H/RH

	%С	%Mn	%Si	%Ni	%Cr	%Mo	
Н	0.37/0.44	0.65/1.10	0.15/0.35		0.75/1.20	0.15/0.25	
RH	0.38/0.43	0.75/1.00	0.15/0.35		0.80/1.10	0.15/0.25	

**DISTANCE FROM QUENCHED END – MILLIMETERS** 



HARD SPECIF		LIMITS ON PUI		6							
"J" DISTANCE											
MILLIMETERS	4140 H	4140 RH	4140 RH	4140 H							
1.5 3 5 7	60 60 60 59	59 59 59	54 59 53	53 52 52 51							
9 11 13 15	59 58 57 57	58 56 55 54	52 50 49 47	50 48 46 43							
20 25 30 35	55 53 51 49	51 49 48 46	39 38 37	38 35 33 32							
40 45 50	48 46 45	44 43 41	36 35 33	32 31 30							
HEAT TRI		TEMPER	ATURES 870 °C								
AUSTENITIZE 845 °C											
*For forged	or rolled s	pecimens o	only.								

HARD SPECIF		LIMITS		5				
"J" DISTANCE SIXTEENTHS	MAX	HRC	MIN	HRC				
OF AN INCH	4140 H	4140 RH	4140 RH	4140 H				
1 2 3 4	60 60 60 59	59 59 59	54 54 54 53	53 53 52 51				
5	59	58	52	51				
6	58	57	51	50				
7	58	56	50	48				
8	57	55	49	47				
9	57	54	48	44				
10	56	53	46	42				
11	56	52	44	40				
12	55	52	<b>43</b>	39				
13	55	51	42	38				
14	54	50	41	37				
15	54	50	40	36				
16	53	49	39	35				
18	52	48	38	34				
20	51	47	37	33				
22	49	46	37	33				
24	48	45	36	32				
26	47	44	35	32				
28	46	43	35	31				
30	46	42	34	31				
32	44	41	33	30				
HEAT TREATING TEMPERATURES  *NORMALIZE 1600 °F AUSTENITIZE 1550 °F								

FIG. 1 Comparison of H-Band and RH-Band for 4140 Steel<sup>A</sup>

HARDNES SPECIFICAT		
"J" DISTANCE SIXTEENTHS		RC MAN
OF AN INCH	MAX. 47 46	MIN. 42 41
2 3 4	44 42	39 33
5 6 7 8	37) 30 24 22	24 20  
9 10 11 12	20 	1 1
13 14 15 16		
18 20 22 24		
26 28 30 32		

### HEAT TREATING TEMPERATURES

\*NORMALIZE 1700 °F AUSTENITIZE 1700 °F

HARDNESS LIMITS FOR

## **HARDENABILITY BAND**

15B21 RH

%С	%Mn	%Si	%Ni	%Cr	%Mo	%В
0.17/0.22	0.80/1.10	0.15/0.35	-	-		*

<sup>\*</sup>can be expected to contain 0.0005/0.003 percent boron.

		А	PP	ROX. D	IA. OF	ROUN	NDS WI	TH SAM	E AS -	QUE	NCHED	HRC,	in.	LOCA	TION IN	N ROU	ND		QU	ENCH
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SPECIFICAT	TION PUF	RPOSES
"J" DISTANCE	Н	RC
MILLIMETERS	MAX.	MIN.
1.5 3 5 7	47 46 44 40	41 39 31
9 11 13 15	34) 24 22 20	23   
20 25 30 35		
40 45 50		

\*NORMALIZE 925 °C
AUSTENITIZE 925 °C
\*For forged or rolled specimens only.

APPROX. DIA. OF ROUNDS WITH SAME AS - QUENCHED HRC, mm LOCATION IN ROUND QUENCH 50 75 SURFACE MILD 3/4 RADIUS FROM CENTER WATER QUENCH 20 30 60 90 20 30 40 50 60 80 100 CENTER 20 60 40 100 SURFACE 80 MILD OIL QUENCH 45 3/4 RADIUS FROM CENTER CENTER 10 20 30 40 50 60 75 65 60 ROCKWELL HARDNESS C SCALE 55 50 45 40 35 30 25 20 11 13 15 20 25 30 45 50 **DISTANCE FROM QUENCHED END – MILLIMETERS** 

FIG. 2 Limits for Hardenability Band 15B21 RH

<sup>\*</sup>For forged or rolled specimens only.



#### HARDNESS LIMITS FOR **SPECIFICATION PURPOSES** "J" DISTANCE HRC SIXTEENTHS MAX. MIN. OF AN INCH 55 © 51 33 42 36

HEAT TREATING TEMPERATURES

\*NORMALIZE 1600 °F AUSTENITIZE 1550 °F

\*For forged or rolled specimens only.

## HARDENABILITY BAND

15B35 RH

%С	%Mn	%Si	%Ni	%Cr	%Mo	%В
0.33/0.38	0.80/1.10	0.15/0.35				*

<sup>\*</sup>can be expected to contain 0.0005/0.003 percent boron.

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HARDNES SPECIFICAT								
"J" DISTANCE	Н	RC						
MILLIMETERS	MAX.	MIN.						
1.5 3 5 7	55 55 54 51	52 51 50 47						
9 11 13 15	46 42 35 30	37) 28 24 21						
20 25 30 35	25 23 22 21	  						
40 45 50	20							
HEAT TREATING TEMPERATURES								

\*NORMALIZE 870 °C
AUSTENITIZE 845 °C

\*For forged or rolled specimens only.

APPROX. DIA. OF ROUNDS WITH SAME AS - QUENCHED HRC, mm LOCATION IN ROUND QUENCH 50 75 SURFACE MILD WATER QUENCH 20 30 3/4 RADIUS FROM CENTER 30 40 CENTER SURFACE MILD 3/4 RADIUS FROM CENTER OIL QUENCH CENTER ROCKWELL HARDNESS C SCALE 20 l 11 13 15 **DISTANCE FROM QUENCHED END - MILLIMETERS** 

FIG. 3 Limits for Hardenability Band 15B35 RH

## 4914/A914M – 16

#### HARDNESS LIMITS FOR **SPECIFICATION PURPOSES** "J" DISTANCE HRC SIXTEENTHS MAX. MIN. OF AN INCH 42 37 33 31 37 37

HEAT TREATING TEMPERATURES \*NORMALIZE 1700 °F 1550 °F **AUSTENITIZE** 

\*For forged or rolled specimens only.

## **HARDENABILITY BAND**

3310 RH

% C	% Mn	% Si	% Ni	% Cr	% Mo	
0.08/0.13	0.40/0.60	0.15/0.35	3.25/3.75	1.40/1.75		

				A. OF	ROU	NDS	WITH	SAMI	E AS	- QUI	ENCHE	D HR	C, in.	1	LOCAT	TION I	N ROI	UND			QI	UENC
	2	-												$\perp$						RFACE		MILD
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		1	l	2		3		4						$\top$					SUF	RFACE	$\top$	MILC
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		(	).5		1		1.5		2	2.5		3	3	.5					CE	NTER	Q	UEN
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HARDNES SPECIFICAT		
"J" DISTANCE	Н	RC
MILLIMETERS	MAX.	MIN.
1.5	42	37

"J" DISTANCE	H	RC
MILLIMETERS	MAX.	MIN.
1.5 3 5 7	42 42 41	37 37 37 36
9	41	35
11	40	34
13	40	33
15	39	32
20	38	30
25	37	29
30	36	28
35	35	27
40	35	27
45	34	26
50	34	26

HEAT TREATING TEMPERATURES

925 °C \*NORMALIZE 845 °C **AUSTENITIZE** 

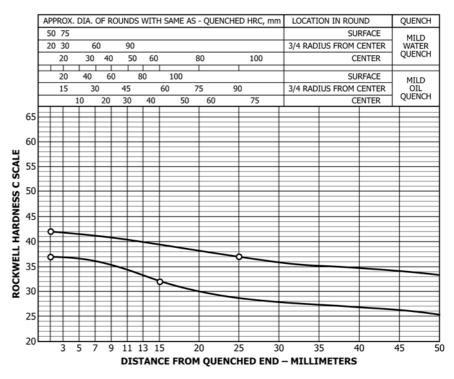


FIG. 4 Limits for Hardenability Band 3310 RH



HARDNES	SIIMITS	FOR
SPECIFICAT		
"J" DISTANCE SIXTEENTHS	Н	RC
OF AN INCH	MAX.	MIN.
1 2 3 4	\$1 48 43 33	(4) 42 33) 28
5 6 7 8	32 28 26 24	24 22 20 
9 10 11 12	23 22 22 21	
13 14 15 16	21 20 	  
18 20 22 24		
26 28 30 32		

HEAT TREATING TEMPERATURES

\*NORMALIZE 1650 °C
AUSTENITIZE 1600 °C

\*For forged or rolled specimens only.

