

Designation: A 304 - 04

Standard Specification for Carbon and Alloy Steel Bars Subject to End-Quench Hardenability Requirements¹

This standard is issued under the fixed designation A 304; 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 (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

- 1.1 This specification covers hot-worked alloy, carbon, and carbon-boron steels in a variety of compositions and sizes which may attain specified depth of hardening in the end quench test. These steel compositions are identified by the suffix letter "H" added to the conventional grade number.
- 1.2 This specification provides for analyses other than those listed under Table 1 and Table 2. Special hardenability limits are also permissible when approved by the purchaser and manufacturer.
- 1.3 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 ASTM Standards: ²

A 29/A 29M Specification for Steel Bars, Carbon and Alloy, Hot-Wrought, General Requirements for

A 255 Test Method for End-Quench Test for Hardenability of Steel

E 112 Test Methods for Determining Average Grain Size E 527 Practice for Numbering Metals and Alloys (UNS)

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. It 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, carbon, 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,
 - 4.1.11 End use or special requirements, and
 - 4.1.12 Leaded steel, when required.

Note 1—A typical ordering description is as follows: 10 000 lb, alloy bars, round, 4.0 in. dia by 10 ft, Grade 1340H, J 40/56 = %16 in., heat analysis required, ASTM A 304, dated ______, worm gear.

- 4.2 The purchaser shall specify the desired grade, including the suffix letter "H," in accordance with Table 1 or Table 2.
- 4.3 Band limits are shown graphically and as tabulations in Figs. 2-87, inclusive. For specifications purposes, the tabulated values of Rockwell C hardness are used. Values below 20 Rockwell C hardness (20 HRC) are not specified because such values are below the normal range of the C scale. The graphs are shown for convenience in estimating the hardness values obtainable at various locations on the end quench test bar and for various locations in oil or water quenched rounds. The relationship between end-quench distance and bar diameter is approximate and should be used only as a guide.
- 4.4 Two points from the tabulated values are commonly designated according to one of Methods A, B, C, D, or E, which are defined in the following paragraphs. Those various methods are illustrated graphically in Fig. 1.
- 4.4.1 *Method A*—The minimum and maximum hardness values at any desired distance. This method is illustrated in Fig. 1 as points *A-A* and would be specified as 43 to 54 HRC at J3.

¹ 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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² 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.

Obviously the distance selected would be that distance on the end quench test bar which corresponds to the section used by the purchaser.

- 4.4.2 *Method B*—The minimum and maximum distances at which any desired hardness value occurs. This method is illustrated in Fig. 1 as points *B-B* and would be specified as 39 HRC at J4 minimum and J9 maximum. If the desired hardness does not fall on an exact sixteenth position, the minimum distance selected should be the nearest sixteenth position toward the quenched end and the maximum should be the nearest sixteenth position away from the quenched end.
- 4.4.3 *Method C*—Two maximum hardness values at two desired distances, illustrated in Fig. 1 as points *C-C*.
- 4.4.4 *Method D*—Two minimum hardness values at two desired distances, illustrated in Fig. 1 as points *D-D*.
- 4.4.5 *Method E*—Any minimum hardness plus any maximum hardness. When hardenability is specified according to one of the above Methods A to E, the balance of the hardenability band is not applicable.
- 4.5 In cases when it is considered desirable, the maximum and minimum limits at a distance of ½16 in. from the quenched end can be specified in addition to the other two points as previously described in 4.4.1 to 4.4.5, inclusive.
- 4.6 In cases when it is necessary to specify more than two points on the hardenability band (exclusive of the maximum and minimum limits at a distance of ½16 in.), a tolerance of two points Rockwell C (HRC) over any small portion of either curve (except at a distance of ½16 in.) is customary. This tolerance is necessary because curves of individual heats vary somewhat in shape from the standard band limits and thus deviate slightly at one or more positions in the full length of the curves.

5. Manufacture

- 5.1 Melting Practice—The steel shall be made by one or more of the following primary processes: open-hearth, basic-oxygen, or electric-furnace. The primary melting may incorporate separate degassing or 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 of 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 A 29/A 29M, unless otherwise provided for herein.

7. Chemical Composition

- 7.1 The heat analysis shall conform to the requirements as to chemical composition prescribed in Table 1 and Table 2 for the grade specified by the purchaser.
- 7.2 When a steel cannot be identified by a standard grade number in accordance with Table 1 and Table 2, other

compositions may be specified, as agreed upon between the purchaser and the manufacturer. Generally, hardenability bands will not be available for such compositions.

7.3 When requested by the manufacturer, and approved by the purchaser, other steels capable of meeting the purchaser's specified hardenability may be furnished in place of the grade specified by the purchaser.

8. Grain Size Requirements

- 8.1 The steel shall conform to the fine austenitic grain size requirement of Specification A 29/A 29M.
- 8.2 Hardenability values specified herein are based on fine-grain steels and are not applicable to coarse-grain material. In case coarse-grain steel is desired, the hardenability values shall be negotiated between the purchaser and the manufacturer.

9. End-Quench Hardenability Requirements

- 9.1 The end-quench hardenability shall conform to the requirements specified on the purchase order.
- 9.2 The hardenability values shall be specified in accordance with the applicable values in Figs. 2-87 inclusive for the grade specified. See Fig. 1 for method of specifying hardenability.
- 9.3 When agreed upon between the purchaser and manufacturer, special hardenability limits may be ordered and shall be reflected on the purchase order.

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 or 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 E 112.
- 11.2 End-quench Hardenability—Test Method A 255.

12. Certification and Reports of Testing

- 12.1 When the full H-band is specified for alloy steels, the hardenability can be reported by listing hardness values at the following distances from the quenched end of the test specimen: 1 through 16 sixteenths, then 18, 20, 22, 24, 28, and 32 sixteenths of an inch.
- 12.2 Tables 2-18 in Test Methods A 255 are to be used to calculate hardenability from the chemical ideal diameter for the grades shown in 10.1 of Test Methods A 255. Hardenability results are to be reported for the first 10 sixteenths (16 mm), then 12, 14, 16, 18, 20, 24, 28, and 32 sixteenths of an inch.
- Note 2—The reporting hardenability using the calculated method differs from the procedure shown in 6.4 of Test Methods A 255.
- 12.3 For carbon H-steels, distances from the quenched end may be reported by listing sixteenths or half sixteenths (rather than full sixteenths only as with alloy steels). Units of sixteenths rather than thirty-seconds are followed for all steels



to avoid misunderstanding. When the full H-band is specified half sixteenths through 8 may be reported, as well as the distances listed in 12.1.

13. Keywords

13.1 alloy steel bars; carbon steel bars; end quench hardenability; steel bars

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this specification since the last issue, A 304 - 96, that may impact the use of this specification.

(1) New section 12.2 added.

(2) Previous section 12.2 renumbered as 12.3.

TABLE 1 Chemical Requirements of Alloy H Steels^A

Note 1— Phosphorus and sulfur in open-hearth steel is 0.035 %, max, and 0.040 %, max respectively. Phosphorus and sulfur in electric-furnace steel (designated by the prefix letter "E") is 0.025 %, max.

Note 2—Small quantities of certain elements are present in alloy steels which 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 A 29/A 29M.

Note 4—Standard "H" Steels can be produced with a lead range of 0.15–0.35 %. Such steels are identified by inserting the letter "L" between the second and third numerals of the grade designation, for example, 41L40H. Lead is generally reported as a range of 0.15–0.35 %.

UNS Desig-	Grade Designation			Chemical Con	nposition, %		
nation ^A		Carbon	Manganese	Silicon	Nickel	Chromium	Molybdenun
H 13300	1330 H	0.27-0.33	1.45-2.05	0.15-0.35			
H 13350	1335 H	0.32-0.38	1.45-2.05	0.15-0.35			
H 13400	1340 H	0.37-0.44	1.45-2.05	0.15-0.35			
H 13450	1345 H	0.42-0.49	1.45–2.05	0.15-0.35			
H 40270	4027 H	0.24-0.30	0.60-1.00	0.15-0.35			0.20-0.30
H 40280	4028 H ^B	0.24-0.30	0.60-1.00	0.15-0.35			0.20-0.30
H 40320	4032 H	0.29-0.35	0.60-1.00	0.15-0.35			0.20-0.30
H 40370	4037 H	0.34-0.41	0.60-1.00	0.15-0.35			0.20-0.30
H 40420	4042 H	0.39-0.46	0.60-1.00	0.15-0.35			0.20-0.30
H 40470	4047 H	0.44-0.51	0.60-1.00	0.15-0.35			0.20-0.30
H 41180	4118 H	0.17-0.23	0.60-1.00	0.15-0.35		0.30-0.70	0.08-0.15
H 41300	4130 H	0.27-0.33	0.30-0.70	0.15-0.35		0.75-1.20	0.15-0.25
H 41350	4135 H	0.32-0.38	0.60-1.00	0.15-0.35		0.75-1.20	0.15-0.25
H 41370	4137 H	0.34-0.41	0.60-1.00	0.15-0.35		0.75-1.20	0.15-0.25
H 41400	4140 H	0.37-0.44	0.65-1.10	0.15-0.35		0.75-1.20	0.15-0.25
H 41420	4142 H	0.39-0.46	0.65-1.10	0.15-0.35		0.75-1.20	0.15-0.25
H 41450	4145 H	0.42-0.49	0.65-1.10	0.15-0.35		0.75-1.20	0.15-0.25
H 41470	4147 H	0.44-0.51	0.65-1.10	0.15-0.35		0.75-1.20	0.15-0.25
H 41500	4150 H	0.47-0.54	0.65-1.10	0.15-0.35		0.75-1.20	0.15-0.25
H 41610	4161 H	0.55-0.65	0.65-1.10	0.15-0.35		0.65-0.95	0.25-0.35
H 43200	4320 H	0.17-0.23	0.40-0.70	0.15-0.35	1.55–2.00	0.35-0.65	0.20-0.30
H 43400	4340 H	0.37-0.44	0.55-0.90	0.15-0.35	1.55-2.00	0.65-0.95	0.20-0.30
H 43406	E4340 H	0.37-0.44	0.60-0.95	0.15-0.35	1.55-2.00	0.65-0.95	0.20-0.30
H 44190	4419 H	0.17-0.23	0.35-0.75	0.15-0.35			0.45-0.60
H 46200	4620 H	0.17-0.23	0.35-0.75	0.15-0.35	1.55-2.00		0.20-0.30
H 46210	4621 H	0.17-0.23	0.60-1.00	0.15-0.35	1.55–2.00		0.20-0.30
H 46260	4626	0.23-0.29	0.40-0.70	0.15-0.35	0.65-1.05		0.15-0.25
H 47180	4718 H	0.15-0.21	0.60-0.95	0.15-0.35	0.85-1.25	0.30-0.60	0.30-0.40
H 47200	4720 H	0.17-0.23	0.45-0.75	0.15-0.35	0.85-1.25	0.30-0.60	0.15-0.25
H 48150	4815 H	0.12-0.18	0.30-0.70	0.15-0.35	3.20-3.80		0.20-0.30
H 48170	4817 H	0.14-0.20	0.30-0.70	0.15-0.35	3.20-3.80		0.20-0.30
H 48200	4820 H	0.17-0.23	0.40-0.80	0.15-0.35	3.20-3.80	•••	0.20-0.30
H 50401	50B40 H ^C	0.37-0.44	0.65-1.10	0.15-0.35		0.30-0.70	
H 50441	50B44 H ^C	0.42-0.49	0.65-1.10	0.15-0.35		0.30-0.70	



