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Hardenability Bands for Carbon H Steels—SAE J776e

SAE Recommended Practice
Last Revised January 1976

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OF THE SAE HANDBOOK

Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096



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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

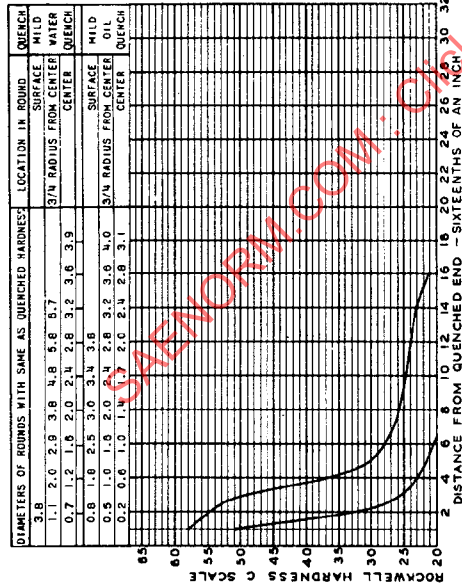
SAE or AISI Steel No.	Chemical Composition, %				
	C	Mn	Si	P, max	S, max
1038H	0.34/0.43	0.50/1.00	0.15/0.30	0.040	0.050
1045H	0.42/0.51	0.50/1.00	0.15/0.30	0.040	0.050
1522H	0.17/0.25	1.00/1.50	0.15/0.30	0.040	0.050
1524H	1.25/1.75	1.25/1.75	0.15/0.30	0.040	0.050
1526H	0.21/0.30	1.00/1.50	0.15/0.30	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

^aBoron—0.0005 min.

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HARDENABILITY BAND 1038H

C	Mn	Si	Ni	Cr	Mo
0.31/0.43	0.50/1.00	0.15/0.30			



HARDNESS LIMITS FOR SPECIFICATION PURPOSES	H	MIN.	MAX.
1	51	52	55
1.5	52	53	56
2	53	54	57
2.5	54	55	58
3	55	56	59
3.5	56	57	60
4	57	58	61
4.5	58	59	62
5	59	60	63
5.5	60	61	64
6	61	62	65
6.5	62	63	66
7	63	64	67
7.5	64	65	68
8	65	66	69
8.5	66	67	70
9	67	68	71
10	68	69	72
11	69	70	73
12	70	71	74
13	71	72	75
14	72	73	76
15	73	74	77
16	74	75	78
17	75	76	79
18	76	77	80
19	77	78	81
20	78	79	82
21	79	80	83
22	80	81	84
23	81	82	85
24	82	83	86
25	83	84	87
26	84	85	88
27	85	86	89
28	86	87	90
29	87	88	91
30	88	89	92
31	89	90	93
32	90	91	94
33	91	92	95
34	92	93	96
35	93	94	97
36	94	95	98
37	95	96	99
38	96	97	100
39	97	98	101
40	98	99	102
41	99	100	103
42	100	101	104
43	101	102	105
44	102	103	106
45	103	104	107
46	104	105	108
47	105	106	109
48	106	107	110
49	107	108	111
50	108	109	112
51	109	110	113
52	110	111	114
53	111	112	115
54	112	113	116
55	113	114	117
56	114	115	118
57	115	116	119
58	116	117	120
59	117	118	121
60	118	119	122
61	119	120	123
62	120	121	124
63	121	122	125
64	122	123	126
65	123	124	127
66	124	125	128
67	125	126	129
68	126	127	130
69	127	128	131
70	128	129	132
71	129	130	133
72	130	131	134
73	131	132	135
74	132	133	136
75	133	134	137
76	134	135	138
77	135	136	139
78	136	137	140
79	137	138	141
80	138	139	142
81	139	140	143
82	140	141	144
83	141	142	145
84	142	143	146
85	143	144	147
86	144	145	148
87	145	146	149
88	146	147	150
89	147	148	151
90	148	149	152
91	149	150	153
92	150	151	154
93	151	152	155
94	152	153	156
95	153	154	157
96	154	155	158
97	155	156	159
98	156	157	160
99	157	158	161
100	158	159	162
101	159	160	163
102	160	161	164
103	161	162	165
104	162	163	166
105	163	164	167
106	164	165	168
107	165	166	169
108	166	167	170
109	167	168	171
110	168	169	172
111	169	170	173
112	170	171	174
113	171	172	175
114	172	173	176
115	173	174	177
116	174	175	178
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118	176	177	180
119	177	178	181
120	178	179	182
121	179	180	183
122	180	181	184
123	181	182	185
124	182	183	186
125	183	184	187
126	184	185	188
127	185	186	189
128	186	187	190
129	187	188	191
130	188	189	192
131	189	190	193
132	190	191	194
133	191	192	195
134	192	193	196
135	193	194	197
136	194	195	198
137	195	196	199
138	196	197	200
139	197	198	201
140	198	199	202
141	199	200	203
142	200	201	204
143	201	202	205
144	202	203	206
145	203	204	207
146	204	205	208
147	205	206	209
148	206	207	210
149	207	208	211
150	208	209	212
151	209	210	213
152	210	211	214
153	211	212	215
154	212	213	216
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156	214	215	218
157	215	216	219
158	216	217	220
159	217	218	221
160	218	219	222
161	219	220	223
162	220	221	224
163	221	222	225
164	222	223	226
165	223	224	227
166	224	225	228
167	225	226	229
168	226	227	230
169	227	228	231
170	228	229	232
171	229	230	233
172	230	231	234
173	231	232	235
174	232	233	236
175	233	234	237
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178	236	237	240
179	237	238	241
180	238	239	242
181	239	240	243
182	240	241	244
183	241	242	245
184	242	243	246
185	243	244	247
186	244	245	248
187	245	246	249
188	246	247	250
189	247	248	251
190	248	249	252
191	249	250	253
192	250	251	254
193	251	252	255
194	252	253	256
195	253	254	257
196	254	255	258
197	255	256	259
198	256	257	260
199	257	258	261
200	258	259	262
201	259	260	263
202	260	261	264
203	261	262	265
204	262	263	266
205	263	264	267
206	264	265	268
207	265	266	269
208	266	267	270
209	267	268	271
210	268	269	272
211	269	270	273
212	270	271	274
213	271	272	275
214	272	273	276
215	273	274	277
216	274	275	278
217	275	276	279
218	276	277	280
219	277	278	281
220	278	279	282
221	279	280	283
222	280	281	284
223	281	282	285
224	282	283	286
225	283	284	287
226	284	285	288
227	285	286	289
228	286	287	290
229	287	288	291
230	288	289	292
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232	290	291	294
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297	355	356	359
298	356	357	360
299	357	358	361
300	358	359	362
301	359	360	363
302	360	361	364
303	361	362	365
304	362	363	366</

