

(R) RESTRICTED HARDENABILITY BANDS FOR SELECTED ALLOY STEELS

1. SCOPE:

Restricted hardenability steels have been in use for some time but the specific restrictions for a particular grade depend upon customer needs and vary from mill to mill. Such steels are desirable to provide more controlled heat treatment response and dimensional control for critical parts. Because of increasing interest in steels with restricted hardenability, the SAE Iron and Steel Technical Committee directed Division 8 to prepare a set of standard steels with restricted hardenability.

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 (see SAE J1268) 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 standard H-band is given for SAE 4140 in Figure 1.

2. REFERENCES:

2.1 Applicable Documents:

SAE J404 OCT80, Chemical Compositions of SAE Alloy Steels

SAE J406 MAY85, Methods of Determining Hardenability of Steels

SAE J409 JUN84, Product Analysis-Permissible Variations from Specified Chemical Analysis of a Heat or Cast of Steel

SAE J418 DEC83, Grain Size Determination of Steels

SAE J1268 FEB88, Hardenability Bands for Carbon and Alloy H Steels

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### 3. GRADES OF STEEL:

RH steels and their corresponding minimum and maximum composition limits are shown in Table 1 for a selected group of 12 alloy steels used in substantial tonnages and covering a nominal carbon content range of 0.20 to 0.60%. As the need arises for restricted hardenability in other grades, they will be added to the standard.

### 4. CHEMICAL COMPOSITION LIMITS:

To meet restricted hardenability, yet provide flexibility for producers, composition limits are the same as those given in SAE J404. (These limits are somewhat narrower than allowed for standard H-steels). It should be understood that alloys which satisfy the restricted hardenability band will fall within SAE J404 composition limits, but not all steels melted to the composition limits would meet the required RH-band. The limits are given in Table 1, and as indicated in the footnotes, are subject to permissible variations for product analysis and may contain certain levels of elements not specified.

### 5. IDENTIFICATION:

As a means of identifying steels specified to restricted hardenability band limits, the suffix letters RH have been added to the conventional series number. It is important that steel consumers use this special identifying designation in specification requirements, as there is no other means of determining when restricted hardenability band limits apply. When the special identification is used, the steel shall conform to all conditions pertaining to chemical composition limits, restrictions, testing technique, and so forth, as outlined herein.

### 6. GRAIN SIZE:

The limits set forth for RH-bands are intended to apply to steels exhibiting austenitic grain size ASTM No. 5 or finer (see SAE J418).

### 7. USE OF RESTRICTED HARDENABILITY LIMITS:

For specification purposes, one must use the tabulated values of Rockwell hardness (HRC) as a function of distance from the quenched end of the hardenability bar, either in U.S. customary units (sixteenths of an inch) or in metric (SI) units (millimeters). Values below 20 HRC are not specified because such values are not as accurate. Band limits are also shown graphically and are so depicted for convenience in estimating the hardness values at various intermediate locations on the end quench test bar and 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 the ranges appearing in Figure 7 of SAE J406. The RH-bands are presented graphically, with distances from the quenched end in both U.S. customary units and also in metric (SI) units.

TABLE 1 - Compositions of Restricted Hardenability Steels

SAE Steel No.	Ladle Chemical Composition, Weight % <sup>a,b,c</sup>					
	C	Mn	Si	Ni	Cr	Mo
SAE 4027RH	0.25/0.30	0.70/0.90	0.15/0.35	--	--	0.20/0.30
SAE 4118RH	0.18/0.23	0.70/0.90	0.15/0.35	--	0.40/0.60	0.08/0.15
SAE 4120RH	0.18/0.23	0.90/1.20	0.15/0.35	--	0.40/0.60	0.13/0.20
SAE 4140RH	0.38/0.43	0.75/1.00	0.15/0.35	--	0.80/1.10	0.15/0.25
SAE 4145RH	0.43/0.48	0.75/1.00	0.15/0.35	--	0.80/1.10	0.15/0.25
SAE 4161RH	0.56/0.64	0.75/1.00	0.15/0.35	--	0.70/0.90	0.25/0.35
SAE 5130RH	0.28/0.33	0.70/0.90	0.15/0.35	--	0.80/1.10	--
SAE 5140RH	0.38/0.43	0.70/0.90	0.15/0.35	--	0.70/0.90	--
SAE 5160RH	0.56/0.64	0.75/1.00	0.15/0.35	--	0.70/0.90	--
SAE 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
SAE 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
SAE 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

<sup>a</sup>Small quantities of certain elements may be found in alloy steel which are not specified or required. These elements are to be considered as incidental and acceptable to the following maximum amounts: copper to 0.35%, nickel to 0.25%, chromium to 0.20%, and molybdenum to 0.06%.

<sup>b</sup>Maximum sulfur content is to be 0.040% and maximum phosphorus content is to be 0.025%.

<sup>c</sup>Ranges and limits are subject to the permissible variations for product analysis shown in Table 4 of SAE J409.

Restricted Hardenability Limits for the Steels in Table 1 appear in Figures 2 through 25.

## 7. (Continued):

The hardenability testing technique used as a basis for acceptance shall be in accordance with SAE J406.

For specification purposes, RH-band steels shall be 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 HRC 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 to exhibit 50% martensite hardness; then the additional two control hardness points shall be 5 HRC below the minimum and maximum hardness specified at the J1 (J1.5mm) position). 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 a portion of the curve not exceeding 3/16 in or 5 mm (not including the control points), a tolerance of two points HRC is permitted.

For example, referring to Figure 1, 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 51 HRC (or even 53 HRC if this 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).

(A similar example, for 4140RH with distances from the quenched end in millimeters, 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.)

