Hardenability Bands for Carbon H Steels—SAE J776e

SAE Recommended Practice
Last Revised January 1976

THIS IS A PREPRINT AND WILL
APPEAR IN THE NEXT EDITION
OF THE SAE HANDBOOK

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HARDENABILITY BANDS FOR CARBON H STEELS—SAE J776e

SAE Recommended Practice

Report of Iron and Steel Technical Committee approved June 1961 and last revised January 1976.

[The SAE Iron and Steel Technical Committee established Division 8 in June 1960, to devise hardenability bands for carbon steels. The American Iron and Steel Institute contributed data on several grades of carbon steels and based on these data, bands for two grades of carbon steel were given the status of recommended practice rather than standard. Division 8 will continue to study these two grades and add other grades of carbon steel to the list as sufficient information becomes available.]

The hardenability bands for carbon steels reported in this SAE Recommended Practice are presented in the same manner used for alloy steels and reported in SAE J407. Pertinent sections of this standard are applicable for methods of specifying either hardness limits or distances from quenched end. The bands are applicable to semifinished products for forging, to hot rolled and cold finished bars, to wire rods, and seamless tubing.

For carbon H steels distances from the quenched end may be specified in half-sixteenths (rather than sixteenths as with alloy steels). Use of sixteenths rather than thirty-seconds is continued in this recommended practice to avoid misunderstanding of units.

Hardenability tests should be performed in accordance with the section on Hardenability Test for Shallow Hardening Steels in SAE J406.

TABLE 1—CARBON AND CARBON BORON H STEELS COMPOSITION

SAE or AISI Steel No.	Chemical Composition, %				
	C	Mn	Si	P, max	S, max
1038H	0.34/0.43	0.50/1.00	0.15/0.30	0.040	0.050
1045H	0.42/0.51	0.50/1.00	0.15/0.30	0.040	0.050
1522H	0.17/0.25	1.00/1.50	0.15/0.30	0.040	0.050
1524H	1.25/1.75	1.25/1.75	0.15/0.30	0.040	0.050
1526H	0.21/0.30	1.00/1.50	0.15/0.30	0.040	0.050
1541H	0.35/0.45	1.25/1.75	0.15/0.30	0.040	0.050
15B21H[a]	0.17/0.24	0.70/1.20	0.15/0.30	0.040	0.050
15B35H[a]	0.31/0.39	0.70/1.20	0.15/0.30	0.040	0.050
15B37H[a]	0.30/0.39	1.00/1.50	0.15/0.30	0.040	0.050
15B62H[a]	0.54/0.67	1.00/1.50	0.40/0.60	0.040	0.050

[a] Boron—0.0005 min.

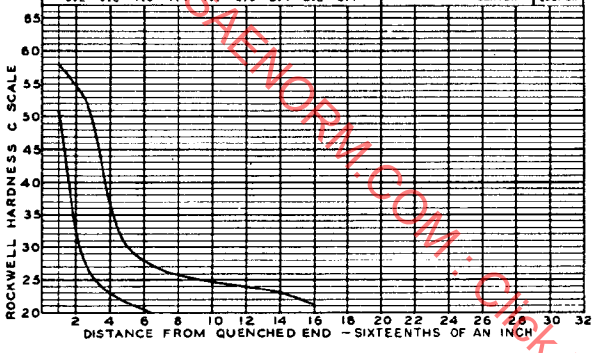
HARDENABILITY BAND 1038H

C	Mn	Si	Ni	Cr	Mo	
0.34/0.43	0.50/1.00	0.15/0.30				

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	H	
	MAX.	MIN.
1	58	51
1.5	56	42
2	55	34
2.5	53	29
3	49	26
3.5	43	24
4	37	23
4.5	33	22
5	30	22
5.5	29	21
6	28	21
6.5	27	20
7	27	-
7.5	26	-
8	26	-
9	25	-
10	25	-
12	24	-
14	23	-
16	21	-

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE
*NORMALIZE 1600 °F
AUSTENITIZE 1550 °F
*For forged or rolled specimens only.