## **HARDENABILITY BAND**

4027 RH

% C	% Mn	% Si	% Ni	% Cr	% Mo	
0.25/0.30	0.70/0.90	0.15/0.35	-	1	0.20/0.30	

		APP	RO)	X. DIA	. OF R	OUN	IDS V	VITH S	AME /	AS - QI	JENCH	IED HR	C, in.	Т	LOCA	TION I	N ROUN	ND		Q	UENCH
		2	4											1					RFACE	$I^-$	MILD
		1		2		3	4				_			4	3/4 R	ADIUS	FROM (	CENTER		۱ ۷	WATER UENCH
		0.	5 工	1	1.5		2	2.5	3	3	.5 I		4	$\pm$				CI	ENTER	Ŧ,	
		_	1		2		3		4					4					RFACE		MILD
		<u> </u>	.5	1.5		1.5	2	1.5	2.5 2	3	.5	5 4 3		3.5	3/4 R	ADIUS	FROM (	CENTE	ENTER	- Q	OIL UENCH
			T			1	_	1.5			.5		_	0.3					INTER	_	
	65		ŧ											#							
ш	60																				
SCAL	55													#							
SSC	50	•																			
RDNE	45	٩					ŧ							#							
L HAI	40		λ	$\setminus$			ŧ														
ROCKWELL HARDNESS C SCALE	35																				
80 2	30			$\setminus$	$\perp$																
	25					\	\														
	20		2			6	8	10		2 1	4	16	18	20	) 2	2 2	4 2	26 2	28 3	0	32
			_	,		-												N INC	-	-	

#### HARDNESS LIMITS FOR **SPECIFICATION PURPOSES** HRC "J" DISTANCE **MILLIMETERS** MAX. MIN. (51) 48 46 42 33 26 1.5 3 42 33 5 7 9 29 23 11 26 20 13 24 --15 23 20 21 25 30 35 40 45 50 HEAT TREATING TEMPERATURES 900 °C \*NORMALIZE **AUSTENITIZE** 870 °C

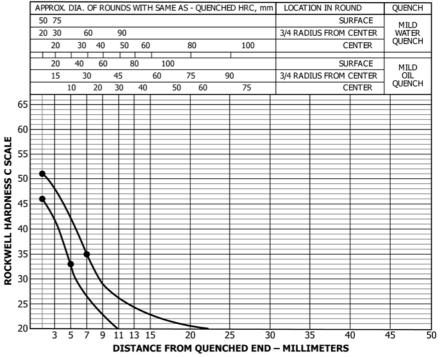


FIG. 5 Limits for Hardenability Band 4027 RH

HARDNES SPECIFICAT		
"J" DISTANCE SIXTEENTHS		RC .
OF AN INCH	MAX.	MIN.
1 2 3 4	47 44 38 33	42 38 30 25
5 6 7 8	29 27 25 24	22 20  
9 10 11 12	23 22 21 20	1111
13 14 15 16		1
18 20 22 24		
26 28 30		

HEAT TREATING TEMPERATURES

32

\*NORMALIZE 1700 °F AUSTENITIZE 1700 °F

\*For forged or rolled specimens only.

## **HARDENABILITY BAND**

4118 RH

% C	% Mn	% Si	% Ni	% Cr	% Mo	
0.18/0.23	0.70/0.90	0.15/0.35		0.40/0.60	0.08/0.15	

1     2     3     4     3/4 RADIUS FROM CENTER     W/QU       0.5     1     1.5     2     2.5     3     3.5     4     CENTER       1     2     3     4     SURFACE     M	ļ	_			DIA	. OF I	ROU	NDS	WITH	SAMI	E AS	- QUE	NCHE	D HRC	, in.	LOCA	ATION	IN RO	DUND			1 Q	JEN
0.5 1 1.5 2 2.5 3 3.5 4 SURFACE 0.5 1 1.5 2 2.5 3 3.5 4 3/4 RADIUS FROM CENTER 0.5 1 1.5 2 2.5 3 3.5 CENTER  65 60 45 40 35	ļ	2		4																		1	MILI
1 2 3 4 SURFACE  0.5 1 1.5 2 2.5 3 3.5 4 3/4 RADIUS FROM CENTER  0.5 1 1.5 2 2.5 3 3.5 CENTER  65 60 60 60 65 60 60 65 60 60 60 60 60 60 60 60 60 60 60 60 60	ļ															3/4 R	RADIU	S FRO	M CE			۱ ۸	VATI
0.5 1 1.5 2 2.5 3 3.5 4 3/4 RADIUS FROM CENTER QUI	ļ	(	0.5		1	1.5	_	2	2.	5	3	3.5		4	<u> </u>					CE	NTER	1 4	JLIV
0.5 1 1.5 2 2.5 3 3.5 4 3/4 RADIUS FROM CENTER QUI	ŀ			1	_	2	_	3		4										SUF	RFACE		1471
65 60 55 50 45 40 35	ı		0.5	5	1		1.5	2		2.5		3	3.5	4		3/4 R	RADIU	S FRO	м се	NTER			OIL
60 55 50 45 40 35 30	ı			0.5	;		1		1.5		2	2.5		3	3.5					CE	NTER	† Q	JEN
55 50 45 40 35 30	65																						
55 50 45 40 35 30	60																						#
50 45 40 35 30											+	$\Rightarrow$							1				1
45 40 35 30	55										ŧ								=				ŧ
40 35 30	50										F												Ŧ
35 30	45	•	V																#				#
30	40	•	V	$\setminus$							ŧ												ŧ
	35			/																			
25	30			1																			
	25				$\setminus$	$\equiv$																	
20 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 3	20					/			`														32

HARDNES SPECIFICAT		
"J" DISTANCE	Н	RC
MILLIMETERS	MAX.	MIN.
1.5 3 5 7	49 44 37 31	42 38 29 24
9 11 13 15	28 25 24 23	21 20  
20 25 30 35	20 	 
40 45 50		
HEAT TREATING *NORMALIZE AUSTENITIZE	9:	URES 25 °C 25 °C

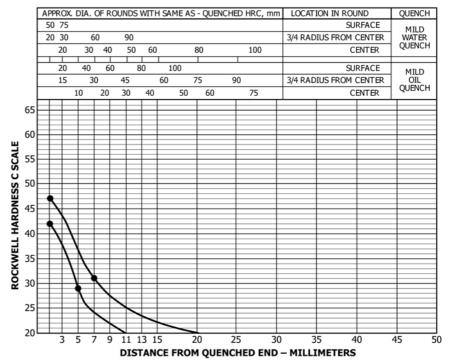


FIG. 6 Limits for Hardenability Band 4118 RH

HARDNES SPECIFICAT		
"J" DISTANCE SIXTEENTHS		RC
OF AN INCH	MAX.	MIN.
1 2 3 4	47 45 41 38	@s 55
5 6 7 8	34) 31 29 28	26 24 22 21
9 10 11 12	26 25 24 23	20   
13 14 15 16	23 22 22 21	
18 20 22 24	20 	
26 28 30 32		

\*NORMALIZE 1700 °F

AUSTENITIZE 1700 °F \*For forged or rolled specimens only.

## HARDENABILITY BAND

4120 RH

% C	% Mn	% Si	% Ni	% Cr	% Mo	
0.18/0.23	0.90/1.20	0.15/0.35		0.40/0.60	0.13/0.20	

		AP	PR(	OX. DI	A. OF F	ROUNE	OS WITH	SAME A	S - QL	JENCHE	D HRC	, in.	LOCA	TION IN	N ROUN	ID		QUI	ENCH
		2		4		_											FACE	M	ILD ATER
			1	1	1.5		4 2 2.5	5 3	3	.5		ı	3/4 K/	ADIUS I	-ROM C	ENTER	NTER		ENCH
		Ë		1	2		3	4		L							FACE		
			0.5			1.5	2	2.5	3	3.5	4		3/4 R/	ADIUS F	FROM C	ENTER		1 0	ILD OIL
			_	0.5		1	1.5	2			3	3.5	9,				NTER	QUE	ENCH
	65																		
ш	60																		
SCALI	55																		
SSC	50																		
DNE	45		V																
ROCKWELL HARDNESS C SCALE	40	•		/															
(WEL	35			/	/														
ROCE	30																		
	25				/														
	20		2		4	6	8 1	0 1	2 1	4 1	6 1	8 2	0 2	2 2	4 2	6 2	8 30	) 3	32
						)IST	ANCE F	ROM	QUEN	NCHE	D END	) – SI	XTEE	NTHS	OF AI	N INC	н		

# HARDNESS LIMITS FOR SPECIFICATION PURPOSES

"J" DISTANCE	Н	RC
MILLIMETERS	MAX.	MIN.
1.5 3 5 7	45 41 39	<b>4</b> 39 <b>3</b> 28
9 11 13 15	32 29 28 26	25 22 21 20
20 25 30 35	23 21 	  
40 45 50		
l		

HEAT TREATING TEMPERATURES

\*NORMALIZE 925 °C AUSTENITIZE 925 °C

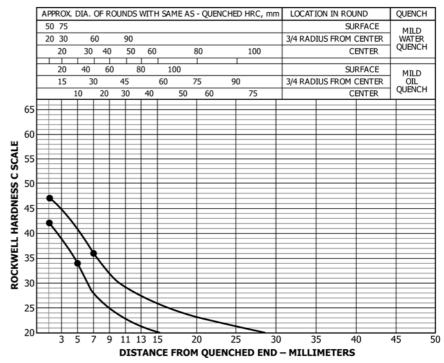


FIG. 7 Limits for Hardenability Band 4120 RH

HARDNES SPECIFICAT		
"J" DISTANCE SIXTEENTHS		RC
OF AN INCH	MAX.	MIN.
1	55	50
2	54	48
3	52	44
4	49	40
5	46	36
6	44	34
7	41	32
8	39	30
9	37	28
10	35	27
11	33	26
12	32	26
13	32	26
14	31	25
15	31	25
16	31	25
18	30	24
20	30	23
22	30	23
24	29	22
26	29	22
28	28	21

HEAT TREATING TEMPERATURES

30

32

28

27

21

20

\*NORMALIZE 1650 °F **AUSTENITIZE** 1600 °F

\*For forged or rolled specimens only.