The (R) is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

SAE 4140 H/RH **HARDENABILITY BAND**

HARDNESS LIMITS FOR SPECIFICATION PURPOSES				
"J" DISTANCE SIXTEENTHS OF AN INCH	MAX HRC		MIN HRC	
	4140 H	4140 RH	4140 RH	4140 H
1	60	59	53	53
2	60	59	54	53
3	60	59	54	52
4	59	58	53	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	51	43	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	45	36	33
24	48	44	35	32
26	47	43	34	32
28	46	42	34	31
30	46	41	33	31
32	44	41	33	30

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE	
*NORMALIZE	1600 °F
AUSTENITIZE	1550 °F

\*For forged or rolled specimens only

	%C	%Mn	%Si	%Ni	%Cr	%Mo
H	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

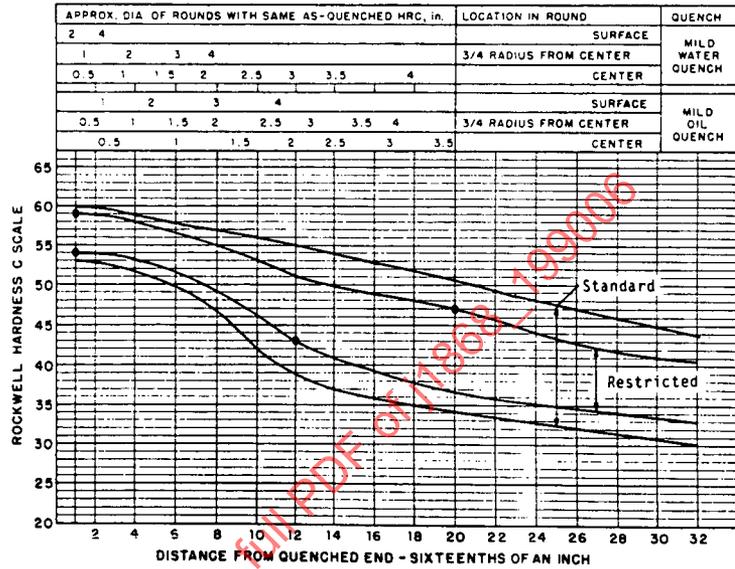


FIGURE 1 - Comparison of H-Band and RH-Band for SAE 4140

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	HRC	
	MAX.	MIN.
1	(51)	(46)
2	48	42
3	43	(34)
4	(37)	28
5	32	24
6	28	22
7	26	20
8	24	--
9	23	--
10	22	--
11	22	--
12	21	--
13	21	--
14	20	--
15	--	--
16	--	--
18		
20		
22		
24		
26		
28		
30		
32		

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 1650 °F  
 AUSTENITIZE 1600 °F

\* For forged or rolled specimens only

SAE 4027RH

**HARDENABILITY BAND**

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

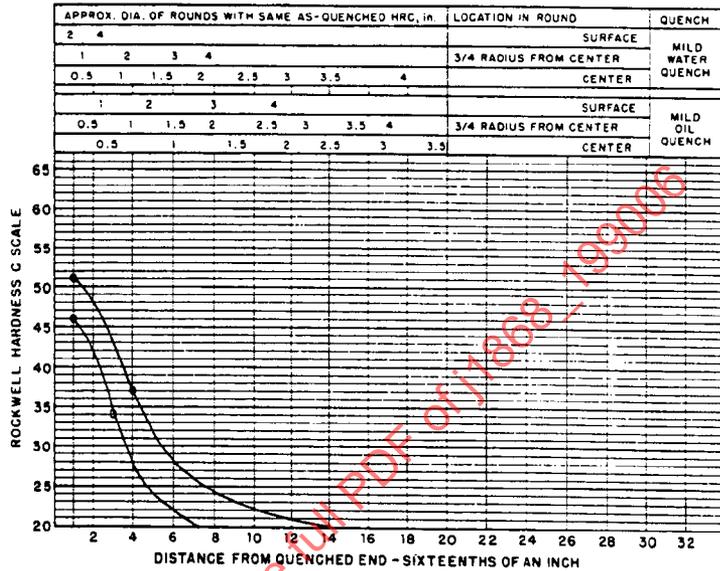


FIGURE 2

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	HRC	
	MAX.	MIN.
1	(47)	(42)
2	44	38
3	38	(30)
4	(33)	25
5	29	22
6	27	20
7	25	--
8	24	--
9	23	--
10	22	--
11	21	--
12	20	--
13	--	--
14	--	--
15	--	--
16	--	--
18		
20		
22		
24		
26		
28		
30		
32		

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 1700 °F  
 AUSTENITIZE 1700 °F

\* For forged or rolled specimens only

SAE 4118RH

**HARDENABILITY BAND**

%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

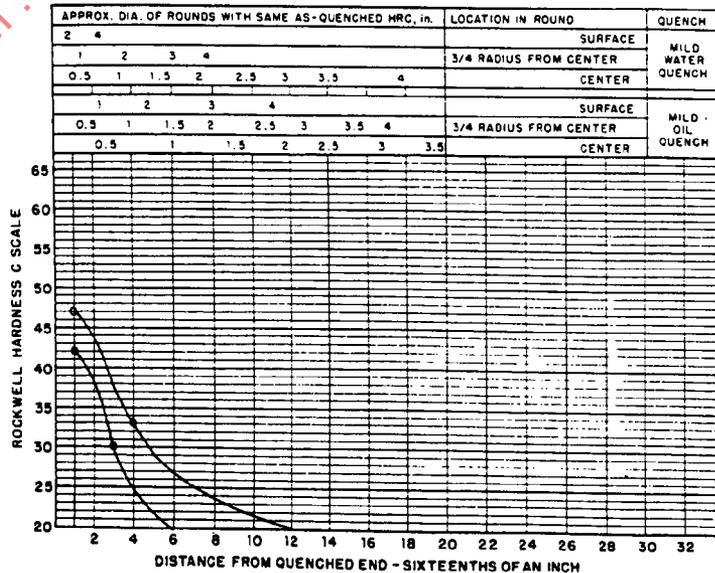


FIGURE 3

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	HRC	
	MAX.	MIN.
1	47	42
2	45	39
3	41	35
4	38	30
5	34	26
6	31	24
7	29	22
8	28	21
9	26	20
10	25	--
11	24	--
12	23	--
13	23	--
14	22	--
15	22	--
16	21	--
18	20	--
20	--	--
22	*	--
24	*	--
26		
28		
30		
32		

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 1700 °F  
AUSTENITIZE 1700 °F