UNS Desig-	Grade Designation			Chemical Cor	nposition, %		
nation ^A		Carbon	Manganese	Silicon	Nickel	Chromium	Molybdenum
H 50460	5046 H	0.43-0.50	0.65-1.10	0.15-0.35		0.13-0.43	
H 50461	50B46 H ^C	0.43-0.50	0.65-1.10	0.15-0.35		0.13-0.43	
H 50501	50B50 H ^C	0.47-0.54	0.65-1.10	0.15-0.35		0.30-0.70	
H 50601	50B60 H ^C	0.55-0.65	0.65-1.10	0.15-0.35		0.30-0.70	•••
H 51200	5120 H	0.17-0.23	0.60-1.00	0.15-0.35		0.60-1.00	
H 51300	5130 H	0.27-0.33	0.60-1.10	0.15-0.35		0.75-1.20	
H 51320	5132 H	0.29-0.35	0.50-0.90	0.15-0.35		0.65-1.10	
H 51350	5135 H	0.32-0.38	0.50-0.90	0.15-0.35		0.70-1.15	
H 51400	5140 H	0.37-0.44	0.60-1.00	0.15-0.35		0.60-1.00	
H 51450	5145 H	0.42-0.49	0.60-1.00	0.15-0.35		0.60-1.00	
H 51470	5147 H	0.45-0.52	0.60-1.05	0.15-0.35		0.80-1.25	
H 51500	5150 H	0.47-0.54	0.60-1.00	0.15-0.35		0.60-1.00	
H 51550	5155 H	0.50-0.60	0.60-1.00	0.15-0.35		0.60-1.00	
H 51600	5160 H	0.55-0.65	0.65–1.10	0.15-0.35		0.60-1.00	
H 51601	51B60H ^C	0.55-0.65	0.65-1.10	0.15-0.35		0.60-1.00	
		0.00 0.00					
H 61180	6118 H ^D	0.15-0.21	0.40-0.80	0.15-0.35		0.40-0.80	
H61500	6150 H ^E	0.47-0.54	0.60-1.00	0.15-0.35		0.75–1.20	
H 81451	81B45 H ^C	0.42-0.49	0.70-1.05	0.15-0.35	0.15-0.45	0.30-0.60	0.08-0.15
H 86170	8617 H	0.14-0.20	0.60-0.95	0.15-0.35	0.35-0.75	0.35-0.65	0.15-0.25
H 86200	8620 H	0.17-0.23	0.60-0.95	0.15-0.35	0.35-0.75	0.35-0.65	0.15-0.25
H 86220	8622 H	0.19-0.25	0.60-0.95	0.15-0.35	0.35-0.75	0.35-0.65	0.15-0.25
H 86250	8625 H	0.22-0.28	0.60-0.95	0.15-0.35	0.35-0.75	0.35-0.65	0.15-0.25
H 86270	8627 H	0.24-0.30	0.60-0.95	0.15-0.35	0.35-0.75	0.35-0.65	0.15-0.25
H 86300	8630 H	0.27-0.33	0.60-0.95	0.15-0.35	0.35-0.75	0.35-0.65	0.15-0.25
H 86301	86B30 H	0.27-0.33	0.60-0.95	0.15-0.35	0.35-0.75	0.35-0.65	0.15-0.25
H 86370	8637 H	0.34-0.41	0.70-1.05	0.15-0.35	0.35-0.75	0.35-0.65	0.15-0.25
H 86400	8640 H	0.37-0.44	0.70-1.05	0.15-0.35	0.35-0.75	0.35-0.65	0.15-0.25
H 86420	8642 H	0.39-0.46	0.70-1.05	0.15-0.35	0.35-0.75	0.35-0.65	0.15-0.25
H 86450	8645 H	0.42-0.49	0.70-1.05	0.15-0.35	0.35-0.75	0.35-0.65	0.15-0.25
H 86451	86B45 H ^C	0.42-0.49	0.70-1.05	0.15-0.35	0.35-0.75	0.35-0.65	0.15-0.25
H 86500	8650 H	0.47-0.54	0.70-1.05	0.15-0.35	0.35-0.75	0.35-0.65	0.15-0.25
H 86550	8655 H	0.50-0.60	0.70-1.05	0.15-0.35	0.35-0.75	0.35-0.65	0.15-0.25
H 86600	8660 H	0.55-0.65	0.70-1.05	0.15-0.35	0.35-0.75	0.35-0.65	0.15-0.25
H 87200	8720 H	0.17-0.23	0.60-0.95	0.15-0.35	0.35-0.75	0.35-0.65	0.20-0.30
H 87400	8740 H	0.37-0.44	0.70-1.05	0.15-0.35	0.35-0.75	0.35-0.65	0.20-0.30
H 88220	8822 H	0.19-0.25	0.70-1.05	0.15-0.35	0.35-0.75	0.35-0.65	0.30-0.40
H 92600	9260 H	0.55-0.65	0.65-1.10	1.70-2.20			
H 93100	9310 H	0.07-0.13	0.40-0.70	0.15-0.35	2.95-3.55	1.00-1.45	0.08-0.15
H 94151	94B15 H ^C	0.12-0.18	0.70-1.05	0.15-0.35	0.25-0.65	0.25-0.55	0.08-0.15
H 94171	94B17 H ^C	0.14-0.20	0.70-1.05	0.15-0.35	0.25-0.65	0.25-0.55	0.08-0.15
H 94301	94B30 H ^C	0.27-0.33	0.70-1.05	0.15-0.35	0.25-0.65	0.25-0.55	0.08-0.15

ANew designations established in accordance with Practice E 527 and SAE J 1086, Recommended Practice for Numbering Metals and Alloys (UNS).

Baselful Content range is 0.035 to 0.050 %.

Chese steels can be expected to have a 0.0005 % min boron content.

Vanadium content range is 0.10 to 0.15 %.

Minimum vanadium content is 0.15 %.

TABLE 2 Chemical Requirements of Carbon H-Steels^A

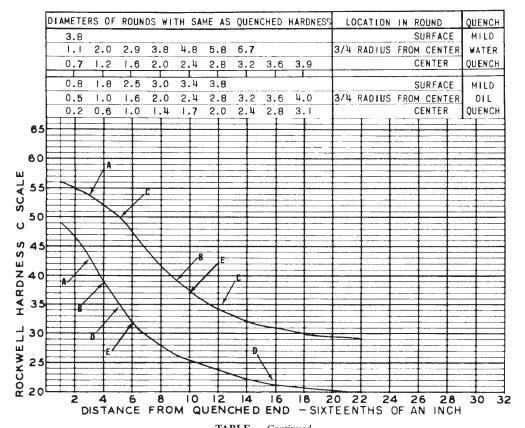
UNS Designation ^B	Grade Designation		Che	emical Composition, %		
		Carbon	Manganese	Phosphorus,	Sulfur,	Silicon
				max	max	
10380	1038 H	0.34-0.43	0.50-1.00	0.040	0.050	0.15-0.30
10450	1045 H	0.42-0.51	0.50-1.00	0.040	0.050	0.15-0.30
l 15220	1522 H	0.17-0.25	1.00-1.50	0.040	0.050	0.15-0.30
l 15240	1524 H	0.18-0.26	1.25-1.75	0.040	0.050	0.15-0.30
15260	1026 H	0.21-0.30	1.00-1.50	0.040	0.050	0.15-0.30
15410	1541 H	0.35-0.45	1.25–1.75	0.040	0.050	0.15-0.30
15211 ^C	15B21 H ^C	0.17-0.24	0.70-1.20	0.040	0.050	0.15-0.30
15351 ^C	15B35 H ^C	0.31-0.39	0.70-1.20	0.040	0.050	0.15-0.30
15371 ^C	15B37 H ^C	0.30-0.39	1.00-1.50	0.040	0.050	0.15-0.30
15411 ^C	15B41 H ^C	0.35-0.45	1.25-1.75	0.040	0.050	0.15-0.30
15481 ^C	15B48 H ^C	0.43-0.53	1.00-1.50	0.040	0.050	0.15-0.30
l 15621 ^C	15B62 H ^C	0.54-0.67	1.00-1.50	0.040	0.050	0.40-0.60

A Standard H Steels can be produced with a lead range of 0.15–0.35 %. Such steels are identified by inserting the letter "L" between the second and third numerals of the grade designation, for example, 15L22 H. Lead is generally reported as a range of 0.15–0.35 %.

B New designations established in accordance with Practice E 527 and SAE J 1086, Recommended Practice for Numbering Metals and Alloys (UNS).

^CThese steels can be expected to have 0.0005 % min boron content.

Hardenability Band



	Method	Points on	Example—End Quench
		Charts	Hardenability
A	Minimum and maximum hardness values at a designated distance	A-A	HRC 43 to 54 at J3
В	A hardness value at minimum and maximum distances	B-B	HRC 39 at J4 minumum and J9 maximum
С	The maximum hardness values at two designated distances	C-C	HRC50 at J5 maximum HRC 34 at J12 maximum
D	Two minimum hardness values at two distances	D-D	HRC 35 at J5 minimum HRC 21 at J16 minimum
Е	Any minimum hardness plus any maximum hardness	E-E	HRC 32 at J6 minimum HRC 37 at J10 maximum

FIG. 1 Examples Illustrating Alternative Method of Specifiying Hardenability Requirements (tabulated hardness values are used in ordering)



HARDENABILITY BAND 1330 H HARDNESS LIMITS FOR SPECIFICATION PURPOSES Mn Si 0.27 1330 M 1.45/2.05 0.15/0.35 56 56 55 53 19 17 11 10 DIAMETERS OF ROUNDS WITH SAME AS QUENCHED HARDNESS LOCATION IN ROUND LOCATION IN ROUND QUENCH
SURFACE HILD
3/4 RADIUS FROM CENTER QUENCH
CENTER QUENCH 3.8 1.1 2.0 2.9 3.8 4.8 5.8 6.7 35 31 28 26 52 50 48 45 0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9 0.8 1.8 2.5 3.0 3.4 3.8 0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.6 4.0 0.2 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1 SURFACE 3/4 RADIUS FROM CENTER CENTER MILD R DIL QUENCH 43 42 40 39 25 23 22 21 20 38 37 36 35 13 14 15 16 ა ⁵⁰ 34 33 32 31 SSUNCE SE 26 28 30 32 31. HEAT TREATING TEMPERATURES RECOMMENDED BY SAE "NORMALIZE 1650 OF AUSTENITIZE 1600 OF *For forced or rolled specimens only.