DIAMETERS OF ROUNDS WITH SAME AS QUENCHED HARDNESS	LOCATION IN ROUND	QUENCH
3.8	SURFACE	MILD
1.1 2.0 2.9 3.8 4.8 5.8 6.7	3/4 RADIUS FROM CENTER	WATER
0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9	CENTER	QUENCH
0.8 1.8 2.5 3.0 3.4 3.8	SURFACE	MILD
0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.6 4.0	3/4 RADIUS FROM CENTER	OIL
0.2 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1	CENTER	QUENCH



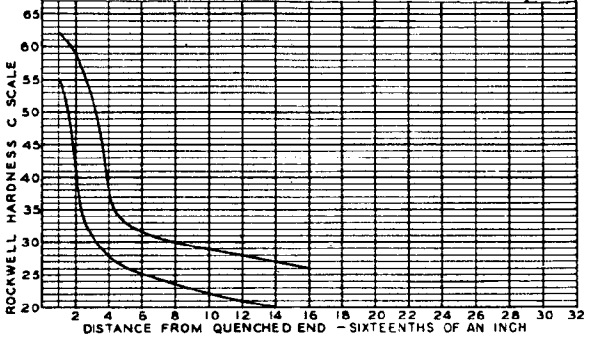
HARDENABILITY BAND 1045H

C	Mn	Si	Ni	Cr	Mo	
0.42/0.51	0.50/1.00	0.15/0.30				

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	H	
	MAX.	MIN.
1	62	55
1.5	61	52
2	59	42
2.5	56	34
3	52	31
3.5	46	29
4	38	28
4.5	34	27
5	33	26
5.5	32	26
6	32	25
6.5	31	25
7	31	25
7.5	30	24
8	30	24
9	29	23
10	29	22
12	28	21
14	27	20
16	26	-

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE
*NORMALIZE 1600 °F
AUSTENITIZE 1550 °F
*For forged or rolled specimens only.

DIAMETERS OF ROUNDS WITH SAME AS QUENCHED HARDNESS	LOCATION IN ROUND	QUENCH
3.8	SURFACE	MILD
1.1 2.0 2.9 3.8 4.8 5.8 6.7	3/4 RADIUS FROM CENTER	WATER
0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9	CENTER	QUENCH
0.8 1.8 2.5 3.0 3.4 3.8	SURFACE	MILD
0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.6 4.0	3/4 RADIUS FROM CENTER	OIL
0.2 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1	CENTER	QUENCH



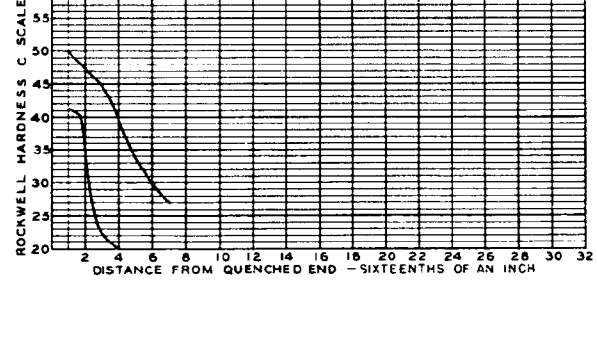
HARDENABILITY BAND 1522H

C	Mn	Si	Ni	Cr	Mo	
0.17/0.25	1.00/1.50	0.15/0.30				

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	H	
	MAX.	MIN.
1	50	41
1.5	48	41
2	47	32
2.5	46	27
3	45	22
3.5	42	21
4	39	20
4.5	37	-
5	34	-
5.5	32	-
6	30	-
6.5	28	-
7	27	-
7.5	-	-
8	-	-
9	-	-
10	-	-
12	-	-
14	-	-
16	-	-

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE
*NORMALIZE 1700 °F
AUSTENITIZE 1700 °F
*For forged or rolled specimens only.

DIAMETERS OF ROUNDS WITH SAME AS QUENCHED HARDNESS	LOCATION IN ROUND	QUENCH
3.8	SURFACE	MILD
1.1 2.0 2.9 3.8 4.8 5.8 6.7	3/4 RADIUS FROM CENTER	WATER
0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9	CENTER	QUENCH
0.8 1.8 2.5 3.0 3.4 3.8	SURFACE	MILD
0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.6 4.0	3/4 RADIUS FROM CENTER	OIL
0.2 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1	CENTER	QUENCH