\*For forged or rolled specimens only

SAE 4120RH

HARDENABILITY BAND

%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

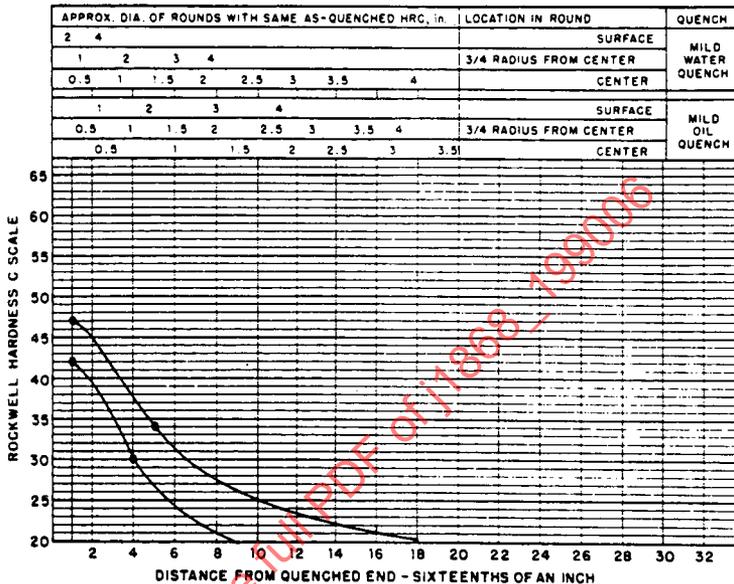


FIGURE 4

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	HRC	
	MAX.	MIN.
1	59	54
2	59	54
3	59	54
4	59	53
5	58	52
6	57	51
7	56	50
8	55	49
9	54	48
10	53	46
11	52	44
12	52	43
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 RECOMMENDED BY SAE

\*NORMALIZE 1600 °F  
AUSTENITIZE 1550 °F

\*For forged or rolled specimens only

SAE 4140RH

HARDENABILITY BAND

%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

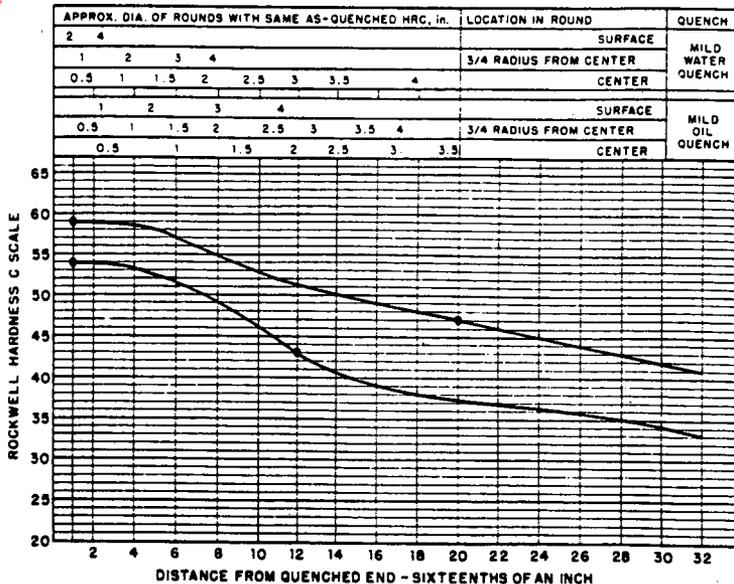


FIGURE 5

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	HRC	
	MAX.	MIN.
1	62	57
2	62	57
3	61	56
4	61	56
5	60	55
6	60	55
7	59	54
8	59	53
9	58	52
10	58	52
11	58	51
12	57	50
13	57	49
14	56	48
15 <sup>A</sup>	56	47
16	55	46
18	54	44
20	53	43
22	52	42
24	51	40
26	51	40
28	50	39
30	50	38
32	49	37

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 1600 °F  
AUSTENITIZE 1550 °F

\*For forged or rolled specimens only

SAE 4145RH HARDENABILITY BAND

%C	%Mn	%Si	%Ni	%Cr	%Mo
0.43/0.48	0.75/1.00	0.15/0.35	--	0.80/1.10	0.15/0.25

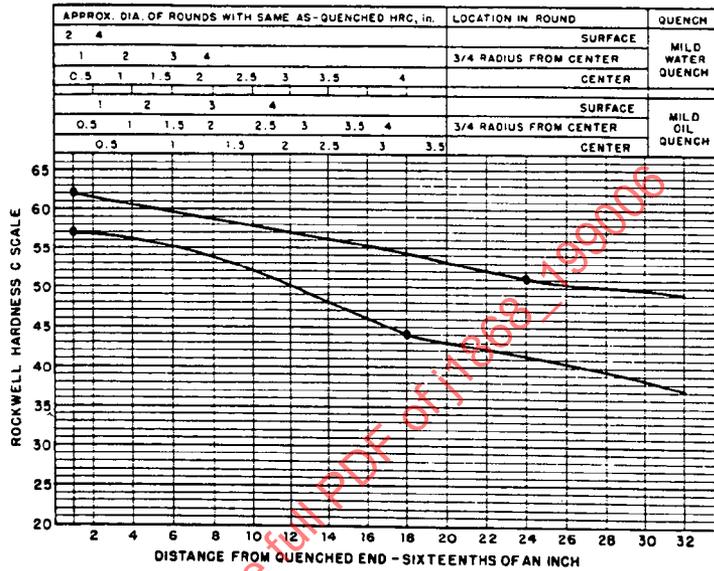


FIGURE 6

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	HRC	
	MAX.	MIN.
1	65	60
2	65	60
3	65	60
4	65	60
5	65	60
6	65	60
7	65	60
8	65	60
9	65	60
10	65	60
11	65	60
12	64	59
13	64	59
14	64	59
15	63	58
16	63	57
18	62	56
20	62	54
22	61	53
24	60	51
26	59	49
28	58	47
30	57	46
32	57	45

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 1600 °F  
AUSTENITIZE 1550 °F