 $Note - 1 \; in. = 25.4 \; mm.$ FIG. 2 Limits for Hardenability Band 1330 H

HARDENABILITY BAND 1335 H HARDNESS LIMITS FOR SPECIFICATION PURPOSES Mn Si "J" DISTANCE SIXTEENTHS OF AN INCH 32/_{0.38} 1.45/_{2.05} 0.15/_{0.35} 1335 H 0.32/ 58 57 56 55 5! 49 47 44 54 52 50 48 38 34 31 29 0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9 0.8 1.8 2.5 3.0 3.4 3.8 SURFACE MILD 3/4 RADIUS FROM CENTER OIL CENTER QUENCH 27 26 25 24 9 10 11 12 40 39 38 37 23 22 22 21 13 14 15 16 20 35 34 33 32 18 20 22 24 31 30 30 HEAT TREATING TEMPERATURES RECOMMENDED BY SAE
"NORMALIZE 1600 OF
AUSTENITIZE 1550 OF For farged or folled specimens only.

Note -1 in. = 25.4 mm.

FIG. 3 Limits for Hardenability Band 1335 H



HARDENABILITY BAND ___ 1340_H HARDNESS LIMITS FOR SPECIFICATION PURPOSES 0.37/0.44 1.45/2.05 0.15/0.35 53 52 51 49 60 60 59 58 3.8 1.1 2.0 2.9 3.8 4.8 5.8 6.7 0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9 0.8 1.8 2.5 3.0 3.4 3.8 0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.6 4.0 0.2 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1 57 56 55 54 46 40 35 33 SURFACE HILD 3/4 RADIUS FROM CENTER CENTER 31 29 28 27 44 44 41 26 25 25 24 18 14 15 16 39 38 37 36 23 23 22 22 18 20 22 24 HEAT TREATING TEMPERATURES
RECOMMENDED BY SAE
"NORMALIZE 1600 °F
AUSTENITIZE 1550 °F *For forged or rolled specimens only. 4 6 8 10 12 14 16 DISTANCE FROM QUENCHED END 18 20 22 24 26 28 - SIXTEENTHS OF AN INCH

 $\label{eq:Note-1} Note-1 \ \mbox{in.} = 25.4 \ \mbox{mm}.$ FIG. 4 Limits for Hardenability Band 1340 H

<u> </u>	45_H						ī.	Si					С		r			SS LIMITS 1 CATION PURP	
	-			-					0.15	, 	1.45			0.4	- }		II	1345	J" BISTANCE
							35	/o.;	0.1	2.05			/o.	U.4			MIH.	MAX-	SIXTEENTES OF AN INCH
				_					L				/		L		56	63	- 1
																	56	63	2
OUE	DUND	N EN I	CATIO	LO	DNESS	D HAR	NCHE	OUI	AME A	WITH:	OUNDS	OF R	TERS	AHE	- 6		55	62	3
HII	URFACE												я	3.	- 1		54	61	4
R WAT	CENTE	S FRO	RADIU	3/4			7	6.	5.6	8 4.	.9 3	0 2	1 2.		ı		51	61	
OUE	ENTER	_		-	9	6 3.	2 3.	3.	2.8	0 2.	.6 2	2 1	7 1	0.	r		44	60	
-							Ť	Ť	. 1						- 1		38	60	;
	URFACE								3.6	0 3.	.5 3	.8 2	8 1	_0.			35	59	: 1
	CENTE		RADIU	3/4			23.				.6 2			0.	L				
QUE	ENTER		_		. 1	8 3	1 2.	2.	2.0	¥ 1.	.0 1	.6 1	2 0	٠0.	L		33	58	
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-	\vdash	!						-	-		-			#	٠,		31	56	
			-					_	- †					+	60		30	_ 55	12
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$=$ \mp		-	1				=	-1		\rightarrow	<u> </u>			1	- 1		24	45	32
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8 30	6 28	24 2	22 2	0 2	8 2			- 1	2 12		6	t_	느	۲	205	ြင္ဆ	- '		AUSIERI or forged or

Note -1 in. = 25.4 mm.

FIG. 5 Limits for Hardenability Band 1345 H



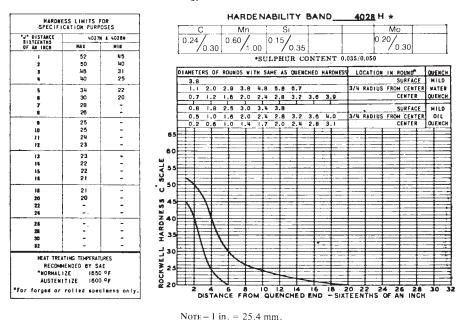


FIG. 6 Limits for Hardenability Band 4027 H and 4028 H

	SS LIMITS F										BAND	_	032				
J" DISTANCE	4032 1			-	_C_		Mn_		Si	-			-	M	,		
SIXTEENTHS -	ALL	MIR		0	.29 /	0.6			15/0	26			C	0.20	0.00		
1.1	57	50		!	/0.3	55	/ 1.00	i i	/ 0	.35					0.30		
2	54	45															
	51	36		DIAN	ETERS (F ROUND	SWITH	SAME	45 0	ENCHE	HARDNES	4 10	CATIO	H IN F	Out to	1,	WENC
•	148	29			3.8	- NOONE	<u> </u>	UKI-IE	22 4	LHCHL	HANDRES	9 100	CALLO		URFAC		HILL
-	39	25			1,1 2,0	2.9	3.B 4	.8 5	.8 6	7		3/11	BADIO		CENT		WATE
: 1	34	23		}	0.7 1.1						6 3.9	3/4 /	MAD I U.		ENTER		UENC
7	31	22			/. / '				10 3	1 1	3.9	1			LH I CH	- LY	UENC
	29	21			0.8 1.1	2.5	3.0 3	.4 3	.0			I		5	SURFAC	E	MILI
					0.5 1.0	1.6	2.0 2	.4 2		.2 3.		3/4	RADIU	S FROM	CENT	ER	OIL
	28	20			0.2	1.0	1.4 1	.7 2	.0 2	.4 2.	8 3.1	T		(ENTER	·] 0	UEN
10	26	-	6	5₩	++								I	I -			L
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12	20	-	60	ı≡			_	=	1			+		!	-		1-
13	24	- 1		Έ	1			-						Ι			Ε
14	24	-	ء تر		++			! ==	-	-		+	1	1		_	1
15	23	-	SCALE	7	1	_	\rightarrow		!		\Rightarrow	+-	1				+
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16	23		5 ن ت	° ⊢	+		-					1					-
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22	22		54	•									I	1			-
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			Z 4		11	\leftarrow	+	<u> </u>	-		-	+	-	-	=	=	+
26	21	-	NOW Y		\perp	VI			<u> </u>		=	-	1	Ŀ		_	1
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92			금하	ıЩ	\perp \vee	-13		<u> </u>	I .			1	1	1			1
HEAT TREA	TING TEMPERATI	URES	7, 2,		1 7		\checkmark	ΕΞ	-								1-
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r forged or			£ 2	,	2 4	6	-	10	2 1	4 1	5 16	20 2	-	4 2	6 2		30

 $Note-1 \ in. = 25.4 \ mm.$ FIG. 7 Limits for Hardenability Band 4032 H



HARDENABILITY BAND 4037 H HARDNESS LIMITS FOR SPECIFICATION PURPOSES Si 4037 M 0.20/0.30 0.34/0.41 0.60/1.00 0.15/0.35 MIN 59 57 54 51 52 49 42 35 45 38 34 32 30 26 23 22 SURFACE 3/4 RADIUS FROM CENTER CENTER MILD R OIL QUENCH 20 26 26 26 25 25 25 25 24 24 24 23 23 25 WELL HEAT TREATING TEMPERATURES. RECOMMENDED BY SAE *NORMAL12E 1600 °F AUSTENITIZE 1550 °F 2 4 6 8 10 12 14 16 18 20 22 24 26 28 DISTANCE FROM QUENCHED END -SIXTEENTHS OF AN INCH *For forged or rolled specimens only.

 $\label{eq:Note-1} Note-1 \ in. = 25.4 \ mm.$ FIG. 8 Limits for Hardenability Band 4037 H

	SS LIMITS FO			_					- 14 %						042	-n Mo	,		
J. DISTANCE	4042 H			-	С,	-			+	Si	-		-		-				_
SIXTEENTHS OF AN INCH	MAX	MIR		0.			0.60		0.1						0.	20/0	20		
ı	52	55		L	/ U	46	/	1.00	IJ	/ 0.	35					- 0	.50		
2	60	52																_	
3	58	48		DIAM	ETERS	OF R	OUNDS	WITH	SAME	AS QL	ENCHE	D HAP	DNESS	LO	CATION	IN R	OUND	QUE	ENC
4	55	40		3	.a											S	URFACE	H	ILI
	50	33				.0 2	.9 3	.в 4	.8 5	.8 6	.7			3/4 /	RADIUS	FROM	CENTE	R WA	TE
•	115	29			.7 1	2 1	.8 2	0 2	.4 2	.8 3	2 3	.6 3	9			C	ENTER	Tour	ENO
•					Ĺ		1												
(39	27 26		0	.B I	8 2		.0 з									URFACE		
	36			0			.6 2				.2_3			3/4	RADIUS		CENTE		11
9	34	25			.2 0	.6 1	.0 1	, ų I	.7 2	.0 2	.4 2	.8 3	. 1	L		Ç	ENTER	QUE	EM
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14	30	23	ш	=	+	-	+	=		-	-	=		_	=			=	=
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		o _F	Ŋ	⊞				-	-	=			-					\exists	Ξ
or forged or		-	₩ 20		2 .	4	6	8	0 1	2 1	4 1	6		0 2	2 2	4 2	6 28	30	~

 $\label{eq:Note-1} Note-1 \ in. = 25.4 \ mm.$ FIG. 9 Limits for Hardenability Band 4042 H



HARDENABILITY BAND ___4047 H HARDNESS LIMITS FOR SPECIFICATION PURPOSES Мо 0.20/0.30 4/ 0.60/ 0.51 1.00 0.15/0.35 64 62 60 58 57 55 50 42 55 52 47 43 35 32 30 28 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9 1.8 2.5 3.0 3.4 3.8 1.0 1.6 2.0 2.4 2.8 3.2 3.6 4.0 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1 QUENCH SURFACE MILD 3/4 RADIUS FROM CENTER OIL CENTER QUENCH 28 27 26 26 40 38 37 35 34 33 33 32 25 25 25 25 25 24 24 23 23 30 29 29 29 22 22 21 26 28 30 32 30 80CK WELL HEAT TREATING TEMPERATURES RECOMMENDED BY SAE "NORMALIZE 1600 °F AUSTENITIZE 1550 °F For forged or rolled specimens only. 4 6 8 10 12 14 16 18 20 22 24 26 28 DISTANCE FROM QUENCHED END - SIXTEENTHS OF AN INCH

FIG. 10 Limits for Hardenability Band 4047 H

Note - 1 in. = 25.4 mm.