## **HARDENABILITY BAND**

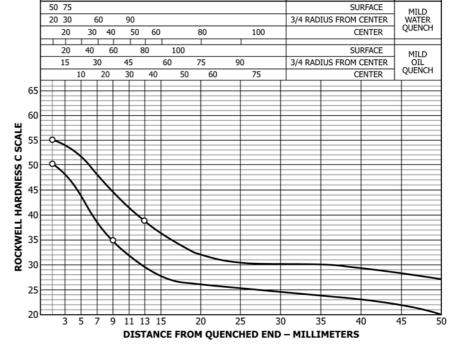
4130 RH

% C	% Mn	% Si	% Ni	% Cr	% Mo	
0.28/0.33	0.40/0.60	0.15/0.35		0.80/1.10	0.15/0.25	

2 4 1 2 0.5 1	2 3	4													
		4							2/4 0	A DTILLO F	7014		RFACE	M]	LD
	1.5	2	2.5	3	3.5	;	4		3/4 K	ADIUS F	KOM C		NTER	QUE	TER NCH
1	2	3		4									RFACE		
			2.		3	3.5	4		3/4 R	ADIUS F	ROM C			MI O	LD IL
0.5	1		1.5	2	2.5		3	3.5				CE	NTER	QUE	NCH
$\sim$															
$\Lambda$															
<b>'</b>		V													
	10		$\setminus$												
		$\setminus$				$\dashv$									
				$\Rightarrow$	_	_									
2	4 6	Q	10	12	14	16	11	R 2	0 2	2 2	1 2	6 2	8 30		2
	0.5	2 4 6	2 4 6 8	2 4 6 8 10	2 4 6 8 10 12	2 4 6 8 10 12 14	2 4 6 8 10 12 14 16	2 4 6 8 10 12 14 16 1	2 4 6 8 10 12 14 16 18 2	2 4 6 8 10 12 14 16 18 20 2	2 4 6 8 10 12 14 16 18 20 22 2	2 4 6 8 10 12 14 16 18 20 22 24 2	2 4 6 8 10 12 14 16 18 20 22 24 26 2	0.5 1 1.5 2 2.5 3 3.5 CENTER	2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 3

	HARDNESS LIMITS FOR SPECIFICATION PURPOSES											
"J" DISTANCE	Н	RC										
MILLIMETERS	MAX.	MIN.										
1.5	55)	50										
3	54	48										
5	52	44										
7	48	38										
9	45	35)										
11	41	32										
13	39	30										
15	36	27										
20	32	26										
25	31	25										
30	30	24										
35	30	23										
40	29	22										
45	28	21										
50	27	20										
HEAT TREATING TEMPERATURES												
*NORMALIZE	00 °C											
AUSTENITIZE	70 °C											

\*For forged or rolled specimens only.



LOCATION IN ROUND

QUENCH

APPROX. DIA. OF ROUNDS WITH SAME AS - QUENCHED HRC, mm

FIG. 8 Limits for Hardenability Band 4130 RH

HARDNES SPECIFICAT					
"J" DISTANCE SIXTEENTHS	HRC				
OF AN INCH	MAX.	MIN.			
1 2 3 4	59 59 59	54 54 54 53			
5	58	52			
6	57	51			
7	56	50			
8	55	49			
9	54	48			
10	53	46			
11	52	44			
12	52	<b>43</b>			
13	51	42			
14	50	41			
15	50	40			
16	49	39			
18	48	38			
20	47	37			
22	46	37			
24	45	36			
26	44	35			
28	43	35			
30	42	34			
32	41	33			

HEAT TREATING TEMPERATURES 1600 °F \*NORMALIZE **AUSTENITIZE** 1550 °F

*For forged or	rolled specimens only.

## **HARDENABILITY BAND**

4140 RH

% C	% Mn	% Si	% Ni	% Cr	% Mo	
0.38/0.43	0.75/1.00	0.15/0.35	-	0.80/1.10	0.15/0.25	

	APP	ROX.	DIA.	OF ROL	JNDS \	NITH	SAME	AS - (	QUEN	CHEDI	HRC, in	. LO	CATION	IN ROL	JND		QU	ENCH
	2	4														RFACE	М	ILD
	0.		2	1.5	2	2.5	3		.5		1	3/4	RADIUS	5 FROM	CENTE	R ENTER	- W/QU	ATER ENCH
	0.	5				2.5		3	.5		4						<u> </u>	
	<u> </u>	.5	. 2		2		4 2.5	2	-	- 1		2/4	DADIL	- FDOM		RFACE	l M	ILD
	$\vdash$	0.5	1	1.5		1.5	2.5	3 2	.5	5 4	3.		KADIU	5 FROM	CENTE	ENTER	- Qu	DIL ENCH
65					$\equiv$													
05					=	=												
60				$\pm$	$\Rightarrow$	_							+					
ROCKWELL HARDNESS C SCALE 05 05 05 05 05 05 05 05 05 05 05 05 05				$\setminus$		=												
<b>S</b> 55	•	$\vdash$	$\blacksquare$		$\rightarrow$	eg												
၁ ၁ ၁				$\rightarrow$	abla			_										
ĘS					=	$\setminus$					$\rightarrow$	•						
<b>A</b> 5					$\pm$		$\setminus$							$\overline{}$				
<b>₹</b> 40					=			<u> </u>								$\overline{}$		
<b>∄</b> ₩					$\pm$					ightharpoons	$\leftarrow$							
<b>3</b> 5				+	$\pm$										_			
Š					=	_												
<b>≥</b> 30					=	=												
25					$\Rightarrow$													
23					=	=												
20		2	4	6	8	10	) 1	2 1	.4	16	18	20	22	24	26	28 3	0 3	32
		_	•	-											AN INC			_

#### HARDNESS LIMITS FOR **SPECIFICATION PURPOSES** HRC "J" DISTANCE **MILLIMETERS** MAX. MIN. 54 1.5 39 48 HEAT TREATING TEMPERATURES 870 °C 845 °C \*NORMALIZE

\*For forged or rolled specimens only.

**AUSTENITIZE** 

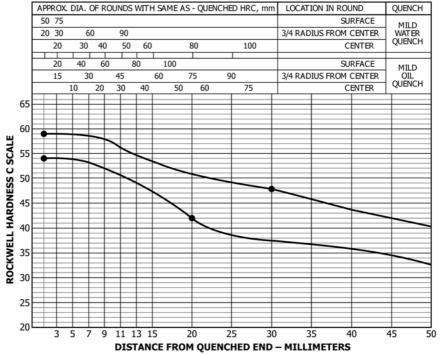


FIG. 9 Limits for Hardenability Band 4140 RH

HARDNES SPECIFICAT						
"J" DISTANCE	Н	RC				
SIXTEENTHS OF AN INCH	MAX.	MIN.				
1 2 3 4	62 61 61	57 56 56				
5 6 7 8	60 60 59 59	55 55 54 53				
9 10 11 12	58 58 58 57	52 52 51 50				
13 14 15 16	57 56 56 55	49 48 47 46				
18 20 22 24	54 53 52 (51)	44) 43 42 40				
26 28 30 32	51 50 50 49	40 39 38 37				
HEAT TREATING T	EMPERATURES					
*NORMALIZE 1600 °F AUSTENITIZE 1550 °F						
*For forged or rolle	ed specimens o	nly.				

## **HARDENABILITY BAND**

4145 RH

% C	% Mn	% Si	% Ni	% Cr	% <b>M</b> o	
0.43/0.48	0.75/1.00	0.15/0.35		0.80/1.10	0.15/0.25	

	_			IA. O	FRO	DUND:	S WITH	SAME	AS-C	QUENC	HED I	IRC, ir	ı.	LOCA	TION	IN RO	OUNI			QL	IENCH
	2		4																FACE		1ILD
	$\vdash$	1		2	3					2.5		4	_	3/4 R	ADIUS	FRO	M C				ATER IENCH
	$\vdash$	0.5	1		1.5	2	2.		, 	3.5		4						CEN		Ų.	LIVEIT
	$\vdash$		1	2			3	4		-			_	2/4.5		. ====			FACE		1ILD
	$\vdash$	0.5	0.5	1	1.		2 1.5	2.5	3	2.5	5 4 3		3.5	3/4 R	ADIUS	FRO	M C	CEN			OIL IENCH
	$\vdash$		0.5		⇉		1.5			2.5	<u> </u>	$\overline{}$	5.5				_	CEN	ILK	1 40	1
65		Ξ		=	$\equiv$												#				
60				-								=					#				
					$\equiv$		$\overline{}$	_									#				
<b>5</b> 5				$\blacksquare$	$\rightarrow$	_				$\supset$	-	_					#				
ž				=	=									_	_						
50 د م					$\equiv$				$\overline{}$								T				1
2 45				=	$\equiv$						$\overline{}$						#				
֡֟֓֟֟֟֟֝֟֟ <u>֟</u>				=	$\equiv$							*		_			#				
40				+	$\exists$							+					+		_		
: :				=	=												#			$\geq$	+
35				=	$\equiv$							=					#				
55 50 45 40 35 30 30 30 30 30 30 30 30 30 30 30 30 30					$\equiv$												#				
¥ 30					$\equiv$												#				
25					$\equiv$												$\pm$				
																	$\pm$				
20	ш		,	4	6		8 1	0 1	2	14	16	18	2	0 2	2	24	26	2	8 3	30	32
		•		•	_		ANCE													, ,	-

HARDNES SPECIFICA	S LIMITS								
"J" DISTANCE	Н	RC							
MILLIMETERS	MAX.	MIN.							
1.5 3 5 7	62 61 61	57 56 56							
9 11 13 15	60 59 59 58	55 54 53 52							
20 25 30 35	57 55 54 52	49 46 44 42							
40 45 50	(51) 50 49	40 39 37							
HEAT TREATING T *NORMALIZE AUSTENITIZE	FEMPERATURES 870 °C 845 °C								
*For forged or roll	*For forged or rolled specimens only.								