\*For forged or rolled specimens only

SAE 4161RH HARDENABILITY BAND

%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

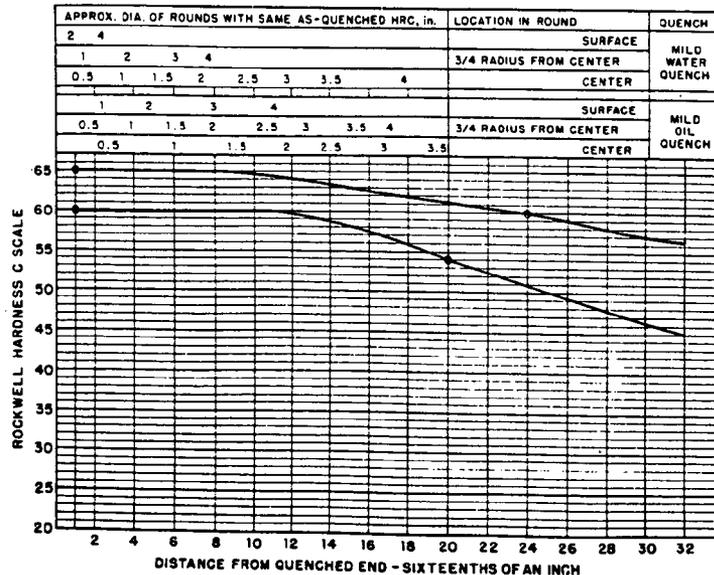


FIGURE 7

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	HRC	
	MAX.	MIN.
1	(55)	(50)
2	53	47
3	51	44
4	49	41
5	46	37
6	44	(35)
7	42	33
8	(39)	31
9	37	29
10	35	27
11	34	26
12	33	25
13	32	24
14	31	23
15	30	22
16	29	21
18	28	20
20	27	--
22	26	--
24	25	--
26	24	--
28	23	--
30	22	--
32	21	--

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 1650 °F  
AUSTENITIZE 1600 °F

\*For forged or rolled specimens only

SAE 5130RH

**HARDENABILITY BAND**

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

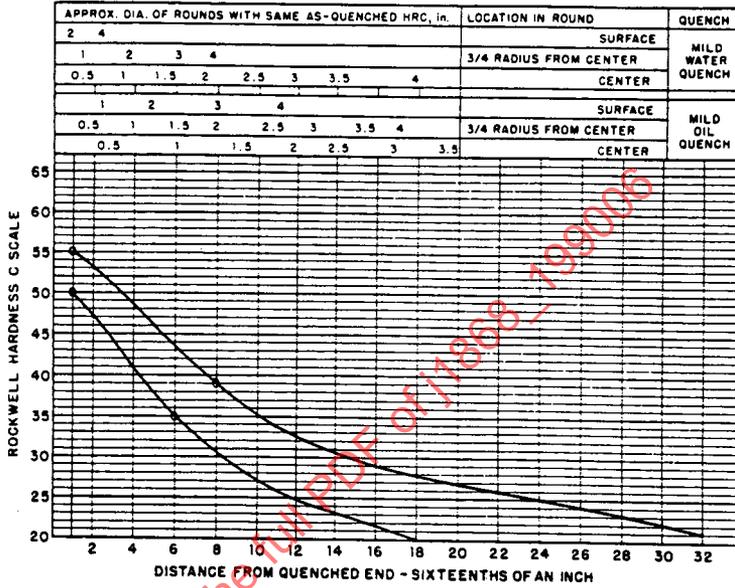


FIGURE 8

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	HRC	
	MAX.	MIN.
1	(59)	(54)
2	58	53
3	57	51
4	55	49
5	53	45
6	51	(41)
7	48	38
8	46	36
9	(44)	34
10	43	33
11	41	32
12	40	31
13	39	30
14	37	29
15	36	28
16	35	27
18	34	26
20	33	25
22	32	24
24	31	23
26	30	22
28	30	21
30	29	20
32	29	--

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 1600 °F  
AUSTENITIZE 1550 °F

\*For forged or rolled specimens only

SAE 5140RH

**HARDENABILITY BAND**

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

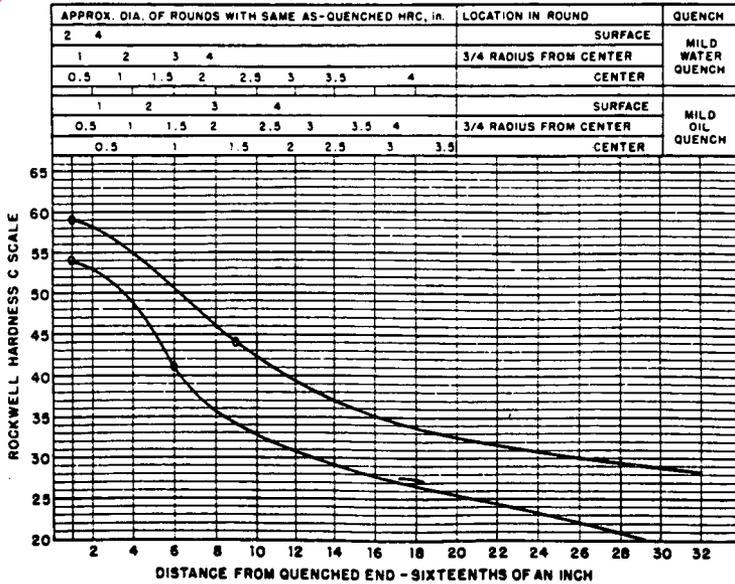


FIGURE 9

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	HRC	
	MAX.	MIN.
1	(65)	(60)
2	65	60
3	65	60
4	65	59
5	64	58
6	63	57
7	62	54
8	60	(50)
9	58	45
10	56	42
11	55	40
12	53	39
13	(51)	38
14	50	37
15	48	36
16	47	36
18	44	35
20	43	34
22	42	33
24	41	32
26	40	31
28	39	30
30	39	29
32	38	29

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 1600 °F  
 AUSTENITIZE 1550 °F