	SS LIMITS F CATION PURPO										11	BAN	<u>'</u> —		110				
"J" DISTANCE	4118 8				C,		Mn		8				<u> </u>	Cr	-	_Mc	,		
SIXTEENTHS -	MAX	MIN		0.13			60 /		0.15,				0.3			.08 /			
2	#0 #8	¥1 36 27		DIAN	O.2			.00		0.3		IED HAI	ROWESS	/0.		/ C	0.15	Tour	ENCI
	35	23			.8									1			URFAC		ILD
5	31 28	20		$\overline{}$								3.6 3	. 9	3/4	RADIU		CENTER		TER ENC
7	27	-		0	.8 (.8 2	.5 3	.0 3	.4 3	.в		-		-			SURFAC	F 10	1 L D
8	25			_							3.2 3	3.6 - 4	.0	3/4	RADIU		CENT)IL
10	24	- 1					.0 1	.ų i	.7 2	.0	2.¥ 2	2.8 3					ENTER	QUI	ENC
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12	21	- !								=	\equiv			-	=				_
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32	-	-			\blacksquare	1													
		o _F	ROCKWELL S S S S					_											

 $Note-1 \ in. = 25.4 \ mm.$ FIG. 11 Limits for Hardenability Band 4118 H



HARDENABILITY BAND ____4130_H HARDNESS LIMITS FOR SPECIFICATION PURPOSES C Mn Si Cr Mo 4130 H 0.27/0.33 0.30/0.70 0.15/0.35 0.75/1.20 0.15/0.25 46 46 42 38 55 55 53 51 DIAMETERS OF ROUNDS WITH SAME AS QUENCHED HARDNESS LOCATION IN ROUND QUENCH 3.8 SURFACE MILD 3.8 1.1 2.0 2.9 3.8 4.8 5.8 6.7 0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9 0.8 1.8 2.5 3.0 3.4 3.8 SURFACE MILD 3/4 RADIUS FROM CENTER WATER CENTER QUENCH 49 47 44 42 34 31 29 27 SURFACE 3/4 RADIUS FROM CENTER CENTER MILD OIL OUENCH 0.8 1.8 2.5 3.0 3.4 3.8 0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.6 4.0 0.2 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1 26 26 25 25 40 60 34 33 33 24 24 23 23 15 16 o 50 22 21 20 18 20 22 32 32 32 31 1E 0E 0E 9E ROCKWELL S 20 HEAT TREATING TEMPERATURES RECOMMENDED BY SAE *NORMALIZE 1650 °F AUSTENITIZE 1600 °F 4 6 8 10 12 14 16 18 20 22 24 26 28 DISTANCE FROM QUENCHED END -SIXTEENTHS OF AN INCH For forged or rolled specimens only.

 $No{\rm TE}-1~in.=25.4~mm. \label{eq:NoTE}$ FIG. 12 Limits for Hardenability Band 4130 H

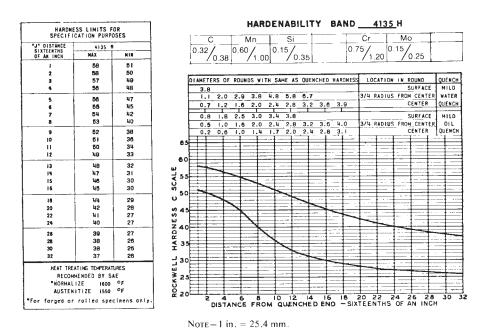
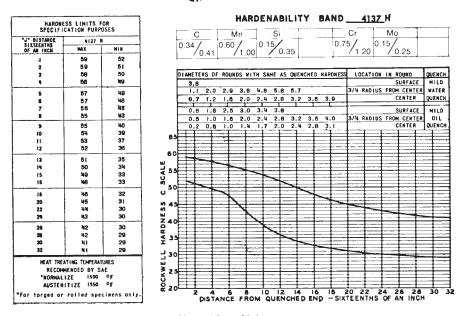
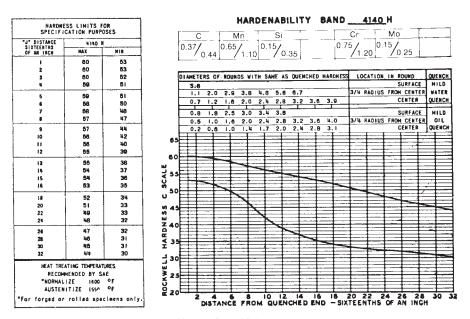


FIG. 13 Limits for Hardenability Band 4135 H





 $Note-1 \ in. = 25.4 \ mm.$ FIG. 14 Limits for Hardenability Band 4137 H



Note-1 in. = 25.4 mm.

FIG. 15 Limits for Hardenability Band 4140 H



HARDENABILITY BAND ___ 4142 H HARDNESS LIMITS FOR SPECIFICATION PURPOSES Mn Si Cr Mo 0.75/1.20 0.15/0.25 $\begin{bmatrix} C & Mn & SI \\ 0.39 / 0.46 & 0.65 / 1.10 & 0.15 / 0.35 \end{bmatrix}$ 62 62 62 55 55 54 53 | DIAMETERS OF ROUNDS WITH SAME AS QUENCHED HARDNESS | LOCATION IN ROUND | QUENCH | 3.8 | SURFACE | MILD | | AMELIES | 17 | NOVEMBER | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1, 61 61 60 60 53 52 51 50 SURFACE 3/4 RADIUS FROM CENTER CENTER HILD 60 59 59 58 58 57 57 56 42 41 40 39 13 14 15 16 37 36 35 34 55 18 20 22 24 34 34 33 33 28 28 30 32 HEAT TREATING TEMPERATURES RECOMMENDED BY SAE *NORMALIZE 1600 °F AUSTENITIZE 1550 °F 2 4 5 8 10 12 14 15 18 20 22 24 26 28 DISTANCE FROM QUENCHED END - SIXTEENTHS OF AN INCH *For forged or rotled specimens only.

 $\label{eq:Note-1} Note-1~in. = 25.4~mm.$ FIG. 16 Limits for Hardenability Band 4142 H

	SS LIMETS CATION PURP				С	Τ	Mn	11	S	i	Г		Τ-	Cr		Мо			
J" DISTANCE	4145	н	1	0.42		0.6		10	15 /	/-	+ .		0.7	5 /	0	15/			_
SIXTEENTHS -	MAX	MIN	1	0.42	0.4		J _{1.1}			0.35			0.,,	/1.2			.25		
1	63	56]	<u></u>		-		L					-						
2	63	55	l .															_	_
a	62	55	i	DIAME	TERS	OF ROL	NDS W	TH S	SAME	AS QL	JENCHE	DHAR	DNESS	LOC	ATION	IN R		QUE	
	62	54		3.	8												URFACE		LD
	62	53	1	1.		0 2.9	3.8	4.6	9 5.	8 8	.7			3/4 R	ADIUS	FROM	CENTE	R WA	TE
•	51	53		0.	7 1.	2 1.6	2.0	2.1	4 2.	В 3	.2 3.	6 3.	9			С	ENTER	QUE	ENC
	81	52									\Box								
′ ′	-	52		0.										ļ			URFACE		ILD
8 .	18	52	-	0.							.2_3.			3/4 R	ADIUS		CENTE		II L
9	60	51	1	0.	2 0.	6 1.0)i_#		7 2	0 2	.4 2	в 3.	·		,		ENTER	QUE	: NC
10	60	50	6:	,EE				=			-					_	_	-	
- 11	60	119	"		_						1					==			=
12	59	48	60	Œ		-	-											=	_
13	59	46		'E=					-		-	-			- :				=
15	59	45	ш				-			-	1			_			- 1		
15	58	43	₹ 5	5								- 1					-		
16	58	42	ပိုင	ļ	1		-				<u> </u>							-	=
		<u> </u>	50	\vdash				-	<u> </u>		Ε		_						
18	57	40	Ü	E				_==	-	١.								=::	_
20	57	38	04	5						\rightarrow	-	-					_		_
22	56	37	L CO					‡						-					_
24	55	36	24	Œ		1	- 1				I								_
26	55	35	2 6 4	'E'		=		. 7			1		\sim			=	=	-	
28	55	35	Q ¥ 3	.⊨≕			==‡-			1	1				_			1	
30	55	34	<u>≰</u> 3.	7						=	Ŧ :=								_
32	54	34					-			=	1 ==		-			_			
			- - 3 (= +	-			1		=		=	-			Ξ
	TING TEMPERA		NOCK WE	-						=	1-		_						_
	ENDED BY S		₹ 2.	5															=
"NORMAL !			ď				- 1	=		1	1 -		-		-				_
AUSTENI	T1ZE 1550	°F	اد ي	يسار			8	<u>i</u>	0 1	<u> </u>	4 1	1	B 2	0 2	1	4 2	6 21	3 3	0

Note - 1 in. = 25.4 mm.

FIG. 17 Limits for Hardenability Band 4145 H



HARDENABILITY BAND 4147_H HARDNESS LIMITS FOR SPECIFICATION PURPOSES C Mn Si 0.42/0.49 0.65/1.10 0.15/0.35 "J" DISTANCE SIXTEENTHS OF AN INCH 71.20 63 63 62 62 56 55 55 54 DIAMETERS OF ROUNDS WITH SAME AS QUENCHED HARDNESS LOCATION IN ROUND SURFACE 3/4 RADIUS FROM CENTER 3.8 1.1 2.0 2.9 3.8 4.8 5.8 6.7 0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9 0.8 1.8 2.5 3.0 3.4 3.8 0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.6 4.0 0.2 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1 WATER 53 53 52 52 62 61 61 CENTER SURFACE 3/4 RADIUS FROM CENTER CENTER HILD 51 50 49 48 60 60 60 59 59 59 58 58 46 45 43 42 13 14 15 16 ပ် 50 18 57 40 38 37 36 35 35 34 34 HEAT TREATING TEMPERATURES RECOMMENDED BY SAE *NORMALIZE 1600 °F AUSTENITIZE 1550 °F 4 6 8 10 12 14 16 18 20 22 24 26 28 DISTANCE PROM QUENCHED END -SIXTEENTHS OF AN INCH for farged or rolled specimens only.