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

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

DIAMETERS OF ROUNDS WITH SAME AS QUENCHED HARDNESS		LOCATION IN ROUND		QUENCH		
3.6		SURFACE		MILD		
		3/4" RADIUS FROM CENTER		QUENCH		
1.1	2.0	2.9	3.8	4.8	5.8	6.7
0.7	1.2	1.6	2.0	2.4	3.2	3.6
						3.9
						4.2
						4.5
						4.8
						5.1
						5.4
						5.7
						6.0
						6.3
						6.6
						6.9
						7.2
						7.5
						7.8
						8.1
						8.4
						8.7
						9.0
						9.3
						9.6
						9.9
						10.2
						10.5
						10.8
						11.1
						11.4
						11.7
						12.0
						12.3
						12.6
						12.9
						13.2
						13.5
						13.8
						14.1
						14.4
						14.7
						15.0
						15.3
						15.6
						15.9
						16.2
						16.5
						16.8
						17.1
						17.4
						17.7
						18.0
						18.3
						18.6
						18.9
						19.2
						19.5
						19.8
						20.1
						20.4
						20.7
						21.0
						21.3
						21.6
						21.9
						22.2
						22.5
						22.8
						23.1
						23.4
						23.7
						24.0
						24.3
						24.6
						24.9
						25.2
						25.5
						25.8
						26.1
						26.4
						26.7
						27.0
						27.3
						27.6
						27.9
						28.2
						28.5
						28.8
						29.1
						29.4
						29.7
						30.0
						30.3
						30.6
						30.9
						31.2
						31.5

Temperature (°F)	Rockwell C
100	55
200	52
300	48
400	42
500	35
600	28
700	22
800	20
900	20
1000	20

HEAT TREATING TEMPERATURES
RECOMMENDED BY SAE
*NORMALIZE 1650 OF
AUSTENITIZE 1600 OF

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

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

DIAMETERS OF ROUNDS WITH SAME AS QUENCHED HARDNESS										LOCATION IN ROUND		QUENCH
										SURFACE	CENTER	
										3/4" RADIUS FROM CENTER	CENTER	
3.8	1.1	2.0	2.9	3.8	4.8	5.8	6.7					MILD
0.7	1.2	1.6	2.0	2.4	2.8	3.2	3.6	3.9				WATER
0.8	1.8	2.5	3.0	3.4	3.8							QUENCH
0.5	1.0	1.5	2.0	2.4	2.8	3.2	3.5	4.0				MILD
0.2	0.6	1.0	1.4	1.7	2.0	2.4	2.8	3.1				OIL
												QUENCH

Graph showing Rockwell Hardness C Scale (Y-axis, 20 to 65) versus Distance from End - Sixtenths of an Inch (X-axis, 2 to 30). The graph illustrates the relationship between Rockwell Hardness and distance from the end for various diameters (3.8, 0.7, 0.8, 0.5, 0.2 inches) and quenching media (MILD, WATER, OIL, QUENCH). The hardness generally increases with distance from the end and is higher for larger diameters and oil quenching.

HEAT TREATING TEMPERATURES
RECOMMENDED BY SAE
*NORMALIZE 1600 OF
AUSTENITIZE 1550 OF

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

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 const.

[illegible][illegible]

*For forged or rolled specimens

HARDENABILITY BAND 15835H					
C	Mn	Si	Ni	Cr	Mo
0.31/0.39	0.70/1.20	0.15/0.30			

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

[illegible]

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

ROCKWELL HARDNESS C SCALE

2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38

INCHES FROM QUENCHED END - SIXTEENTHS OF AN INCH

20
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
DISTANCE FROM QUENCHED END - SIXTEENTHS OF AN INCH