\*For forged or rolled specimens only

SAE 5160RH HARDENABILITY BAND

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

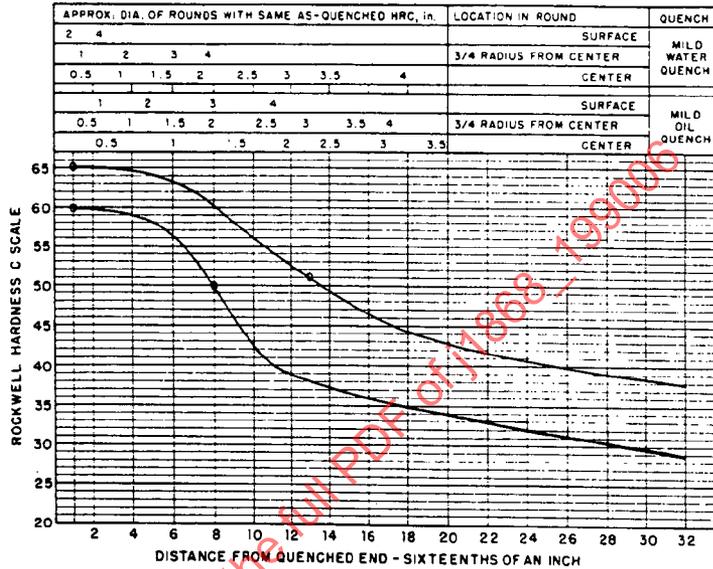


FIGURE 10

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	HRC	
	MAX.	MIN.
1	(47)	(42)
2	45	39
3	41	35
4	38	(30)
5	(34)	26
6	31	24
7	29	22
8	28	21
9	26	20
10	25	--
11	24	--
12	23	--
13	23	--
14	22	--
15	22	--
16	21	--
18	20	--
20	--	--
22	--	--
24	--	--
26	--	--
28	--	--
30	--	--
32	--	--

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 1700 °F  
 AUSTENITIZE 1700 °F

\*For forged or rolled specimens only

SAE 8620RH HARDENABILITY BAND

%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

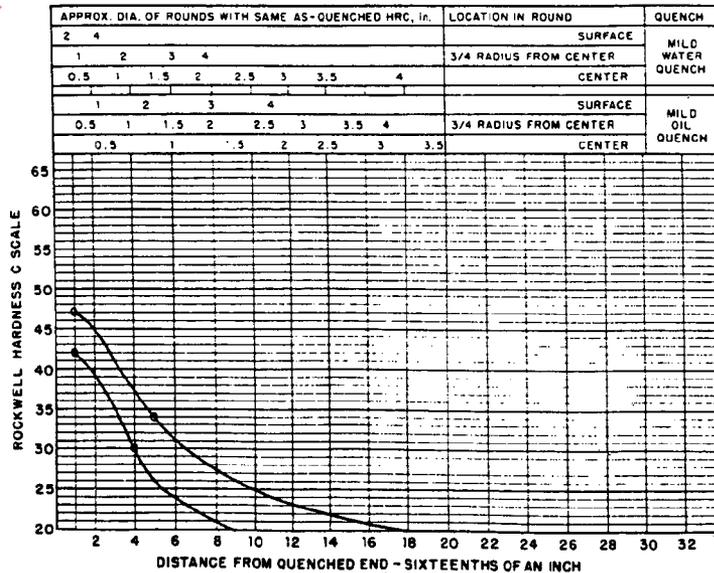


FIGURE 11

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	HRC	
	MAX.	MIN.
1	47	42
2	45	39
3	43	37
4	40	32
5	36	28
6	33	26
7	31	24
8	29	23
9	28	22
10	27	21
11	26	20
12	25	--
13	25	--
14	24	--
15	24	--
16	23	--
18	23	--
20	22	--
22	22	--
24	21	--
26	20	--
28	--	--
30	--	--
32	--	--

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 1700 °F  
AUSTENITIZE 1700 °F

\*For forged or rolled specimens only

SAE 8720RH

HARDENABILITY BAND

%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

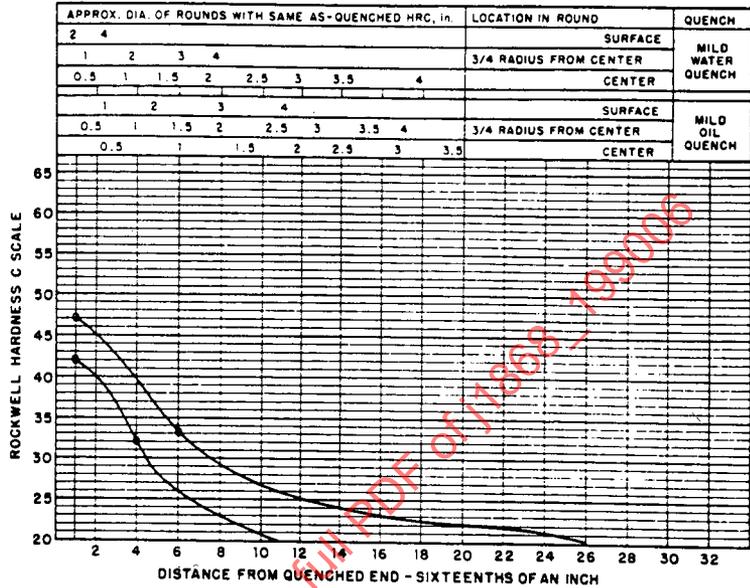


FIGURE 12

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	HRC	
	MAX.	MIN.
1	49	44
2	48	43
3	47	40
4	43	35
5	40	31
6	37	29
7	35	27
8	33	26
9	32	25
10	31	25
11	30	24
12	30	23
13	29	23
14	28	23
15	28	22
16	27	22
18	27	21
20	26	20
22	26	--
24	26	--
26	26	--
28	25	--
30	25	--
32	25	--

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 1700 °F  
AUSTENITIZE 1700 °F