Note-1 in. = 25.4 mm. FIG. 18 Limits for Hardenability Band 4147 H

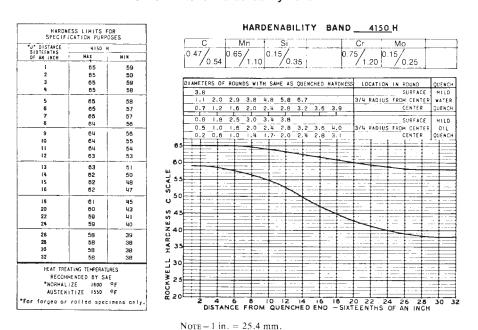


FIG. 19 Limits for Hardenability Band 4150 H



	SS LIMITS I			_	<u> </u>		Mn		S		I		1	Cr.	<u></u>	Mo	1.18	· —	
" DISTANCE	4161	-		0.55	-,	0.6		-	15/	/	1		0.6		0	25 /		+-	
F AN INCH	MAX.	NIH-		0.55	0.65		² /1.			0.35			10.0	7 _{0.9}			.35		
1	65	60				٠							-		1			٠.	*****
ž	65	60																_	
3	65	60		D1 AME	TERS C	F RO	UNDS	WITH	SAHE	AS Ot	ENCH	ED HA	RDNESS	Loc	ATION	IN R	OUND	- lo	UEN
	65	60		3.												- 5	URFAC	E	HIL
	65	60		HŤ.		3 2.	9 3.	8 4.	8 5.	8 6	.7			3/4 F	ADIUS	FROM	CENT	ER W	ATI
5	65	60	ľ	0.								.6 3	.9	-		-	ENTER	1o	UEN
: 1	65	60									Ť	i .	Ë	==	_			-	_
- 1	65	60		0.	8 1.6	8 2.			¥ Э.	.0				!			URFAC		HIL
				0.									.0.	3/4 1	ADIUS		CENT		01
	65	59	l	0.	2 0.0	8 1.	0 1.	N 1.	7 2	.0 2	.4 2	.8 3	1.1	ــــــ	,		ENTER	. 10	UEX
10	65	59	l 69	=		==		<u> </u>	=	-		+	1	-			-		ŧ
!!	65	59 59							_			-	 	!				<u> </u>	÷
12	64	29	60	Œ		=						1							1
13	64	58		Ή						-	_	+==	1	-				_	+
15	64	58	ا "	.EE	=				=	-		ᠰ		-		=			‡
15	64	57	₹ 5:	7			=					\equiv	\sim	I					Ŧ
16	64	56	Ů,			_		-		-			1	\sim					‡
	64	55	5 ° ن	שׁוּ	=				-	-	=	-	-		1				+
18	63	53					_	-		==	£	1_	1						Ŧ
20 22	63	50	\$ 4	5								\vdash		1	<u> </u>		$\overline{}$		+
25	63	48	11		===	_		-		=	1	+	+ -	1	-				Ŧ.
				⊟⊟ه	=		=				1	1	=	1		_			H
26	63	45	Z 4								1	+	+						+
28	63	43	₹ 3				=	<u> </u>	-	-	 	+-	+	₩	-	=	-	=	+
30	63	42	[<u> </u>			==	=	!	<u> </u>		1	1	1						I
32	63	41	رو بـ ا	SEE.						_	-	1=	1					_	+
HEAT TRE	TING TEMPERA	TURES						-		-	+==	-	+=	1		==	-		+
RECOM	MENDED BY	SAE	- ₹ -	.==							Ī	1	Ι	I			F		1
"NORMAL	IZE ISO	O °F	700 CK 1	'								=	=	1					1
AUSTEN		iO °F	8 .	, 			_	-			+-	+	!	ŧ				=	#
or forged or	salled sa		£ 2	,	2 4			8 1	0 1	2 1	4	16	16	20 2	2 2	4 2	6 2	8	30

Note - 1 in. = 25.4 mm.FIG. 20 Limits for Hardenability Band 4161 H

	SS LIMITS FO CATION PURPO		1	C		Mn		Si	- т	- Ni		T —	Cr	T	Мо			
" BISTMICE	4320 K			0.17/		40 /	-+0	15/	- +	1.55/		0.3	5/	0.	20/			
SIXTEENTHS OF AM INCH	MAX	MIN			0.23		70 l	13/0	.35	1.33/	2.00	0.5	7 o.e			.30		
	48	*1	- 1		2.25L.					'-		<u>.</u>						
2	47	38																
3	45	35		DIAMET	ERS OF	ROUNDS	WITH	SAME	AS QU	ENCHED	HAR	DNESS	LOC	ATION	IN F	DUND	QI	UENC
4	43	32		3.6								\neg				URFAC	E +	HILD
		29		1.1	2.0	2.9 3.	8. 4.	8 5.	8 6.	7			3/4 F	RADIUS	FROM	CENT	ER W	ATER
	38	27		0.7	1.2	1.6 2.	0 2.	4 2.	в 3.	2 3.6	3.	9				ENTER	1 Q	JENC
: 1	36	25							=				-				- T	
4	34	23		0.8		2.5 3.							2 (1)			URFAC		HILD
				0.5		1.6 2				2_3.6			3/4 1	ADTUS		CENT		OIL UENC
	33	22		0.2	0.6	1.0 1.	4 1	7 2.	0 2.	4 2.E	3.	'	_		·	ENTER	I I O	I
10	31	21	6.5	⊭			=			1			<u> </u>					1
11	30	20	-	=									-				===	ŧ
12	29	50	60	E	=E					-			=					=
13	28	-	w U			-				\rightarrow	_			-	=		-	-
14	27	-	¥ 5:	\vdash		1						\equiv			<u> </u>			-
15	27	-	SCAL	'EEE										<u> </u>			-	==
16	26	-	й.								=							1-
			ີ 50	'==			-							-	-			Η.
18	25	-				-1										1		+-
20	25	-	9.4	H	V	+						_		=	=	=		=
22	24	_	M N	$\vdash = \downarrow$	\rightarrow			=		\vdash	=			-				I
24	24		741			\—					=		-					\equiv
26	24	-	M ¥ 3:			λ				\Box			==	=			-	+ -
28	24	-	₹ 3:		\mathbf{L}	\rightarrow	—	-	_		=			=		=	-	+
30	24	- 1		=	7	#=-					=							Ŧ
32	24	-	رو لہ	E	$-\lambda$			_								_		-
RECOM "NORMAL	ATING TEMPERAT MENDED BY SI 1ZE 1700 ITIZE 1700	of Of	ROCKWELL															

 $\label{eq:Note-1} Note-1~in. = 25.4~mm.$ FIG. 21 Limits for Hardenability Band 4320 H



HARDENABILITY BAND E4340 H HARDNESS LIMITS FOR SPECIFICATION PURPOSES Ni Cr Mo E4340 H 7/0.44 0.60/0.95 0.15/0.35 1.55/0.00 0.65/0.95 0.20/0.3030 60 60 53 53 53 53 | 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 QUENCH | QUENC 3.8
1.1 2.0 2.9 3.8 4.8 5.8 6.7
0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9
0.8 1.8 2.5 3.0 3.4 3.8
0.5 1.6 2.0 2.4 2.8 3.2 3.6 4.0
0.5 1.0 1.8 2.0 2.4 2.8 3.2 3.6 4.0 60 60 60 SURFACE 3/4 RADIUS FROM CENTER CENTER 60 60 60 53 53 53 52 9 10 11 12 59 59 59 52 52 52 51 13 14 15 16 58 58 58 57 51 50 49 48 18 20 22 24 57 57 57 57 47 48 45 44 26 28 30 32 ROCKWELL S HEAT TREATING TEMPERATURES
RECOMMENDED BY SAE
"NORMALIZE 1800 OF
AUSTENITIZE 1550 OF *For forged or rolled specimens only 4 6 8 10 12 14 16 DISTANCE FROM QUENCHED END

 $Note-1 \ in. = 25.4 \ mm.$ FIG. 22 Limits for Hardenability Band E 4340 H

	SS LIMITS F CATION PURP				Ċ	_	Mn		S		ITY	Ni		Cr	77.	<u></u>	0	_	
J" DISTANCE	4340 1			0.37	-,	0.		-).15	7	1.55		0.0		-	0.20	7	+-	
SIXTEENTHS OF AN INCH	MAX	MIB		0.37	/ _{0.4}		0/0			, 0.35		/2.0			.95		0.30	1	
	50	53			0.4		/ 0	30		0.00			ч_		.00				
2.	60	53																	
	50	53		DIAM	TERS	OF R	DUNDS	WITH	SAME	AS O	IENCHE	D HAF	ONESS	10	CATIO	N IN	DUIND	1	NENC
	60	53			.8												SURFA		HILD
						.0 2	.9 3	R 1	B 5	.в 6	.7			3/4	RADIII		H CEN		WATE
5	60	53				.2 [.4 2		.2 3.	6 2		,,,			CENTE		UENC
6	60	53					. 6						9	_			CLHILL	` '	UENC
7	60	53		0	.8 1	.8 2	.5 3	.0 3	.4 3	.в				I			SURFAC	CE_	MILD
8	60	52		0	.5 1	.0 !	.6 2	.0 2	.4 2	.8 3	.2 3.	6 4.	.0	3/4	RADIU	S FRO	4 CEN	TER	OIL
9	60	52		0	.2 0	1 8.	.0 i	14 1	.7 2	.0 2	.4 2	8 3	. 1		-	_ (CENTE	₹](NENC
10	60	52	6			1			1	I	I				-	1	1	1	1
- 11	59	51	•	1		-			1						Ε.				\mathbf{F}
12	59	51		, <u> </u>	==	-	-	=	==	+				_				-	+
13	59	50	60	"		-			-	-					-	-			1
13.	58	49	щ				I		I	1				_		1	-		1
15	58	49	₹ 5:	5										_					
16	58	48	Š	=		-	-	-			-			_			ļ		+
			50						_	_		==		-				-	+
18	58	47	U		-	1 -	1	-	-	1						1 -	ŧ	1	1
20	57	46	94	عطره		-	1			_				-					
22	57	45	47	1					!	:==					-	_	-	-	ļ.,
24	57	44	ш 2 4 (1	1		<u> </u>		-	-			1	‡	-	_	-
26	57	43	240	′⊞					1	1	-			mar	1=	1			
28	56	142	H 3:	.⊨=		=	-									-	<u> </u>		
30	56	NI.	≨ 3:	4			=		=	1			=		-	1	_	_	+
32	56	40		E					1						-	1			+
			글 30	-															+
	TING TEMPERAT			-			-			1	=		_		-		-		+
	ENDED BY SA		₹ 2:	5		1	-	<u> </u>	-	-				70.00			-	-	+
"NORMAL I			ROCK WE	E		I									_	-	-		1-
AUSTENI	T L ZE 1550	o.F	₽ 20	L	<u> </u>	<u> </u>	<u> </u>	<u> </u>						0 2					I

Note -1 in. = 25.4 mm.

FIG. 23 Limits for Hardenability Band 4340 H



HARDNESS LIMITS FOR SPECIFICATION PURPOSES

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

-

"J" DISTANCE SIXTEENTHS OF AN INCH

HARDENABILITY BAND 4419H

С	Mn	Si		Мо	
0.17	0.35	0.15		0.45	

_	ETERS	OF ROL	JNDS 1	VITH S				HAR	DNESS		ATION		URFACE	QUENC
_		.1 2.				3.		3.	9	3/4 F	ADIUS		CENTER	QUENC
0	.5 1	.0 I.	8 2.	0 2.4	2.8	3.				3/4 F	ADIUS	FROM	URFACE CENTE	
65	.2 0	6 1	0 1.	4 1.7	2.0	2.	2.8	3.	<u> </u>				ENTER	QUENC
60														
55														
50														
45	$\overline{}$				=									
40														\equiv
35														
30 25 20	X				1									
						-		=				4 2	6 26	30

 $N_{OTE}-1 \text{ in.} = 25.4 \text{ mm.}$

FIG. 24 Limits for Hardenability Band 4419 H

	SS LIMITS FO CATION PURPO				C	т	Mn	T	S	i	Τ-	Ni	\top		T	Мо	1	
J" DISTANCE	4620 N					10.		· · †).15.	7	1.55	$\overline{}$	+-		0	20 7		
SIXTEENTHS OF AM INCH	MAX	14116		0.1	0.2		35/ ₀	.75		, 0.35		/2.0	ol		0.		.30	
i i	48	41		ļ	/ 0.2	ا				-100	1 .							
2	45	35											_	_				T
3	42	27		DIAM	ETERS	OF_RC	DUMPS	WITH	SAME	AS QL	JENCHE	D HAR	DNESS	LOC	ATION			QUENC
•	39	24		3	. в												URFACE	-1 '
3	34	21		1	, 2.	0 2	.9 3			.8 6				3/4	ADIUS		CENTE	
	31	- 1		[0	.7 _ 1.	2 1.	.6 2	.0 2	.4 2	.8 3	.2 3	6 3.	9	↓			ENTER_	QUENC
7	29	- 1		F	.8 1.	9 2	.5 3	.0 3	.4 3	.8						SI	URFACE	HILE
8	27	- 1		_	.5					-	.2 3	B 4.	0	3/4 /	RADIUS	FROM	CENTER	OIL
9	26	-			.2 0.				.7 2		. 4 2			T -		C	ENTER	QUENC
10	25	-			1		I -	-	- -		1	I					- 1	
ii	24	-	65	+			-		1	I		-	-				= 1	:==
12	23	-		\equiv				=	1	-				-		=		
13	22		60	Ħ					1	1 -		-				-		_
18	22	- 1	m.	\equiv					_				_					
15	22	-	SCALI	H-	+		ļ		ļ	-	1=	-		<u> </u>			= 1	
16	21	- 1	ပ္ထ	1-	1		·		! —	1	1			I			==	
			50	\pm						1=				 			- +	
10	21	-	U				!	‡ ::	 	 -		=	=	1-			- 1	
20	20	-	W 45	H,	X		-	1	<u> </u>	1	<u> </u>						==	_
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*NORMAL			£ 25	Ė				1 -			Ī	-					-	
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r forged or			<u>≈</u> ≥ 2 0	ت,	2 4	-	6	8	10	2 1	4 1	6 1	6	0 2	2 2	4 2	6 28	30

Note-1 in. = 25.4 mm.