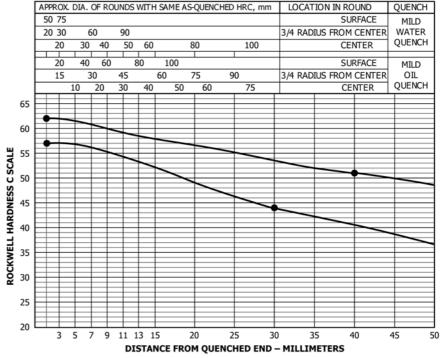


FIG. 10 Limits for Hardenability Band 4145 RH

#### HARDNESS LIMITS FOR **SPECIFICATION PURPOSES** "J" DISTANCE HRC SIXTEENTHS MAX. MIN. OF AN INCH 65 54 53 HEAT TREATING TEMPERATURES \*NORMALIZE 1600 °F AUSTENITIZE 1550 °F

## **HARDENABILITY BAND**

4161 RH

% C	% Mn	% Si	% Ni	% Cr	% Mo	
0.56/0.64	0.75/1.00	0.15/0.35		0.70/0.90	0.25/0.35	

	_			A. OF I	ROUN	DS W	TH S	AME	AS-Q	UENC	HED H	IRC, i	n.	LOCA	NOITA	IN R	OUN	D		Qυ	ENCH
	2		4		_														FACE		1ILD
	_	1	2		3	4	2.5	_				_	_	3/4 F	RADIUS	S FRC	OM C				ATER ENCH
	$\vdash$	).5	1	1.5		2	2.5	3		3.5 I		4						CEN	IER	QU	LIVEII
	L		1	2		3		4	_				_					_	FACE		1ILD
	L	0.5	0.5	L :	1.5	2	.5 .5	.5	3	2.5	.5 4		3.5	3/4 F	RADIUS	5 FRC	)M C	CEN			DIL ENCH
	H	$\exists$	0.5		1		.5	$\stackrel{\sim}{\dashv}$		1.5		_	3.5				_	CEN	IEK	1 40	1
65									_								#				=
60														_							$\equiv$
50										$\overline{}$	$\overline{}$						$\Rightarrow$		_		=
55	Ħ	#										$\rightarrow$	$\neg$				#				=
		$\equiv$													$\overline{}$		#				=
50		#															$\rightarrow$				
45																	$\pm$		$\overline{}$		
73		$\equiv$										$\pm$					$\pm$				$\pm$
40							-				+	+					$\pm$				=
1		=					-					-					7				$\equiv$
55 50 45 40 35		7																			
20		7															7				$\equiv$
30		=															#				$\equiv$
25		=					#					$\mp$					#				$\equiv$
-		=															#				=
20	Ш					$\perp$	10	4.	_		16	10	_		1	24	26	_			1
		2	•	4	6	8	10	12		14	16	18	2	TEEN		24	26	2	8 3	80	32

# HARDNESS LIMITS FOR **SPECIFICATION PURPOSES**

\*For forged or rolled specimens only.

"J" DISTANCE	н	RC
MILLIMETERS	MAX.	MIN.
1.5 3 5 7	65 65 65	60 60 60
9 11 13 15	65 65 65 65	60 60 60
20 25 30 35	64 63 62 61	59 57 53
40 45 50	59 58 57	50 47 45
HEAT TREATING TE	MPERATURES	

870 °C 845 °C

\*NORMALIZE

AUSTENITIZE

	_	50		DIA.	. OF I	KUU	INDS	WIIT	SAME AS	-QUENCH	IED HKC,		LOCAI	ION IN RO	IRFACE	QUENC	
	$\vdash$	20			60		90						3/4 RAD	IUS FROM		WATE	
			20	30	) 4	0	50	60	;	80	10	0			NTER	QUENC	H
	F		20	40	) 6	50	1 - 8	30	100					SU	IRFACE	MILD	_
			15		30		45	6		75	90		3/4 RAD	IUS FROM		OIL	
	Г	_	_	10	20	_	30	40	50	60	75			CE	NTER	QUENC	H.
65	F	•			H				_								Ξ
60	F	•										$\Rightarrow$					
	F	F	F		F	F					$\overline{}$	$\equiv$				$\vdash$	_
55	F			F			F					$\rightarrow$	<u> </u>				Ξ
50	E																=
45	E											=				$\searrow$	_
40																	Ξ
	E																Ξ
35	E						E					=					Ξ
30																	Ξ
25	E																
20																	Ξ
			3	5	7	9		13 15		20 <b>M QUEN</b>	25	30	3	35 4	40	45	

FIG. 11 Limits for Hardenability Band 4161 RH

HARDNES SPECIFICAT									
"J" DISTANCE	HF	RC							
SIXTEENTHS OF AN INCH	MAX.	MIN.							
1 2 3 4	47 46 44 41	42 40 37 34							
5 6 7 8	39 36 34 32	31) 29 27 25							
9 10 11 12	31 29 28 26	24 23 22 21							
13 14 15 16	25 24 24 23	20   							
18 20 22 24	22 22 21 21								
26 28 30 32	21 21 21 21	  							
HEAT TREATING T									
*NORMALIZE AUSTENITIZE	1700 °F 1700 °F								
*For forged or rolled specimens only.									

## HARDENABILITY BAND

4320 RH

% C	% Mn	% Si	% Ni	% Cr	% Mo	
0.17/0.22	0.45/0.65	0.15/0.35	1.65/2.00	0.40/0.60	0.20/0.30	

	APP	ROX. DI	A. OF R	OUNDS	WITH	H SAM	E AS-	QUENC	HED HI	RC, in.	LOCA	TION I	IN ROU			QUE	NCH
	2	4													FACE		ILD
	1										3/4 R	ADIUS	FROM				TER
	0.	5 1	1.5	2	2.5	5 3		3.5	4					CEN	TER	Qui	NCH
		1	2	3		4									FACE		ILD
	0		1 1.			2.5	3	3.5			_	ADIUS	FROM				IL NCH
	$\vdash$	0.5	1		1.5	2		2.5	3	3.5				CEN	TER	QUE	INCH
65																	
60																	
<b>3</b> 55																	
ROCKWELL HARDNESS C SCALE 45 45 30 30 30																	
S 50																	
SS	0																
<b>2</b> 45																	
ARI.	٩																
¥ 40		$\setminus$															
<b>N</b> 35																	
≨ ″				٩													
≥ 30			٩		$\overline{}$												
_						/											
25					$\overline{}$		$\overline{}$										
						$\setminus$			$\overline{}$	_							
20		2	4 6	8	10	) 1	2	14	16 1	.8 2	20 2	2 2	4 2	6 2	8 3	0 3	2
									D END								

	HARDNESS LIMITS FOR SPECIFICATION PURPOSES											
"J" DISTANCE	HE	RC										
MILLIMETERS	MAX.	MIN.										
1.5 3 5 7	47 46 44 40	42) 40 37 32										
9 11 13 15	37 34 31 29	30 27 25 23										
20 25 30 35	25 23 22 21	20   										
40 45 50	21 21 21	 										
HEAT TREATING T												
*NORMALIZE AUSTENITIZE	925 °C 925 °C											
*For forged or rolled specimens only.												

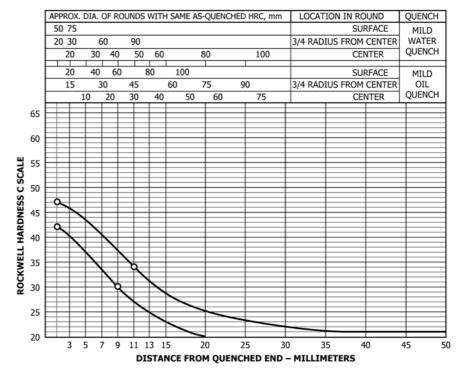


FIG. 12 Limits for Hardenability Band 4320 RH

HARDNES SPECIFICAT		
"J" DISTANCE	H	RC
SIXTEENTHS OF AN INCH	MAX.	MIN.
1 2 3 4	47 44 40 37	@37 SS(D)
5 6 7 8	32) 29 27 25	24 21 20 
9 10 11 12	24 23 22 21	
13 14 15 16	20 	
18 20 22 24		
26 28 30 32		
HEAT TREATING TO	EMPERATURES	
*NORMALIZE AUSTENITIZE	1700 °F 1700 °F	
*For forged or rolle	d specimens on	ıly.