\*For forged or rolled specimens only

SAE 8822RH

HARDENABILITY BAND

%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

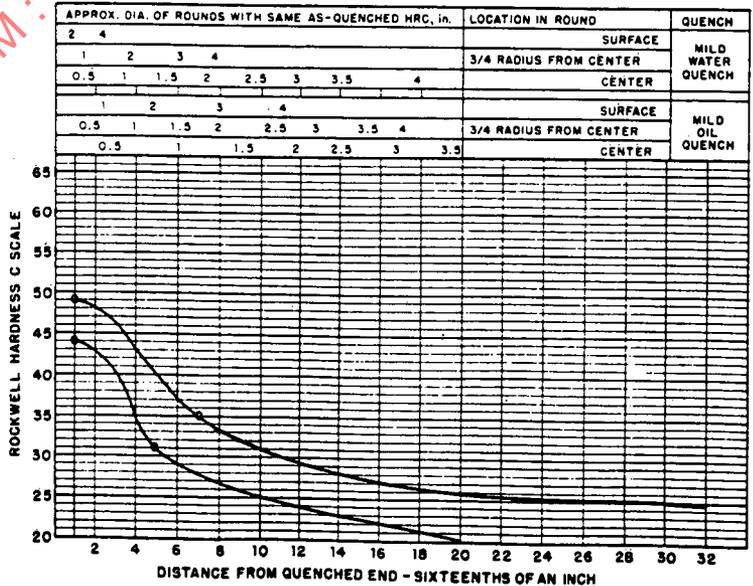


FIGURE 13

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE MILLIMETERS	HRC	
	MAX.	MIN.
1.5	(51)	(46)
3	48	42
5	42	(33)
7	(35)	26
9	29	23
11	26	20
13	24	--
15	23	--
20	21	--
25	--	--
30		
35		
40		
45		
50		

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 900 °C  
AUSTENITIZE 870 °C

\* For forged or rolled specimens only

SAE 4027RH

HARDENABILITY BAND

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

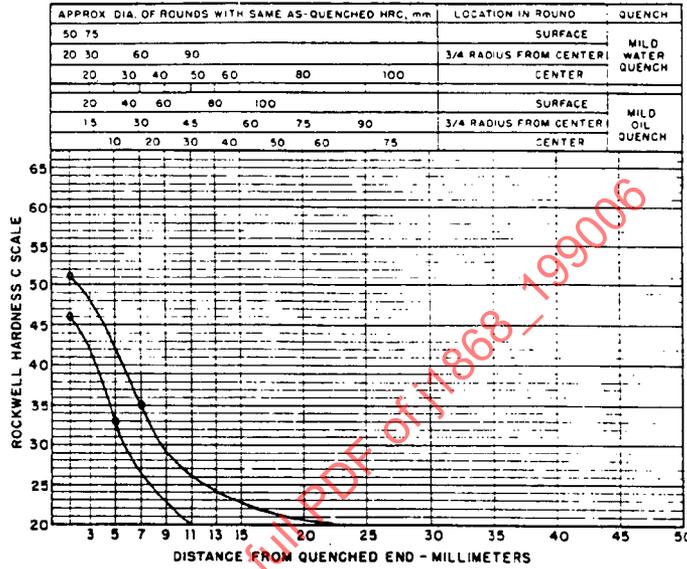


FIGURE 14

SAE 4118RH

HARDENABILITY BAND

%C	%Mn	%Si	%Ni	%Cr	%Mo
0.18/0.23	0.70/0.90	0.15/0.30	--	--	0.08/0.15

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE MILLIMETERS	HRC	
	MAX.	MIN.
1.5	(47)	(42)
3	44	38
5	37	(29)
7	(31)	24
9	28	21
11	25	20
13	24	--
15	23	--
20	20	--
25	--	--
30		
35		
40		
45		
50		

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 925 °C  
AUSTENITIZE 925 °C

\* For forged or rolled specimens only

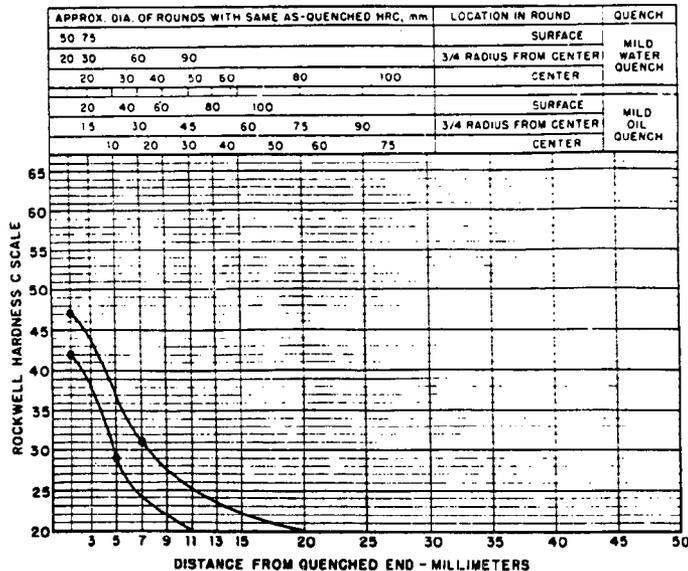


FIGURE 15

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE MILLIMETERS	HRC	
	MAX.	MIN.
1.5	(47)	(42)
3	45	39
5	41	(34)
7	(36)	28
9	32	25
11	29	22
13	28	21
15	26	20
20	23	--
25	21	--
30	--	--
35	--	--
40		
45		
50		

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 925 °C  
AUSTENITIZE 925 °C

\* For forged or rolled specimens only

SAE 4120RH HARDENABILITY BAND

%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

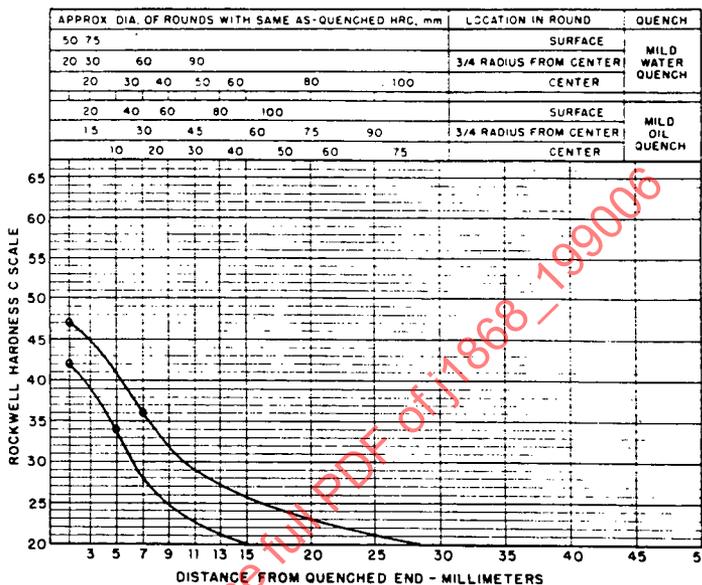


FIGURE 16

SAE 4140RH HARDENABILITY BAND

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

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE MILLIMETERS	HRC	
	MAX.	MIN.
1.5	(59)	(54)
3	59	54
5	59	54
7	59	53
9	58	52
11	56	50
13	55	49
15	54	47
20	51	(42)
25	49	39
30	(48)	38
35	46	37
40	44	36
45	43	35
50	41	33