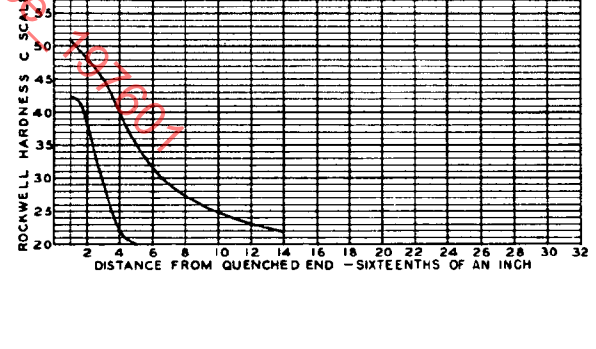
HARDENABILITY BAND 1524H

C	Mn	Si	Ni	Cr	Mo	
0.18/0.26	1.25/1.75	0.15/0.30				

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	h	
	MAX.	MIN.
1	51	42
1.5	49	42
2	48	38
2.5	47	34
3	45	29
3.5	43	25
4	39	22
4.5	38	20
5	35	-
5.5	34	-
6	32	-
6.5	30	-
7	29	-
7.5	28	-
8	27	-
9	26	-
10	25	-
12	23	-
14	22	-
16	-	-

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE
*NORMALIZE 1650 °F
AUSTENITIZE 1600 °F
*For forged or rolled specimens only.

DIAMETERS OF ROUNDS WITH SAME AS QUENCHED HARDNESS	LOCATION IN ROUND	QUENCH
3.8	SURFACE	MILD
1.1 2.0 2.9 3.8 4.8 5.8 6.7	3/4 RADIUS FROM CENTER	WATER
0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9	CENTER	QUENCH
0.8 1.8 2.5 3.0 3.4 3.8	SURFACE	MILD
0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.6 4.0	3/4 RADIUS FROM CENTER	OIL
0.2 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1	CENTER	QUENCH



HARDENABILITY BAND 1526H

C	Mn	Si	Ni	Cr	Mo	
0.21/0.30	1.00/1.50	0.15/0.30				

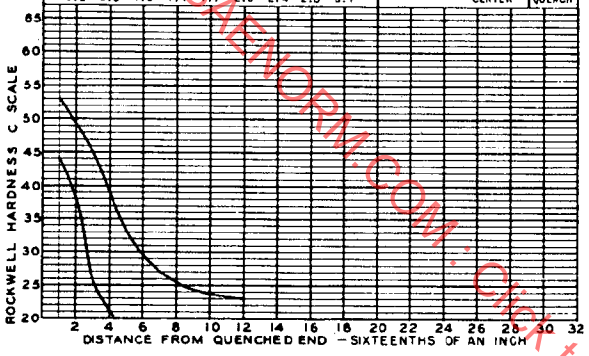
HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	H	
	MAX.	MIN.
1	53	44
1.5	50	42
2	49	38
2.5	47	33
3	46	26
3.5	42	25
4	39	21
4.5	37	20
5	33	-
5.5	31	-
6	30	-
6.5	28	-
7	27	-
7.5	26	-
8	26	-
9	24	-
10	24	-
12	23	-
14	-	-
16	-	-

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

*NORMALIZE	1650 °F
AUSTENITIZE	1600 °F

*For forged or rolled specimens only.

DIAMETERS OF ROUNDS WITH SAME AS QUENCHED HARDNESS*	LOCATION IN ROUND	QUENCH
3.8	SURFACE	MILD
1.1 2.0 2.9 3.8 4.8 5.8 6.7	3/4 RADIUS FROM CENTER	WATER
0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9	CENTER	QUENCH
0.8 1.8 2.5 3.0 3.4 3.8	SURFACE	MILD
0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.6 4.0	3/4 RADIUS FROM CENTER	OIL
0.2 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1	CENTER	QUENCH



HARDENABILITY BAND 1541H

C	Mn	Si	Ni	Cr	Mo	
0.35/0.45	1.25/1.75	0.15/0.30				

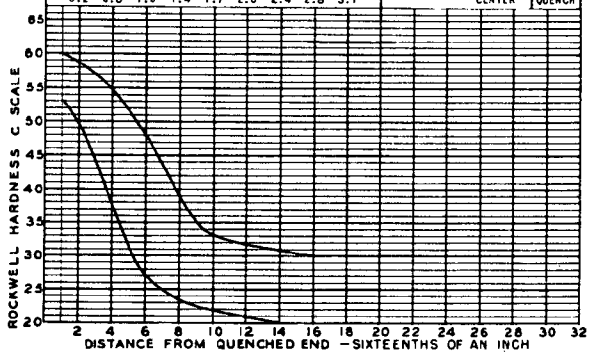
HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	H	
	MAX.	MIN.
1	60	53
1.5	59	52
2	59	50
2.5	58	47
3	57	44
3.5	56	41
4	55	38
4.5	53	35
5	52	32
5.5	50	29
6	48	27
6.5	46	26
7	44	25
7.5	41	24
8	39	23
9	35	23
10	33	22
12	32	21
14	31	20
16	30	-

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

*NORMALIZE	1600 °F
AUSTENITIZE	1550 °F

*For forged or rolled specimens only.