## **HARDENABILITY BAND**

4620 RH

% C	% Mn	% Si	% Ni	% Cr	% <b>M</b> o	
0.17/0.22	0.45/0.65	0.15/0.35	1.65/2.00		0.20/0.30	

	APP	APPROX. DIA. OF ROUNDS WITH SAME AS-QUENCHED HRC, in. LOCATION IN ROUND													ND		QUE	NCH
	2	4														FACE		ILD
	1		2	3	4							3/4 R	ADIUS	FROM				TER
	0.	5 1	1 1.	.5	2	2.5	3	3.	5	4					CEN	TER	QUE	NCH
		1	2		3		4								SUR	FACE	M	ILD
	0	.5	1	1.5	2	2.		3	3.5	4		3/4 R	ADIUS	FROM			OIL QUENCH	
	<u> </u>	0.5		1	1	.5	2	2.	5	3	3.5				CEN	TER	QUE	:NCH
65	i			+		=	=											
						=	=											
60	<b>'</b>																	
<b>5</b> 5																		
₹ ੰ				+		$\pm$	_											
<b>S</b> 50		+		+		+	$\rightarrow$											
SS	a			+		-	_											
<b>8</b> 45		lacksquare		+		_	=											
AR	9	$\perp$																
¥ 40	<b>'</b>	$\forall$				-												
ROCKWELL HARDNESS C SCALE 12		1				=	=											
8 ~		$\perp$	∃>			=	=											
<b>2</b> 30		+		$\forall$			=											
_			\d_															
25				$\pm$	$\rightarrow$	$\overline{}$												
20				$\setminus$			$\setminus$											
20		2	4	6	8	10	12	14	1	6 1	8 2	0 2	2 2	4 2	6 2	8 3	0 3	2
				DI	STAN	CE FF	ком	QUEN	CHE	END	- SIX	TEEN	THS O	F AN I	NCH			

HARDNES SPECIFICAT		
"J" DISTANCE	HE	RC
MILLIMETERS	MAX.	MIN.
1.5 3 5 7	47 45 39 34	(2) 38 (3) 25
9 11 13 15	31) 27 25 23	22 20  
20 25 30 35	21 	
40 45 50		
HEAT TREATING TO *NORMALIZE AUSTENITIZE	EMPERATURES 925 °C 925 °C	_

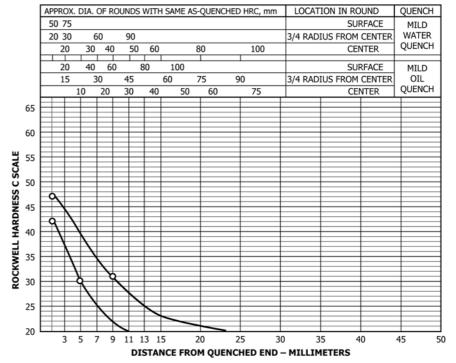


FIG. 13 Limits for Hardenability Band 4620 RH

HARDNES SPECIFICAT		
"J" DISTANCE		RC
SIXTEENTHS OF AN INCH	MAX.	MIN.
1	47	42
2	47	42
3	46	41
4	45	40
5	43	36
6	41	33
7	40	32
8	38	30
9	36	28
10	35	27
11	34	26
12	33	25
13	32	24
14	31	24
15	30	23
16	29	23
18	28	22
20	27	22
22	26	21
24	25	20
26	25	20
28	25	
30	24	
32	23	
HEAT TREATING T *NORMALIZE AUSTENITIZE	EMPERATURES 1700 °F 1550 °F	
*For forged or rolle	ed specimens or	nly.

## **HARDENABILITY BAND**

4820 RH

% C	% Mn	% Si	% Ni	% Cr	% Mo	
0.18/0.23	0.50/0.70	0.15/0.35	3.25/3.75		0.20/0.30	

			. DIA	. OF	ROU	NDS	WITI	H SAM	IE AS-	QUEN	CHED H	RC, in.	LOCA	TION	in Rol			QUE	ENCH
	2	4															FACE		ILD
	-	1 .5	1	1.5	3	4 2	2.	5 3	2 1	3.5		ı	3/4 R	ADIUS	FROM	CENT			TER ENCH
					, 		۷.,			J. J								Ė	
	<u> </u>	1 0.5	1	2	1.5	2		2.5	3	3.5	5 4		2/4 0	ADTUC	FROM		FACE		ILD IL
	Η,	0.			1		1.5	2.5		2.5	3	3.5		ADIOS	FROM	CENT			ENCH
65		Ť	Ĭ		Ē	$\mp$	2.0			<u> </u>	Ť					-	-		
03		+				#													
60		$\pm$				$\equiv$													
						$\pm$													
<b>5</b> 5																			
SOCKWELL HARDNESS C SCALE 40 40 35 30 30																			
SS	0					$\pm$													
<b>y</b> 45			$\geq$			$\pm$													
8	0	+		_		#													
<b>¥</b> 40		$\pm$	$\rightarrow$			$ \langle \langle $													
<b>- 35</b>				$\overline{}$			$\overline{}$												
ڲؚ		$\pm$			$\setminus$	$\pm$		Ø											
<b>ខ្ល</b> 30		$\pm$				ʹ∕ϙ				$\searrow$									
_						$\pm$	_					_							
25		$\pm$				#			$\overline{}$	$\overline{}$									
20																			
		2	4		6	8	1	.0	12	14	16 1	.8 2	20 2	22 2	24 2	26 2	8 3	0 3	32

HARDNES SPECIFICAT		
"J" DISTANCE	Н	RC
MILLIMETERS	MAX.	MIN.
1.5	47	42
3	47	42
5	46	41
7	44	38
9	42	34
11	40	32)
13	37	29
15	35	27
20	32	24
25	29	22
30	27	21
35	26	21
40	25	20
45	24	
50	23	
HEAT TREATING TO *NORMALIZE AUSTENITIZE	EMPERATURES 925 °C 845 °C	

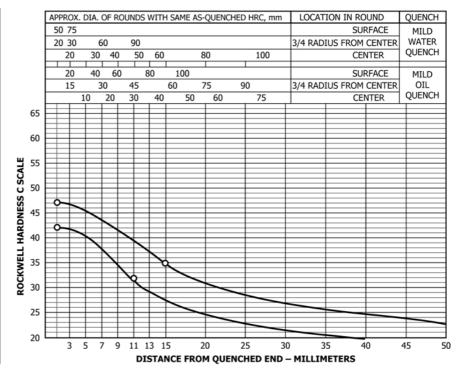


FIG. 14 Limits for Hardenability Band 4820 RH

HARDNES SPECIFICAT										
"J" DISTANCE SIXTEENTHS	н	RC								
OF AN INCH	MAX.	MIN.								
1 2 3 4	© 59 58 58	54 53 53								
5	57	52								
6	56	50								
7	55	47								
8	54	43								
9	52	38								
10	50	35								
11	49	33								
12	47	32								
13	45	31								
14	44	30								
15	41	29								
16	38	28								
18	36	26								
20	34	24								
22	33	23								
24	32	22								
26	31	21								
28	30	20								
30	29									
32	28									
*NORMALIZE AUSTENITIZE										

## **HARDENABILITY BAND**

50B40 RH

% C	% Mn	% Si	% Ni	% Cr	% Mo	% В
0.38/0.43	0.75/1.00	0.15/0.35	-	0.40/0.60		*

<sup>\*</sup>can be expected to contain 0.0005/0.003 percent boron.

		APP	ROX	. DIA	. OF R	OUND	S WIT	H SAM	1E AS-	QUE	NCHED	HRC,	in.	LOCA	TION I	N ROU	IND		ŢÇ	UEI	NCH
		2	4															FACE	_	MII	
		1		2	3								_	3/4 R	ADIUS	FROM					rer Nch
		0.	5	1	1.5	2	2.	5 3	3	3.5		4	$\dashv$				CEN	ITER	Ψ,	UEI	NCH
			1		2		3	4									SUR	FACE		MII	D
		0	.5	1				2.5	3		3.5 4			3/4 R	ADIUS	FROM			$\Box$ $\Box$	OI	
		L.	0.	.5	1		1.5		2	2.5	3		3.5				CEN	TER	1 6	UEI	NCH
	65		$\pm$																	$\exists$	
			$\pm$	_															+	$\equiv$	
	60	<b>~</b>																		$\exists$	
ш			$\mp$	$\supset$	$\overline{}$															$\equiv$	
ξ	55	<b>~</b>	╄	$\overline{}$		_														$\equiv$	
ROCKWELL HARDNESS C SCALE	50		$\pm$									$\pm$							$\pm$	$\equiv$	
SS	50		+	=		$\overline{}$						-								=	
Ę	45					$\rightarrow$			ď											$\equiv$	
≅						_ `	<b>\</b>			$\checkmark$										$\equiv$	
₹	40	H	+	$\rightarrow$						+		+							+	$\Rightarrow$	
=			$\equiv$																	$\equiv$	
WE	35		$\pm$	=			<b>\</b>					$\rightarrow$	$\overline{}$						+	$\exists$	
S			$\pm$												_					$\equiv$	
2	30			7						$\overline{}$									$\overline{}$		
			+	$\Rightarrow$							$\rightarrow$	$\overline{}$								$\exists$	
	25													_						$\equiv$	
	20															_				=	
	20		2	4	6		8 1	0 :	12	14	16	18	2	0 2	2 2	4 2	6 2	28	30	32	2
						DIST	ANCE	FROM	4 OUI	ENC	HED EI	ND -	SIX	TEEN	THS O	FAN	INCH				