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 870 °C  
AUSTENITIZE 845 °C

\* For forged or rolled specimens only

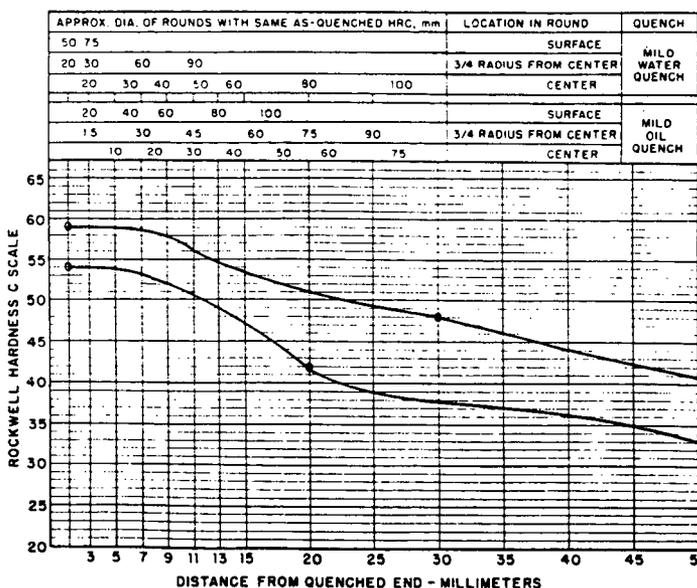


FIGURE 17

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE MILLIMETERS	HRC	
	MAX.	MIN.
1.5	(52)	(57)
3	52	57
5	51	56
7	51	56
9	50	55
11	50	54
13	50	53
15	50	52
20	50	49
25	50	48
30	50	(44)
35	50	42
40	(51)	40
45	50	39
50	49	37

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 870 °C  
 AUSTENITIZE 845 °C

\* For forged or rolled specimens only

SAE 4145RH

HARDENABILITY BAND

%C	%Mn	%Si	%Ni	%Cr	%Mo
0.43/0.48	0.75/1.00	0.15/0.35	--	0.80/1.10	0.15/0.25

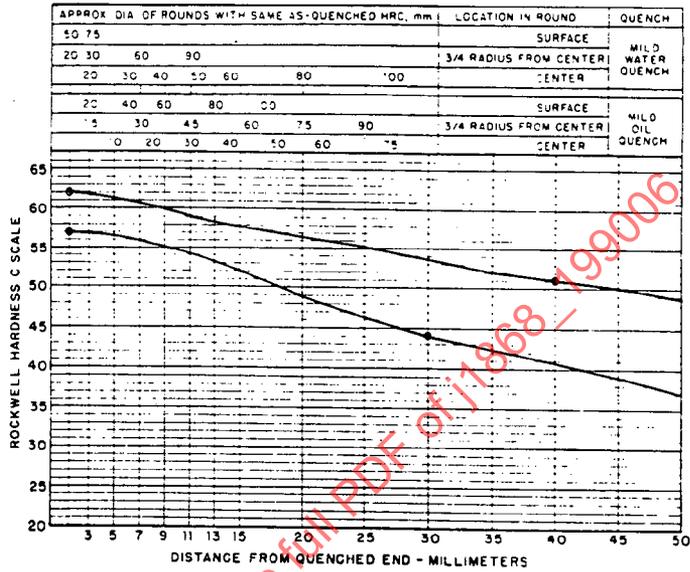


FIGURE 18

SAE 4161RH

HARDENABILITY BAND

%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

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE MILLIMETERS	HRC	
	MAX.	MIN.
1.5	(65)	(60)
3	65	60
5	65	60
7	65	60
9	65	60
11	65	60
13	65	60
15	65	60
20	64	59
25	63	57
30	62	(55)
35	(61)	53
40	59	50
45	58	47
50	57	45

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 870 °C  
 AUSTENITIZE 845 °C

\* For forged or rolled specimens only

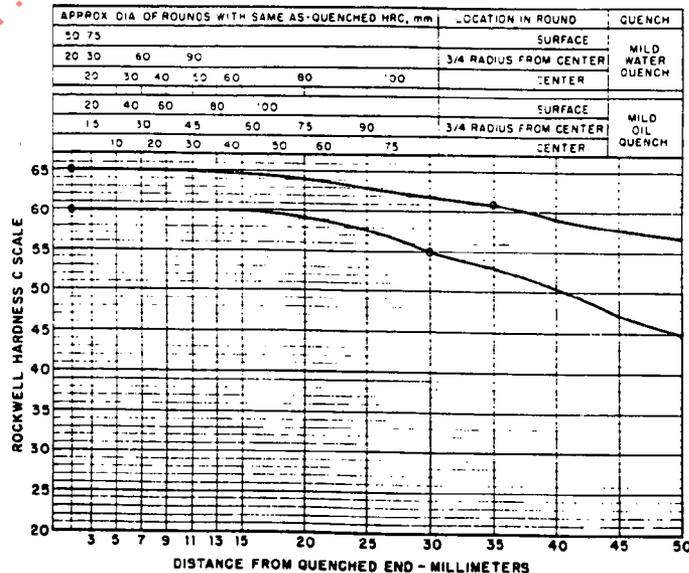


FIGURE 19

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE MILLIMETERS	HRC	
	MAX.	MIN.
1.5	55	50
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	--

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 900 °C  
 AUSTENITIZE 870 °C