FIG. 25 Limits for Hardenability Band 4620 H



HARDENABILITY BAND ___4621_H MARDNESS LIMITS FOR SPECIFICATION PURPOSES Мо Mn Si Ni 0.20/0.30 0.17 0.23 0.60 1.00 0.15 0.35 1.55/2.00 41 38 34 30 48 47 46 44 3.8 1,1 2.0 2.9 3.8 4.8 5.8 6.7 27 25 23 22 CENTER SURFACE MILD 3/4 RADIUS FROM CENTER OIL CENTER QUENCH 30 28 27 18 20 22 25 30CK WELL HEAT TREATING TEMPERATURES RECOMMENDED BY SAE *NORMALIZE 1700 °P AUSTENITIZE 1700 °F 4 6 8 10 12 14 16 18 20 22 24 25 28 DISTANCE FROM QUENCHED END -SIXTEENTHS OF AN INCH For forged or rolled specimens only:

 $N_{\text{OTE}-1~in.} = 25.4~\text{mm}.$ FIG. 26 Limits for Hardenability Band 4621 H

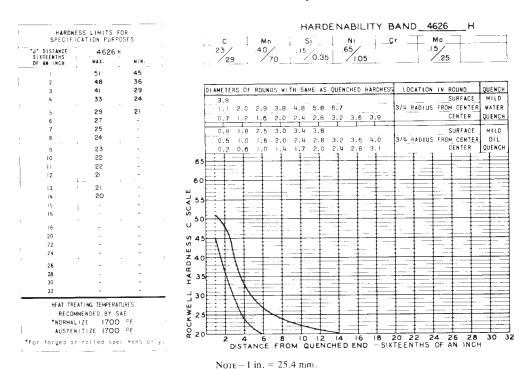


FIG. 27 Limits for Hardenability Band 4626 H



HARDMESS LIMITS FOR SPECIFICATION PURPOSES
STANCE 4718 N
ENTINS MAX. N

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

HARDENABILITY BAND 4718H

С		Mn	Si _	Ni	Cr	Мо	
0.15	/ 0.6 0.21	0/0.95	0.15/0.35	0.85	0.30	0.30/0.40	

ŀ	_	3.1	_	3 01	ALL.	UNI	-		-	JA.		-3		- H	, et E	-	•	UH ES	1-		ATION		SUR			HIL HIL
Ì		1.		2.0	2.	9	3.	В	4.	8	5.	8	6.	.7					3/1	Į F	ADIUS	FRO	M CE	NTE	R	IAT
1	-	0.	7	1.2	1.	6	2.	0	2.	4	2.	8	3.	2	3.	6	3.	9					CENT	ER	₽	JEN
-		0.1		1.8	2.	=	3.	<u>_</u>	3.	11	3.				ш	-			╌	_			SURI			HIL
- 1	_	0.1	_	1.0	_	6	2.	_	2.		2.		3.	-	3.	-	4.	<u> </u>	12/1	1 6	ADIUS					01
H		0.3		0.6	- <u>'</u>		1.		1.		2.			. 4	2.		3.		13/		ADIUS		CENT			UEP
	\neg	Ť	_	-		ř	ä	-	ä	_	ä	Č	_	Ë	-	Ĕ	ă	_	-	_			1	7		F
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		4			-			=	\equiv	=			=		_	E	_	=	+=				+	#		#
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		∄	=	1	1				_		\equiv	1	=	-	_	Е			Ł			_		\exists		Ŧ
25 20		4		+	_		_		=		_	⊨	-	-	=		\equiv		=	-	\vdash	_		_		+
		⇉	-	1-					$\overline{}$				Ξ						Ⅎ═	_			Ε	1	Ξ	Ε
امد			Ξ	Ŧ		Ε		\sqsubseteq	=						_	E			+-			_	+	1	_	£
		2		4		6		3			1			4		6			50	2	2 2 THS		26	28		30

Note -1 in. = 25.4 mm.

FIG. 28 Limits for Hardenability Band 4718 H

	SS LIMITS F			C Mn	Si	TY BAND_	Cr	Mo	_
" DISTANCE	4720 H				· · · · · · ·	-	0.30 /	0.15/	_
F AN INCH	MAX	MIR		7/0.23 0.45/0.75	0.15		0.60		
1	46	341		70.23 70.73	7 0.00	7 1.23	7 0.00	7 0.20	
2	147	39							_
3 1	43	31		ETERS OF ROUNDS WIT	H SAME AS QU	JENCHED HARDNES	LOCATIO	N IN ROUND	QUEN
•	39	27		3.8				SURFACE	
				1.1 2.0 2.9 3.8	4.8 5.8 6	.7	3/4 RADIU	S FROM CENTE	R WAT
- 1	35 32	23		0.7 1.2 1.6 2.0	2.4 2.8 3	.2 3.6 3.9		CENTER	QUE
,	29	51		0.8 1.8 2.5 3.0	3.4 3.8			SURFACE	нц
	28					.2 3.5 4.0	2/11 040111	IS FROM CENTER	
1	27			0.5 1.0 1.6 2.0		.4 2.8 3.1	3/4 4010	CENTER	QUE
10	26	- 1		J. 2 0.0 1.0 1.4	1 1	1 1	+ -		1
- 11	26		65		-11				=
12	24						1 - 1 -		
		-	60			L	+	+ + - +	==
13	24	- 1	M		1 -1 -		1-1		
15	23 23	- 1						+	=
16	23		J 5:					1 1 1	=
	. 66		50					$\overline{}$	=
18	21	- 1	U				+	+	
20	. 21	·-	9 4	N. I. I.				$\overline{}$	===
22	21	-	₩.					+	=
24	20	<u>-</u>		4 V		1 1			=
26	- 1	-	N 40 V 3	X X			1	+ + +	
28	-	-	_ 3	+1 +1 ++++			+ +	\pm	=
30	- 1	- 1	I				+		=
32	-	-	ع بـ ع	+ \	$\Rightarrow =$		+	+	=
HEAT TREA	TING TEMPERATI	URES						+	_
RECOM	ENDED BY SA	IE .	. ₹ 2				+ +-	+-+-	\pm
"NORMAL	2E 1700	ot	ROCKWE						\equiv
AUSTEN	T17E 1700	ot	£ 2		1 -1 -		20 22	24 26 28	3 30

Note -1 in. = 25.4 mm.

FIG. 29 Limits for Hardenability Band 4720 H



HARDENABILITY BAND 4815 H HARDNESS LIMITS FOR SPECIFICATION PURPOSES Ni Мо 4815 H 0.12 0.30 0.70 0.15 3.20 3.80 0.20/0.30 MIR 38 37 34 30 45 44 44 42 ¥1 39 37 35 27 24 22 21 0.8 1.8 2.5 3.0 3.4 3.8 3.2 3.6 3.9 0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.6 3.9 0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.6 4.0 0.2 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1 SURFACE MILD 3/4 RADIUS FROM CENTER OIL CENTER QUENCH 20 33 31 30 29 28 28 27 27 26 25 24 24 18 20 22 24 24 23 23 23 HEAT TREATING TEMPERATURES
RECOMMENDED BY SAE
"MORMALIZE 1700 OF
AUSTENITIZE 1550 OF For forged or rolled specimens only.

 $\label{eq:Note-1} \text{Note-1 in.} = 25.4 \text{ mm}.$ FIG. 30 Limits for Hardenability Band 4815 H

	SS LIMITS F CATION PURP			C			/n	1	Si			Ni	ND.		1	Mo		-	
J" DISTANCE	4817 H				_			+-	_				-+				,	+-	
SIXTEENTHS -	MAX	MIN		0.14		0.30			.15/	0 0 =	3.20		_ ا		10	.20/			
	46	39			0.20	/	0.7	UL.		0.35		/3.8	U]				0.30		
;	46	38		-															
	45	35		DIAMET	ERS O	F ROUI	NDS W	TH:	SAME	AS OL	JENCHE	O HAR	ONESS	LOC	CATIO	N 19 1	COUND	To.	UENCE
1	3436	32		3.6									_				SURFAC	E	HILD
	42	29		1.1		2.9	3.8	4.	8 5.	8 6	.7			3/4 1	RADIU	5 FROM	4 CENT	ER W	ATER
:	41	27		0.7	1.2	1.6	2.0	2.	4 2.	.6 3	.2 3.	8 3.	9			-	CENTER	Qu	UENCE
7	39	25						I	, a					_		_			
8	37	23		0.6		2.5						• V	_				SURFAC		HILD
,	35	22		0.5	0.8						2 3			3/4	CIDIO		CENTER		OIL
10	33	21			1	1.0									_	_	1 1	14	I
ii l	32	20	6	5	=+	\rightarrow	\Rightarrow	=		-					==	=		_	=
iz	31	20				\perp				_									
			60	+		_	_	_		_	=				_	=	=	_	=
13	30 29		w.			-	-			-		-		-					
15	29	1 []	₹ 5:	5 T											-				\equiv
16	28	[7 5:		_	-	-			-	-	-					\vdash	=	=
			50							_	_								
18	27	- 1	U			-	_			-	-				-	-	+	=	=
20	26	-	97.4	5	$\overline{}$	-										-			=
22	25 25	-	m S		_				_		-	-			=	-	-		
49			Z 40		-	_	-				<u> </u>								-
26	25	-	08		\equiv	\equiv	V				=					-			‡ =
28	25	ļ - ļ	< 3:	ا ا	$\mathbf{\lambda}$		-	$\overline{}$	\vdash	1					-	\vdash		_	1
30	24	-	I		V		\exists	\exists		-						=	-	_	#
32	24		그 30	>	-	\leftarrow	-	=	=	$\overline{}$	<u> </u>	-			-	=			=
HEAT TREA	TING TEMPERAT	URES			-	\vee						_							
	ENDED BY SA		₹ 2.	5	-	4	\checkmark	=	=	-	-	-			<u> </u>	-	-	=	=
PHORMAL			ROCK WE					≤ 1											-
AUSTENI	T1ZE 1550	°F	₽ 20		4		8	\rightarrow		2 !	4 1	6 1	6 2	0 2	<u> </u>	24 2	6 2	Ļ	30