HARDNES SPECIFICA		
	1	RC
"J" DISTANCE MILLIMETERS	MAX.	MIN.
1.5	59	54
3	59	54
5	58	53
7	57	52
9	56	51
11	55	47
13	53	41
15	51	36
20	46)	31
25	39	28
30	35	25
35	33	23
40	31	21
45	29	20
50	28	
HEAT TREATING T	TEMPERATURES 870 °C	

845 °C

AUSTENITIZE

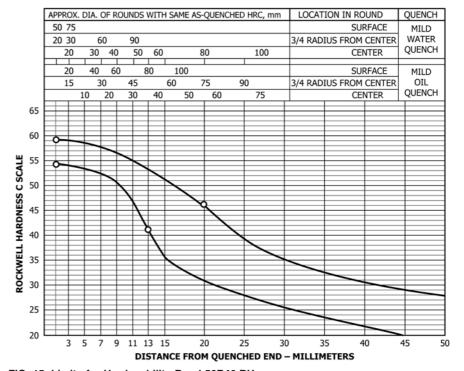


FIG. 15 Limits for Hardenability Band 50B40 RH

#### HARDNESS LIMITS FOR **SPECIFICATION PURPOSES** "J" DISTANCE HRC SIXTEENTHS MAX. MIN. OF AN INCH (55) 53 (50) 47 35 33 39 --HEAT TREATING TEMPERATURES \*NORMALIZE 1650 °F AUSTENITIZE 1600 °F

## **HARDENABILITY BAND**

5130 RH

% C	% Mn	% Si	% Ni	% Cr	% Mo	
0.28/0.33	0.70/0.90	0.15/0.35		0.80/1.10		

				IA. OF F	ROUNI	OS WITH	H SAMI	E AS-Ç	UENC	HED HR	C, in.	LOCA	TION	IN ROU			QUE	NCH
		2	4													FACE		ILD
		0.5	1	1.5	_	4 2.	5 3		3.5	4	1	3/4 R	ADIUS	FROM	CENTE			TER NCH
		0.5							).5 L		L						Ė	
		0.	1	2 1 1	_	2	2.5	3	3.5			2/4 D	A DTLIC	FDOM		FACE		ILD IL
		<del>- 0</del> .	0.5		.5 1	1.5	2.5		3.5 2.5	3	3.5	_	ADIUS	FROM	CENT			NCH
	65		1.5			1.5	_			Ď	J.5				- CEIT			
	05																	
	60																	
щ																		
ROCKWELL HARDNESS C SCALE	55	₽																
cs	50																	
SS	-																	
×	45																	
AR	40																	
Ŧ	40					*												
Ē	35																	
≨																		
õ	30								$\overline{}$									
_	25										$\overline{}$	_						
	25							$\setminus$										
	20					2 4	2 1											
			2		6 											8 3	0 3	32
				D	)IST/	ANCE F	ROM	QUEI	NCHE	DEND	– SI	XTEE	NTHS	OF A	INC	Н		

SPECIFICAT	TION PUR	RPOSES
Na DICTANCE	Н	RC
"J" DISTANCE MILLIMETERS	MAX.	MIN.
1.5	55)	\$0
3	53	47
5	51	44
7	48	39
9	45	36
11	42	33
13	39	31
15	36	28
20	32	24
25	29	21
30	28	20
35	26	
40	24	
45	23	
50	21	

\*For forged or rolled specimens only.

HARDNESS LIMITS FOR

\*NORMALIZE 900 °C
AUSTENITIZE 870 °C
\*For forged or rolled specimens only.

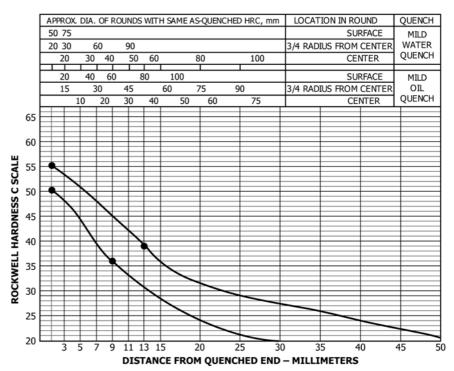


FIG. 16 Limits for Hardenability Band 5130 RH

#### HARDNESS LIMITS FOR **SPECIFICATION PURPOSES** "J" DISTANCE SIXTEENTHS MAX. MIN. OF AN INCH (59 58 (54) 53 41 38 43

## HARDENABILITY BAND

5140 RH

% C	% Mn	% Si	% Ni	% Cr	% Mo	
0.38/0.43	0.70/0.90	0.15/0.35		0.70/0.90		

					IA. OF	ROL	INDS	WITH	SAME	E AS-	QUEN	CHED	HR	C, in.	LOCA	TION	IN ROL			QUE	ENCH
		2		4		_									2/4 5				FACE		ILD
		۲	1 0.5	1	2	.5	2	2.	5 3	,	3.5		4		3/4 H	ADIUS	FROM	CENT			TER ENCH
		Ľ	J.5		I	.5 	$\Box$	۷.		<u> </u>	J.5		$\vec{\Box}$							Ė	
		⊢	0.5	1	2	4.5	2		4	-			_		2/4 5	A DTI IC	FROM		FACE		ILD IL
		⊢	0.5	0.5	1	1.5		1.5	2.5	3	2.5		<u>4</u> 3	3.5	_	ADIUS	FROM	CENT	TER		INCH
	65			0.5		Ť	$\exists$	1.5			<u> </u>	Ŧ	Ť	5.5				CLIV		Ť	
	05					Ŧ	=														
	60	4	_																		
CALE	55	4	_	${=}$																	
SCS	50			_		\															
DNES	45							×													
ROCKWELL HARDNESS C SCALE	40					٦			\												
WELI	35							$\overline{}$				\	\								
ROCK	30									<u></u>	_							_			
	25													<u> </u>	_						
	20		2	!	4	6	8	1	0 1	2	14	16	1	8 2	20 2	22 2	24 2	26 2	8 3	80 3	32
						DIS	TAN	CE F	ROM	QUE	NCH	IED I	END	– SI	XTEE	NTHS	OF A	N INC	Н		

LOCATION IN ROUND

3/4 RADIUS FROM CENTER

3/4 RADIUS FROM CENTER

SURFACE

CENTER

SURFACE

CENTER

QUENCH

MILD

WATER QUENCH

MILD

OIL

**OUENCH** 

# HARDNESS LIMITS FOR **SPECIFICATION PURPOSES**

1600 °F

1550 °F

HEAT TREATING TEMPERATURES

\*For forged or rolled specimens only.

\*NORMALIZE

**AUSTENITIZE** 

"J" DISTANCE	н	RC
MILLIMETERS	MAX.	MIN.
1.5	59	54)
3	58	53
5	57	51
7	55	47
9	52	42)
11	48	38
13	46	36
15	44	34
20	39	30
25	35	27
30	33	25
35	32	24
40	31	22
45	30	21
50	29	20

HEAT TREATING TEMPERATURES

\*For forged or rolled specimens only.

870 °C

845 °C

\*NORMALIZE

AUSTENITIZE

ROCKWELL HARDNESS C SCALE 

**DISTANCE FROM QUENCHED END - MILLIMETERS** 

APPROX. DIA. OF ROUNDS WITH SAME AS-QUENCHED HRC, mm

50 75

20 30

30 40

FIG. 17 Limits for Hardenability Band 5140 RH

11 13 15

## 4914/A914M – 16

HARDNES SPECIFICAT								
"J" DISTANCE	Н	RC .						
SIXTEENTHS OF AN INCH	MAX.	MIN.						
1 2 3 4	65 65 65	60 60 59						
5 6 7 8	64 63 62 60	58 57 54						
9 10 11 12	58 56 55 53	45 42 40 39						
13 14 15 16	51) 50 48 47	38 37 36 36						
18 20 22 24	44 43 42 41	35 34 33 32						
26 28 30 32	40 39 39 38	31 30 29 29						
HEAT TREATING T	HEAT TREATING TEMPERATURES							
*NORMALIZE AUSTENITIZE	1600 °F 1550 °F							
*For forged or rolled specimens only.								