\* For forged or rolled specimens only

SAE 5130RH HARDENABILITY BAND

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

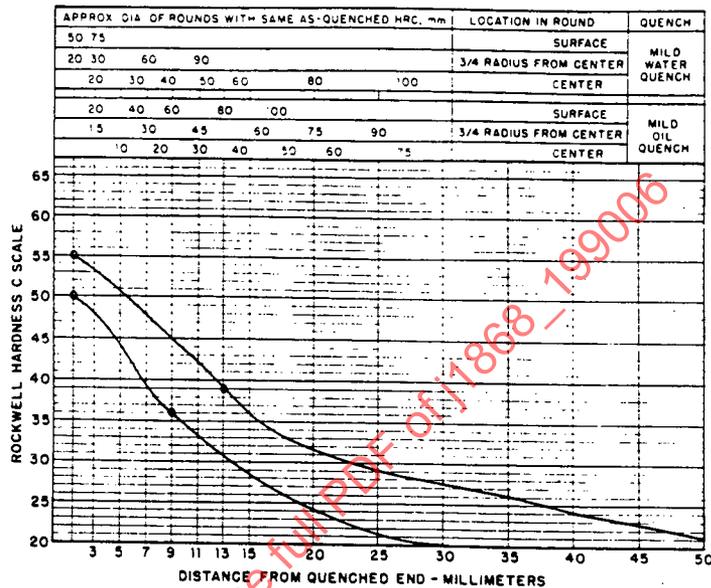


FIGURE 20

SAE 5140RH HARDENABILITY BAND

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

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE MILLIMETERS	HRC	
	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 RECOMMENDED BY SAE

\*NORMALIZE 870 °C  
 AUSTENITIZE 845 °C

\* For forged or rolled specimens only

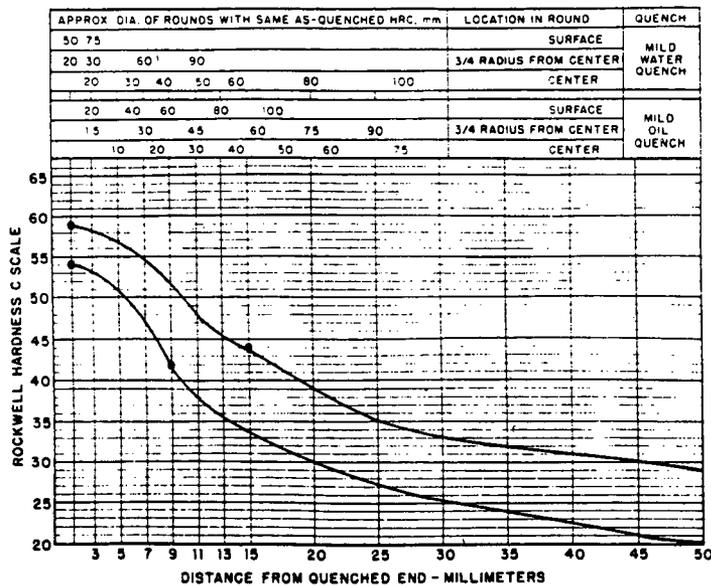


FIGURE 21

SAE 5160RH

**HARDENABILITY BAND**

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

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE MILLIMETERS	HRC	
	MAX.	MIN.
1.5	(65)	(60)
3	65	60
5	65	60
7	65	59
9	63	57
11	62	54
13	60	(49)
15	57	43
20	(52)	38
25	47	36
30	43	34
35	41	32
40	40	31
45	39	30
50	38	29

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 870 °C  
AUSTENITIZE 845 °C

\* For forged or rolled specimens only

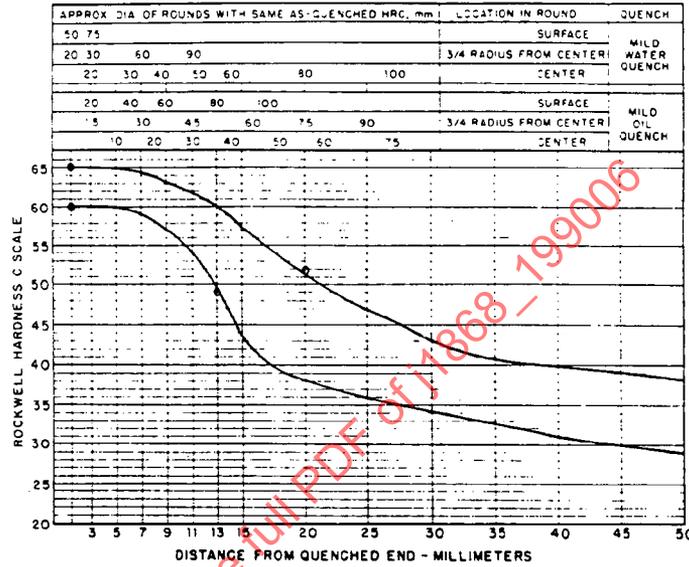


FIGURE 22

SAE 8620RH

**HARDENABILITY BAND**

%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

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE MILLIMETERS	HRC	
	MAX.	MIN.
1.5	(47)	(42)
3	45	39
5	41	(34)
7	(36)	28
9	32	25
11	29	22
13	28	21
15	26	20
20	23	--
25	21	--
30	--	--
35	--	--
40		
45		
50		

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

\*NORMALIZE 925 °C  
AUSTENITIZE 925 °C

\* For forged or rolled specimens only

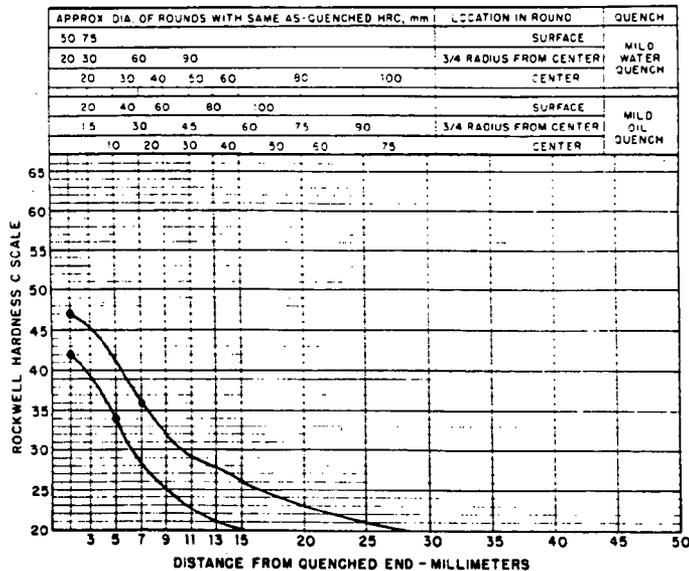


FIGURE 23