DIAMETERS OF ROUNDS WITH SAME AS QUENCHED HARDNESS*	LOCATION IN ROUND	QUENCH
3.8	SURFACE	MILD
1.1 2.0 2.9 3.8 4.8 5.8 6.7	3/4 RADIUS FROM CENTER	WATER
0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9	CENTER	QUENCH
0.8 1.8 2.5 3.0 3.4 3.8	SURFACE	MILD
0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.6 4.0	3/4 RADIUS FROM CENTER	OIL
0.2 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1	CENTER	QUENCH



HARDENABILITY BAND 15B21 H

C	Mn	Si	Ni	Cr	B	
0.17/0.24	0.70/1.20	0.15/0.30			*	

* Can be expected to be a minimum of 0.0005%.

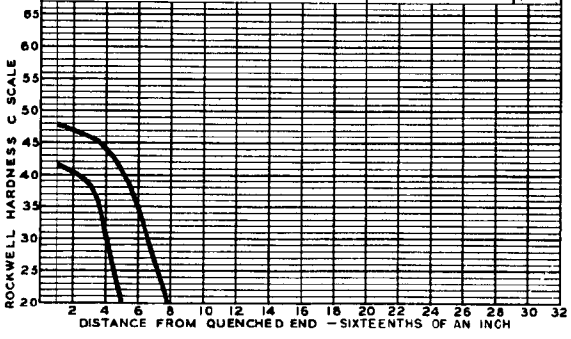
HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	H	
	MAX.	MIN.
1	48	41
1.5	48	41
2	47	40
2.5	47	39
3	46	38
3.5	45	36
4	44	30
4.5	42	23
5	40	20
5.5	38	-
6	35	-
6.5	32	-
7	27	-
7.5	22	-
8	20	-
9	-	-
10	-	-
12	-	-
14	-	-
16	-	-

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

*NORMALIZE	1700 °F
AUSTENITIZE	1700 °F

*For forged or rolled specimens only.

DIAMETERS OF ROUNDS WITH SAME AS QUENCHED HARDNESS	LOCATION IN ROUND	QUENCH
3.8	SURFACE	MILD
1.1 2.0 2.9 3.8 4.8 5.8 6.7	3/4 RADIUS FROM CENTER	WATER
0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9	CENTER	QUENCH
0.8 1.8 2.5 3.0 3.4 3.8	SURFACE	MILD
0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.6 4.0	3/4 RADIUS FROM CENTER	OIL
0.2 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1	CENTER	QUENCH



HARDENABILITY BAND T5B35H

C	Mn	Si	Ni	Cr	Mo	B
0.31/0.39	0.70/1.20	0.15/0.30				*

*Can be expected to have 0.0005 percent minimum Boron content

HARDNESS LIMITS FOR SPECIFICATION PURPOSES		
"J" DISTANCE SIXTEENTHS OF AN INCH	H	
	MAX.	MIN.
1	58	51
2	56	50
3	55	49
4	54	48
5	53	39
6	51	25
7	47	24
8	41	22
9	-	-
10	30	20
11	-	-
12	27	-
13	-	-
14	26	-
15	-	-
16	25	-
18	-	-
20	24	-
22	-	-
24	22	-
26	-	-
28	20	-
30	-	-
32	-	-

HEAT TREATING TEMPERATURES RECOMMENDED BY SAE

*NORMALIZE	1600 °F
AUSTENITIZE	1550 °F

*For forged or rolled specimens only.

DIAMETERS OF ROUNDS WITH SAME AS QUENCHED HARDNESS	LOCATION IN ROUND	QUENCH
3.8	SURFACE	MILD
1.1 2.0 2.9 3.8 4.8 5.8 6.7	3/4 RADIUS FROM CENTER	WATER
0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9	CENTER	QUENCH
0.8 1.8 2.5 3.0 3.4 3.8	SURFACE	MILD
0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.6 4.0	3/4 RADIUS FROM CENTER	OIL
0.2 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1	CENTER	QUENCH