## **HARDENABILITY BAND**

5160 RH

% C	% Mn	% Si	% Ni	% Cr	% Mo	
0.56/0.64	0.75/1.00	0.15/0.35		0.70/0.90		

				. DI	۹. OF	ROU	NDS	WITI	H SAN	1E AS	-QUE	NCHE	HRC,	in.	L	OCAT	ION IN	ROUN		QUE	NCH
		2	4																FACE		LD
		_	1	2		3	4	2.	-		2.5				3/4 R	ADIUS	FROM	CENTE			TER NCH
			.5	1	1.5		2 T	2.	5 .	3	3.5		4					CEN	ITER	QUL	IVCII
			1		2		3		4										FACE		LD
		_	0.5	1		1.5	2		2.5	3	_		1		3/4 R	ADIUS	FROM	CENT			IL
		H	0.	.5		1	_	1.5		2	2.5	3	_	3.5				CEN	TER	QUE	NCH
	65	•	+	_			-						-								
	60	•	-	_			$\setminus$														
CALE	55																				
SS C S	50						¥			•	$ \leftarrow $										
ROCKWELL HARDNESS C SCALE	45							/					\	_							
LL HA	40								\	\											
CKWE	35													_							
8	30																			_	
	25																				
	20								$\stackrel{\square}{\sim}$	12		16	10	_			4 1	<u> </u>		0 0	
			2	4	ł	6	8			12	14	16	18	2					8 3	0 3	2
						DI	STA	NCE	FRO	M QU	ENC	HED E	ND –	SIX	TEEN	THS C	F AN	INCH			

#### HARDNESS LIMITS FOR **SPECIFICATION PURPOSES** HRC "J" DISTANCE MILLIMETERS MIN. MAX. 65 <u>@</u> 1.5 49 43 (52) 47 HEAT TREATING TEMPERATURES \*NORMALIZE 870 °C 845 °C AUSTENITIZE

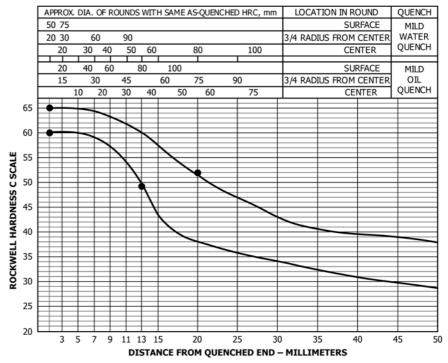


FIG. 18 Limits for Hardenability Band 5160 RH

## 4914/A914M – 16

#### HARDNESS LIMITS FOR **SPECIFICATION PURPOSES** "J" DISTANCE HRC SIXTEENTHS MAX. MIN. OF AN INCH 45 39 30 31 - -- -- -- -- -HEAT TREATING TEMPERATURES \*NORMALIZE 1700 °F **AUSTENITIZE** 1700 °F

## **HARDENABILITY BAND**

8620 RH

% C	% Mn	% Si	% Ni	% Cr	% Mo	
0.18/0.23	0.70/0.90	0.15/0.35	0.40/0.70	0.40/0.60	0.15/0.25	

					IA. OF	ROI	JND9	WITH	H SAM	1E AS	-QUE	NCHE	HRC	, in.	LOCA	NOITA	IN R				Qι	IENCH
	-	2		_		_												_		FACE		1ILD
	ŀ	0.	_	1		3	2	2.		3	3.5		4		3/4 F	RADIU	S FRC			TER		ATER IENCH
	ŀ	0.	$\Box$			_					3.5										Ě	
	ŀ		).5		2	1.5	3 2		2.5	3		3.5	1		2/4 [	A DTL K	C EDC			FACE		1ILD OIL
	ŀ			0.5	1	1.5		1.5		2	2.5	3	+	3.5	3/4 1	RADIU	5 FKC			TER		IENCH
6	<u>.</u>	$\blacksquare$	Ŧ	-		Ť	$\exists$	1.5			<u> </u>	Ť	$\equiv$	5.5				Ŧ				T
0	٦[	$\mp$	7										+									
<b>щ</b> 6	0		#																			
SCAL 2	5																					
SS 5	٥																					
RDN 4	5	•	$ \langle $																			
ROCKWELL HARDNESS C SCALE	٥	•	V	/																		
3 3 3	5			/	/																	
<b>2</b> 3	٥					\																
2	5							\														
2	٥		2			6	Ž	_			1	<u> </u>	١					16				22
			2			-	8 <b>4at</b> :	10 ICF F		12 I OU	14 FNC	16 IFD F	18 ND -			22 2 NTHS	24 OF 4	26 N TI	28 NCH		0	32

HARDNES SPECIFICAT		
"J" DISTANCE	HF	RC
MILLIMETERS	MAX.	MIN.
1.5 3 5 7	47 45 41 36	@# <b>.</b> \$%
9 11 13 15	32 29 28 26	25 22 21 20
20 25 30 35	23 21 	
40 45 50		
HEAT TREATING T *NORMALIZE AUSTENITIZE * For forged or rol	925 °0 925 °0	C C

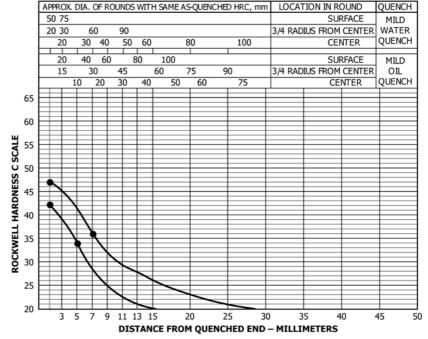


FIG. 19 Limits for Hardenability Band 8620 RH

HARDNES SPECIFICAT								
"J" DISTANCE	н	RC						
SIXTEENTHS OF AN INCH	MAX.	MIN.						
1 2 3 4	49 47 45 41	41 37 32						
5 6 7 8	38 35 32 30	29 27 24 22						
9 10 11 12	29 28 27 26	21 20  						
13 14 15 16	25 24 24 23	  						
18 20 22 24	23 22 22 22	  						
26 28 30 32	22 22 22 22 22	  						
HEAT TREATING TO *NORMALIZE AUSTENITIZE	EMPERATURES 1700 °F 1700 °F							
*For forged or rolled specimens only.								

## **HARDENABILITY BAND**

8622 RH

% C	% Mn	% Si	% Ni	% Cr	% Mo	
0.20/0.25	0.70/0.90	0.15/0.35	0.40/0.70	0.40/0.60	0.15/0.25	

			IA. OF	ROUN	IDS WITI	H SAM	E AS-Q	UENC	HED HE	RC, in.	L	OCATI	ON IN			_	ENCH
	2	4	2	3	4						3/4 D	ADTHE	FROM		FACE		ILD TER
	0.		1 1.	_		5 3	3.	.5	4		3/4 K	ADIU3	FROM	CEN			ENCH
		1	2		3	4								SUR	FACE	М	ILD
	0	.5	1	1.5	2	2.5	3	3.5	4		3/4 R	ADIUS	FROM			1 c	OIL
	$\vdash$	0.5	_	1	1.5	2	2.	.5	3	3.5				CEN	TER	QUI	NCH
65																	
60																	
<b>YE</b> 55																	
<b>S</b> 50	a																
<b>SNES</b> 45	Q																
ROCKWELL HARDNESS C SCALE		$\setminus$															
WELL 35				Q													
<b>8</b> 30			X														
25							_										
20																	
		2	4	6 DT6	8 1		2 1								8 3	0 3	32

HARDNES SPECIFICAT							
"J" DISTANCE	H	RC					
MILLIMETERS	MAX.	MIN.					
1.5 3 5 7	49 48 44 39	44 42 36 31					
9 11 13 15	36 32 29 28	28 24 22 20					
20 25 30 35	25 23 22 22						
40 45 50	22 22 22	  					
HEAT TREATING TEMPERATURES							
*NORMALIZE AUSTENITIZE *For forged or rolle	925 °C 925 °C d specimens on	lv.					

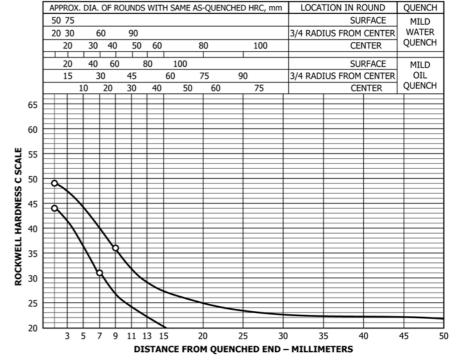


FIG. 20 Limits for Hardenability Band 8622 RH

HARDNES					
SPECIFICAT "J" DISTANCE		RC			
SIXTEENTHS OF AN INCH	MAX.	MIN.			
1 2 3 4	47 45 43 40	49.99 37.63			
5 6 7 8	36 33 31 29	28 26 24 23			
9 10 11 12	28 27 26 25	22 21 20 			
13 14 15 16	25 24 24 23				
18 20 22 24	23 22 22 21	  			
26 28 30 32	20 				
HEAT TREATING TEMPERATURES  *NORMALIZE 1700 °F AUSTENITIZE 1700 °F					
*For forged or roll	ed specimens o	nly.			

## **HARDENABILITY BAND**

8720 RH

% C	% Mn	% Si	% Ni	% Cr	% Mo	
0.18/0.23	0.70/0.90	0.15/0.35	0.40/0.70	0.40/0.60	0.20/0.30	

		API	PRO	X. DI	A. OF I	ROU	NDS	WITH	SAM	E AS-	QUEN	CHED H	RC, in.	ι	OCAT	ION IN	ROUN	D	QUE	ENCH
		2		4														FACE		ILD
		-	1	2		3	4							3/4 R	ADIUS	FROM	CENT			TER ENCH
		$\vdash$	).5	1	1.5		2	2.5	3		3.5	4					CEN	TER	Qui	INCII
				1	2		3		4									FACE		ILD
		⊢	0.5			.5	2		2.5	3	3.5	3	2.5		ADIUS	FROM	CENTE			IL ENCH
		$\vdash$	$\neg$	0.5		1	7	1.5	2		2.5	-	3.5				CEN	IEK	Qui	
	65	Ħ					#													
	60	Ħ					#	=												
		Ħ					#													
Æ	55	Ħ					#	-												
ROCKWELL HARDNESS C SCALE		Ħ					#													
SC	50						#													
Ë	45		$\setminus$				#													
8				$\overline{}$			7													
Ŧ	40			$\leftarrow$			+													
Ξ	35			+			$\mp$													
₹	33			$\rightarrow$			$\pm$													
ĕ	30						$ \langle $													
_								$\setminus$												
	25					$\overline{}$	abla		_	<u> </u>										
	20							$\searrow$												
	20		2	!	4	6	8	10	1	2	14	16	18 2	20 2	22 2	24 2	6 2	8 3	0 3	32
						DI	STA	NCE F	ROM	QUE	NCHE	D END	– SIX	CTEEN	THS O	F AN	INCH			

HARDNES SPECIFICAT		
WW DISTANCE	H	RC
"J" DISTANCE MILLIMETERS	MAX.	MIN.
1.5 3 5 7	45 42 38	@# #S
9 11 13 15	34) 31 29 28	27 24 23 22
20 25 30 35	25 23 23 22	  
40 45 50	20 	
HEAT TREATING T *NORMALIZE AUSTENITIZE *For forged or rolle	925 °C 925 °C	al.