 $\label{eq:Note-1} Note-1~in. = 25.4~mm.$ FIG. 31 Limits for Hardenability Band 4817 H



HARDENABILITY BAND ___ 4820_H HARDNESS LIMITS FOR SPECIFICATION PURPOSES Мо 0.20 0.30 0.40 0.80 0.15 3.20 3.80 41 40 39 38 | DIAMETERS OF ROUNDS WITH SAME AS QUENCHED MARDNESS | LOCATION IN ROUND | QUENCH | 3.8 | S.8 | 6.7 | SURFACE | MILD | SURFAC 3.8 1. 1 2.0 2.9 3.8 4.8 5.8 6.7 0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9 0.8 1.8 2.5 3.0 3.4 3.8 0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.5 4.0 0.2 0.8 1.0 1.4 1.7 2.0 2.4 2.8 3. 45 43 42 40 34 31 29 27 SURFACE HILD 3/4 RADIUS FROM CENTER OIL CENTER QUENCH 39 37 36 35 26 25 24 23 34 33 32 31 22 22 21 21 29 28 28 27 18 20 22 25 27 26 26 25 26 28 30 32 HEAT TREATING TEMPERATURES RECOMMENDED BY SAE "NORMALIZE 1700 OF AUSTENITIZE 1550 OF For forged or rolled specimens only.

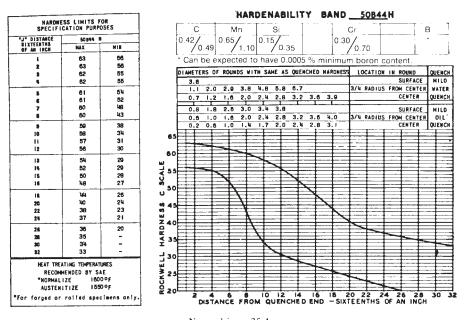
 $\label{eq:Note-1} Note-1 \ in. = 25.4 \ mm.$ FIG. 32 Limits for Hardenability Band 4820 H

	SS LIMITS F			-	—,				-110	Si	BILI				Or .	1			В	
				-	(,	+	Mn	-		-		 i			+			,	
" BISTANCE	50840 N			0	.37	/	0.6			.15/			ŀ	0.30					•	
F AN INCH	MAX	MIN			/	0.44	1	/1.	10	/ (0.35			/	0.70	"				
1	80	53		*	Ca	n be	exp	ecte	d to	have	0.00	05 %	mir	imu	m bo	ron (conte	ent.		
2	60	53		_															1.	_
	59	55		D)	AME	TERS	OF R	DUNDS	MILIA	SAME	AS QU	IENCHE	D HAR	DWESS	LOC	ATION				ENC
- W.	79	51			3.													URFACE		1110
	58	50		L	١,	1 2.	0 2	.9 3	.8 4	.8 5					3/4 R	ADIUS		CENTE		ATE
	58	346		L	٥.	71.	2	.6 2	.0 2	.4 2	.B 3	2 3.	6 3.	9			С	ENTER	100	ENC
7	57	3434		F	ó.	9 1	8 2	.5 3	.0 3	4 3					\vdash			URFACE	1	(ILD
	57	39		⊢	-0.						.8 3	.2 3.	6 4	0	3/4 R	ADIUS		CENTE		OIL
	56	34		- 1-	- 0.						.0 2		В 3					ENTER		JENC
10	55	31		E	Ť											$\dot{=}$			\Rightarrow	\equiv
ii l	53	59		65	=											=			=	
iż	51	28		. E	\equiv					-								=		⇇
	140	27		60=	#	ľ		<u> </u>	-		-	=		=					=	Ε
18	147	26	94	F	#	_				1									=	E
16	111	25	SCALE	55	\pm									_				==	=	⇇
16 16	31	25	Q	F	\blacksquare	I		-	+		-	+		_					=	=
10				50	\pm						N						=		=	
16	38	23	Ų	Е	\blacksquare			L _									=	===		=
20	36	21	69	45	#		-	1	=	-	-	-4	=						=	Ε
22	35	-	81 80	TE	\pm			$-\mathbf{X}$												
24	34	-	7	40F	\blacksquare					-			\sim					==	_	#=
26	33	-	<u> </u>	~~F	#	=	-		1	+	=								=	Ε
	32	-	HARDI	35	\pm		<u> </u>		Λ		-					_		⊨	=	=
20	30	- 1	ì	"E	\pm				+		1	!	=		==		_		_	F
22	29		_	30	\pm		=		=	=	1	_								F
MEAT THE	TING TEMPERAT	970		٦VE	\mp				=	1	=				=			##	=	=
	MENDED BY SA		ROCKWE	=	\pm	=		-			\rightarrow									E
"NORMAL!			ž.	25	Ξ	=			1	1	=							⊨	_	#
AUSTEN			႘	E	Ħ				1		=	-	=		=				_	Ŧ
		imens only.	ž	20C			4	-	à	10	2 1	4 1	6 1	8 2	0 2	2 2	4 2	6 2	8 2	30

Note-1 in. = 25.4 mm.

FIG. 33 Limits for Hardenability Band 50B40 H





Note-1 in. = 25.4 mm.

FIG. 34 Limits for Hardenability Band 50B44 H

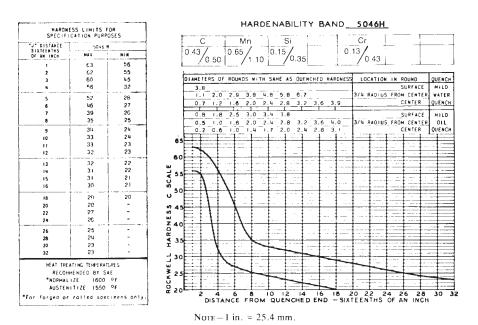


FIG. 35 Limits for Hardenability Band 5046 H



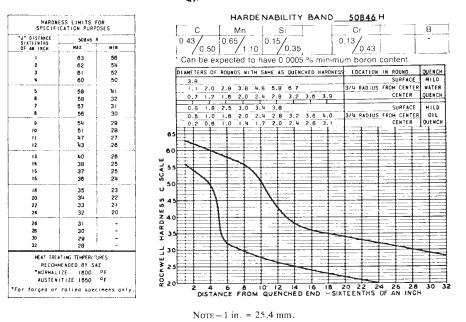


FIG. 36 Limits for Hardenability Band 50B46 H

	SS LIMITS I CATION PURP			С	-	Mn	1	Sī	1		Cr			\perp	В
J* DISTANCE	50850	H		0.47/		65/	0.1		-1		0.30/			i	•
DF AN INCH	MAX	MIN		1/	0.54	/1.10		/0.3	5			1.70			
1	65	59		Can b	e exped	ted to h	ave (0.000	5 % n	ninimu	ın bor	on c	onter	nt.	
2	65	59													_
3	61	58		DIAMETE	RS OF RO	UNDS WITH	SAME	AS QU	IENCHED	HARDN	ESS LO	CATIO	I IN F	ROUND	QUEN
*	64	.57		3.8										SURFAC	
5	63	56		1.1	2.0 2.	9 3.8	4.8 5	.8 6.	.7		3/4	RADIUS		4 CENT	ER WAT
4	63	55		0.7	1.2 1.	6 2.0	2.4 2	.8 3.	2 3.6	3.9				CENTER	QUEN
7	62	52		0.8	1,8 2,	5 3.0	3,4 3	.8			$\overline{}$			SURFAC	E MEL
8	62	147		0.5	1.0 1.				2 3.0	5 4.0	3/11	RADIU		1 CENT	
9	61	42			0.6					3 3.1	-13/4			ENTER	
10	60	37		II.	I I		1	1	1	·		1	ı—-`	1 1	1 27
11	60	35	65	-	_		+==	-			-	-			
12	59	33		E			=					-	-		
13	58	32	60				\geq	\forall				1			
14	57	31	W				-				\rightarrow	+			_
15	56	30	₹ 55	h	\Rightarrow		+==	=	\rightarrow		_	1			_
16	54	29	7 55 S			-	1	1			-i	1		1	
			50												
18	50	28	U		\rightarrow	==#=	+		!==	-	\checkmark		-		
20	47	27	VI 45	=	\rightarrow		-		1		\rightarrow	1 -			
22	¥Ч	26	M .	=	= 1- 1			-							
24	41	25	Z 40									+	\sim	-	
26	39	24	٥				4	1-				T		\sim	
28	38	22	∝ ≼ 35				N						==	+	
30	37	21	¥ 35		$\Rightarrow \exists$		1			_		-	-		_
32	36	20	- 30	-			+				-	1		1	
15.7 705	TING TEMPERA	DIDEC					-								
	ITING TEMPERA IENDED BY S		w				-	1			_	=			-
		OOF	% 2.5 X 2.5 X 2.5		1-1	_	1	1		-		1:-			
"NORMAL"	17E 150		×				1	1							_
-		1	₩ 20	2	4 6	. 8	10	12 1	4 1	5 18	20 2	2 2	4 2	6 2	8 30
ir forged or	rolled spe	cimens only.			ISTANC	E FROM	ı oui	NCH	ED EN	in -s	IXTEE	์าัหร ์	OF A	N IN	
					IJ IAITO	L . NO!	. 40.								

FIG. 37 Limits for Hardenability Band 50B50 H



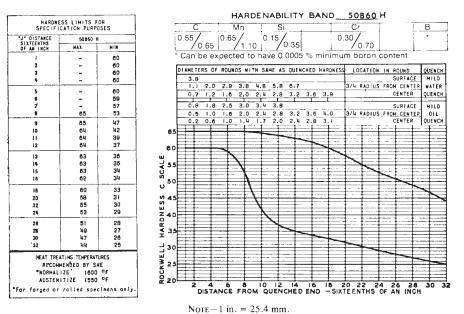
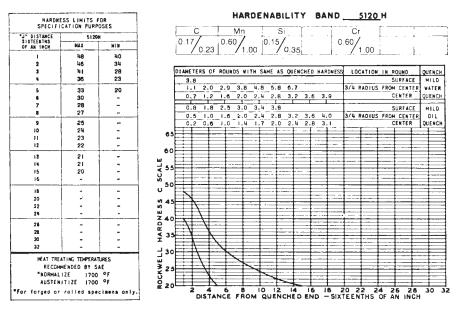


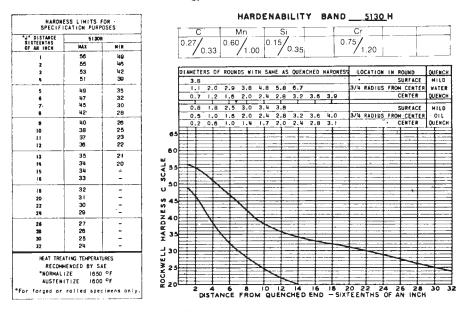
FIG. 38 Limits for Hardenability Band 50B60 H



Note - 1 in. = 25.4 mm.