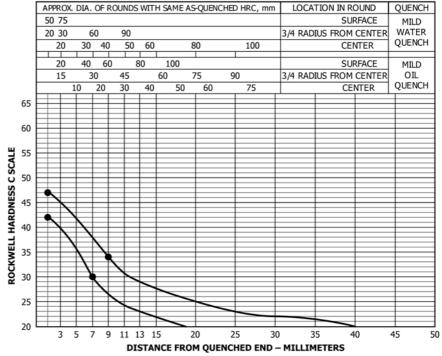


FIG. 21 Limits for Hardenability Band 8720 RH

HARDNES SPECIFICAT							
"J" DISTANCE SIXTEENTHS	Н	RC					
OF AN INCH	MAX.	MIN.					
1 2 3 4	49 48 47 43	43 40 35					
5 6 7 8	40 37 35 33	31) 29 27 26					
9 10 11 12	32 31 30 30	25 25 24 23					
13 14 15 16	29 28 28 27	23 23 22 22					
18 20 22 24	27 26 26 26	21 20  					
26 28 30 32	26 25 25 25 25	  					
HEAT TREATING TEMPERATURES  *NORMALIZE 1700 °F							
AUSTENITIZE	1700 °F						
*For forged or rolle	d specimens on	ly.					

## **HARDENABILITY BAND**

8822 RH

% C	% Mn	% Si	% Ni	% Cr	% Mo	
0.20/0.25	0.75/1.00	0.15/0.35	0.40/0.70	0.40/0.60	0.30/0.40	

		APP	PRC	X. DI	A. OF F	ROUN	NDS V	VITH	SAME	AS-C	QUENC	IED H	RC, in.	l	OCAT	ION IN	ROUN	D	QU	ENCH
		2		4														FACE		ILD
		_	1	2	1.5	3	4 2	2.5	3	2	-			3/4 R	ADIUS	FROM	CENT			ATER ENCH
			1.5 	1			$\perp$	2.5		3	.5	4							Ť	=
		_		1	2	_	3		4		2.5			2/4.5	ABTUG	- FROM		FACE		ILD DIL
		_	0.5	0.5		1.5 1	2	L.5	.5	3 2	3.5	3	3.5	_	ADIUS	FROM	CENT			ENCH
	65		$\exists$	0.5		Ì	Ŧ	-			Ĭ	_	3.3				CLIV		ř	=
,	05							-												=
	60		$\exists$																	=
																				=
ROCKWELL HARDNESS C SCALE	55						$\pm$	_												=
S	50																			
SS	30	0	$\setminus$																	
Ÿ.	45	0		$\rightarrow$			$\pm$													
8		Ĭ	7	$\leftarrow$				$\pm$												=
Ŧ.	40			$\Rightarrow$																$\equiv$
⊒.	35			=		<b>\</b>														
. ₹	33					_ ~	$\setminus$													
چ	30				Ø		$\pm$	$\rightarrow$	$\overline{}$											=
_							$\overline{}$													
:	25							$\rightarrow$	$\overline{}$											
	20											_								=
	20 '		2	2	4	6	8	10	1	2 1	4 1	6 1	8 2	0 2	2 2	4 2	6 2	8 3	0 3	32
						DIS	STAN	ICE F	ROM	QUE	NCHE	END	- SIX	TEEN	THS 0	F AN	INCH			

HARDNES SPECIFICAT		
"J" DISTANCE	H	RC
MILLIMETERS	MAX.	MIN.
1.5 3 5 7	49 48 46 42	<del>4</del> 4 %
9 11 13 15	38 35 33 32	30 27 26 25
20 25 30 35	29 27 27 26	23 22 21 20
40 45 50	26 25 25	
HEAT TREATING T *NORMALIZE AUSTENITIZE	EMPERATURES 925 °C 925 °C	

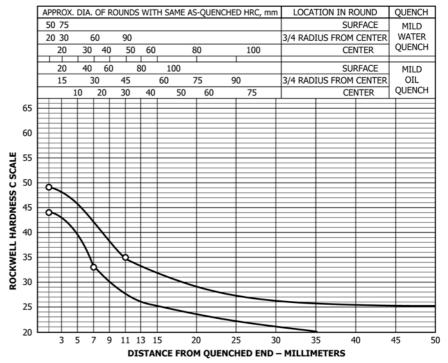


FIG. 22 Limits for Hardenability Band 8822 RH

HARDNES SPECIFICAT		
"J" DISTANCE SIXTEENTHS	HF	RC
OF AN INCH	MAX.	MIN.
1	42	37
2	42	36
3	42	36
4	41	35
5	41	34
6	40	33
7	40	32
8	39	31
9	38	30
10	37	29
11	37	29
12	36	28
13	35	28
14	34	28
15	34	28
16	33	27
18	33	27
20	32	26
22	32	26
24	32	26
26	32	26
28	32	26
30	31	25
32	31	25
HEAT TREATING T *NORMALIZE AUSTENITIZE	EMPERATURES 1700 °F 1550 °F	

## **HARDENABILITY BAND**

9310 RH

% C	% Mn	% Si	% Ni	% Cr	% <b>M</b> o	
0.08/0.13	0.45/0.65	0.15/0.35	3.00/3.50	1.00/1.40	0.08/0.15	

					A. OF	ROL	JNDS	WITI	H SAM	E AS-	QUEN	ICHED	HR	C, in.	LOCA	TION	IN RO			QU	ENCH
		2	_	4															FACE		1ILD
		_	1_	2		3	4						_		3/4 R	ADIUS	FROM	1 CENT			ATER IENCH
		$\vdash^{0}$	0.5 1		1.	1.5 2		2.5 3		3.5			4		CENTER				Qu	QULINCIT	
				1	2				4						SURFACE					MILD	
		0.5 1		L	1.5 2				3 3					3/4 RADIUS FROM CENTER					OIL QUENCH		
ROCKWELL HARDNESS C SCALE		0.5				1		1.5 2		2.5		3	3 3.5		CENTER						T QU
	65												$\pm$								$\pm$
	60											$\pm$	$\pm$								+
	00											+	$\pm$								
	55		$\exists$									+	$\pm$								+
													$\pm$								
	50												$\pm$								
	45												$\pm$								
¥	45						=					+	7								=
$\exists$	40	Ĭ	$\equiv$			$\overline{}$							$\mp$								=
WE		0						$\nearrow$					$\mp$								
Š	35	Ħ	=							$\overline{}$			$\mp$								_
8		Ħ	=			7	${}^{\vee}$					$\rightarrow$	$\dashv$	_				-			
	30	$\exists$	=					_					$\mp$								
	25	$\exists$	=										#								
			$\exists$									=	#								
	20						_				<u></u>	16					<u></u>	26 1		<u> </u>	<del></del>
			2	•	4	6	8	1			14	16	18						28 3	30	32
						D.	151/	INCE	FRUM	ı QUE	:NCH	ED EI	ND.	- 21X	IEEN	IHS C	r AN	INCH			

HARDNESS LIMITS FOR SPECIFICATION PURPOSES								
"J" DISTANCE	HRC							
MILLIMETERS	MAX.	MIN.						
1.5	42	37						
3	42	36						
5	42	36						
7	41	35						
9	40	34						
11	40	32						
13	39	31						
15	37	29						
20	35	28						
25	34	27						
30	32	26						
35	32	26						
40	32	26						
45	31	25						
50	31	25						
*NORMALIZE AUSTENITIZE								

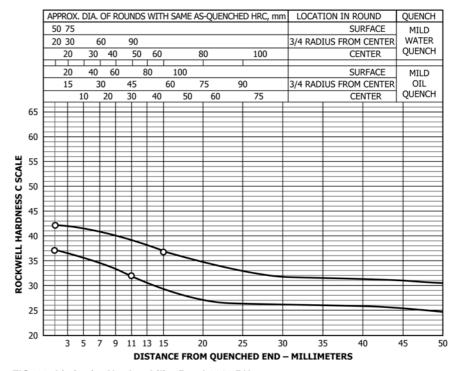


FIG. 23 Limits for Hardenability Band 9310 RH

#### SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A914/A914M–92(2011)) that may impact the use of this standard. (Approved Dec. 1, 2016)

- (1) In 5.1, removed "open-hearth" from the first sentence.
- (3) Inserted new graphs for Fig. 11.
- (2) In Table 1, removed the first sentence of Note 1.

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