FIG. 39 Limits for Hardenability Band 5120 H





 $\label{eq:Note-1} Note-1 \ in. = 25.4 \ mm.$ FIG. 40 Limits for Hardenability Band 5130 H

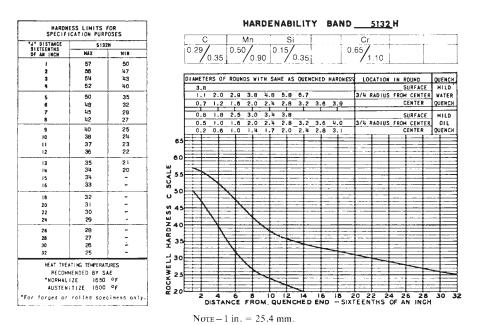


FIG. 41 Limits for Hardenability Band 5132 H



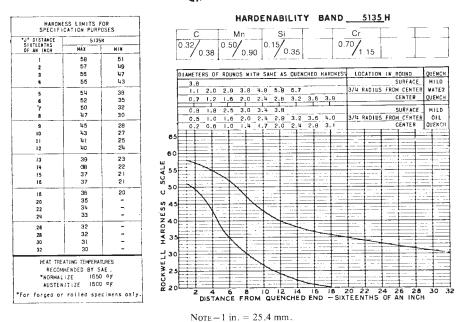


FIG. 42 Limits for Hardenability Band 5135 H

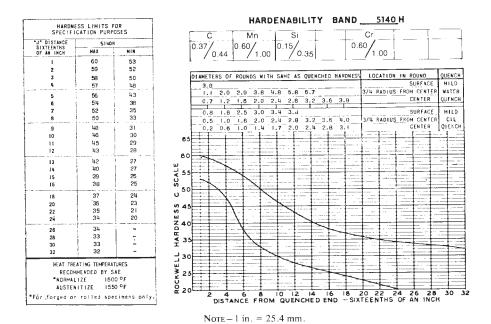


FIG. 43 Limits for Hardenability Band 5140 H



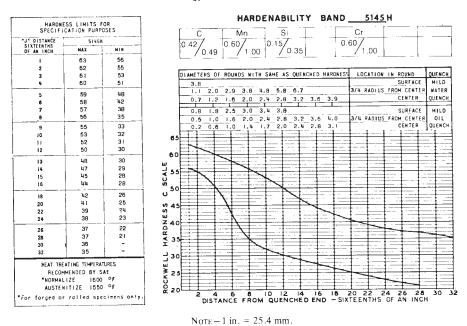


FIG. 44 Limits for Hardenability Band 5145 H

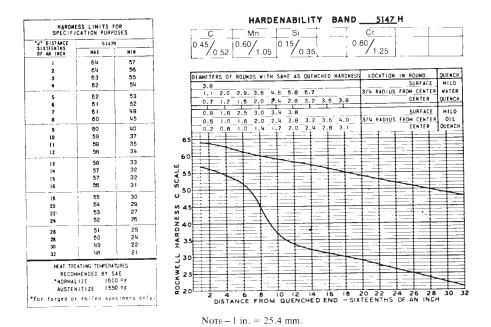


FIG. 45 Limits for Hardenability Band 5147 H



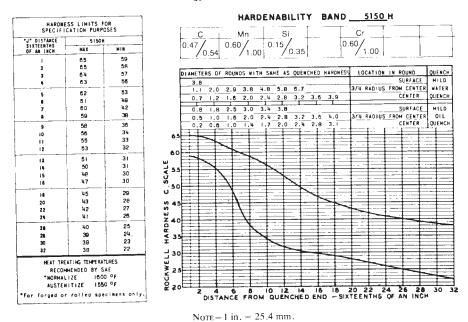
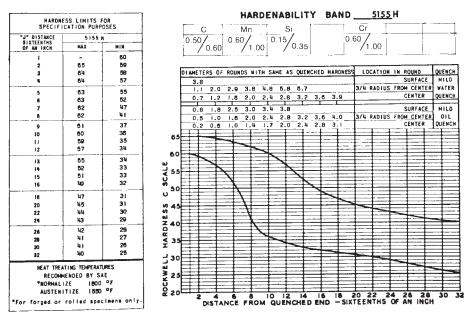


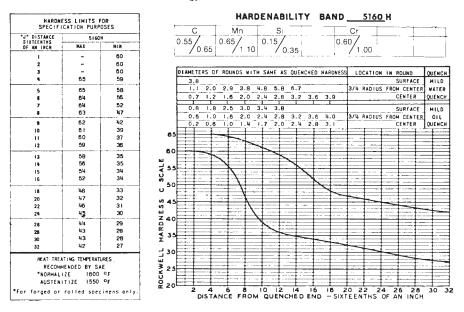
FIG. 46 Limits for Hardenability Band 5150 H



Note -1 in. = 25.4 mm.

FIG. 47 Limits for Hardenability Band 5155 H





 $N_{\text{OTE}}\!-\!1~\text{in.} = 25.4~\text{mm}.$ FIG. 48 Limits for Hardenability Band 5160 H

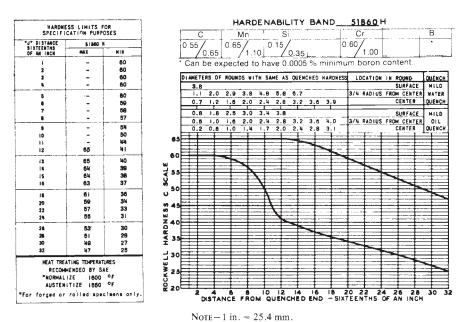
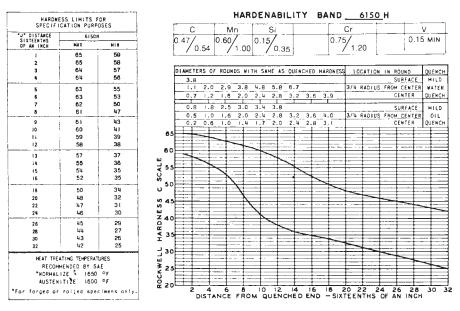


FIG. 49 Limits for Hardenability Band 51B60 H



HARDENABILITY BAND 6118H HARDNESS LIMITS FOR SPECIFICATION PURPOSES v Si Cr 0.10 0.40/0.80 6118 # 0.15/0.21 0.40/0.80 0.15/0.35 45 44 38 33 39 36 28 24 DIAMETERS OF ROUNDS WITH SAME AS QUENCHED HARDNESS LOCATION IN ROUND QUENCH MILD WATER 3.8 1.1 2.0 2.9 3.8 4.8 5.8 6.7 20 30 28 27 26 0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9 0.8 1.8 2.5 3.0 3.4 3.8 0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.6 4.0 0.2 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1 QUENCH SURFACE 3/4 RADIUS FROM CENTER CENTER 26 25 25 24 24 23 23 22 15 16 ပ 50 22 21 21 20 18 20 22 24 26 28 30 32 ROCKWELL 02 22 HEAT TREATING TEMPERATURES
RECOMMENDED BY SAE
"NORMALIZE 1700 °F
AUSTENITIZE 1700 °F QUENCHED END 18 20 22 24 26 28 - SIXTEENTHS OF AN INCH *For forged or rolled specimens only.

 $Note-1 \ in. = 25.4 \ mm.$ FIG. 50 Limits for Hardenability Band 6118 H



Note -1 in. = 25.4 mm.

FIG. 51 Limits for Hardenability Band 6150 H



SPECIFI	SS LIMITS F CATION PURP	OSES		С	Mn	Si	Y BAND	81B.4.5 Cr	Mo	В
* DISTANCE	81845 :	4								
IXTEENTHS F AN INCH	HAX	MIM		0.42	0.70/	0.15	0.15	0.30	0.08	•
1 1	63	58		* Can be d	vpected to	have 0 00	05 % minir	num horor	Contont	
2	63	56							r content.	
3	63	58		DIAMETERS O	ROUNDS WITH	SAME AS QU	ENCHED HARDNE	SS LOCATIO	N IN ROUND	QUEN
4	63	58		3.8					SURFACE	MIL
5	63	55		1,1 2.0	2.9 3.8	4.B 5.8 6.	7	3/4 RADIU	S FROM CENTER	WATE
6	63	54		0.7 1.2	1.6 2.0 2	2.4 2.8 3.	2 3.6 3.9	1	CENTER	QUEN
7	62	53		0.8 1.8	2.5 3.0	3.4 3.8				
. 8	52	51		0.5 1.0		2.4 2.8 3.	2 3.6 4.0		SURFACE	MILI
9	61	48		0.2 0.8		2.4 2.8 3. 1.7 2.0 2.		3/4 MADIU	S FROM CENTER	
10	60	44		1 1 1	1 1	1 1 1	4 - 2 B - 3 - 1		CENTER	TOUEN
11	60	141	6.5							
f2	59	39				1			1 - 1 - 1 -	-
13	***		60						1 1 1	
14	58 57	38 37	ш	= +						
15	57	36	₹ 55	\longrightarrow						
16	56	35	ŝ		_	1		4	=====	- t-
	- 50	35	້ 50							
18	55	34	ບັ້			44==				
20	53	32	v 45		= = = = >	4 1=			+ 1	<
22	52	31	S				-1			
24	50	30	ш Z 40			1	- 1: .	-1	1 1	
26	49	29	Ω 1		<u> </u>			+ +-		-
28	47	28	OC	$\Rightarrow \Rightarrow \Rightarrow \Rightarrow$	-		$\overline{}$	-		
30	45	28	≨ 35			+ + +				
32	43	27				+ 1 -1		-	 	
MEAT TOCAL	TING TEMPERATI	-DEC	그 30	=======================================				T		
	IING TEMPERAT ENDED BY SA		ų.			+ + +	1	-		_
"NORMAL I			₹ 25					-1-1-		-
	ZE 1600 TIZE 1550		9 25 W 25 O 20			1		\perp		
forged or			£ 20t	2 4	6 8	10 12 14	16 IB	20 22 2	4 26 28	30

 $Note-1 \ in. = 25.4 \ mm.$ FIG. 52 Limits for Hardenability Band 81B45 H

J" DISTANCE	86171			C Mn Si Ni Cr Mo	
SIXTEENTHS OF AN INCH	MAX	MIK.		0.14	
1	46	39		0.20 /0.95 /0.35 /0.75 /0.65 /0.25	
2	111	33			
3	14	27		DIAMETERS OF ROUNDS WITH SAME AS QUENCHED HARDNESS LOCATION IN ROUND	OUEN
4	38	24		3.8 SURFACE	
5	34	20		1.1 2.0 2.9 3.8 4.8 5.8 6.7 3/4 RADIUS FROM CENTE	
	31	-		0.7 1.2 1.8 2.0 2.4 2.8 3.2 3.6 3.9 CENTER	QUEN
7	28	- 1			1
	27	-		0.8 1.8 2.5 3.0 3.4 3.8 SURFACE	
5	26	-		0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.6 4.0 3/4 RADIUS FROM CENTE	
10	25			0.2 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1 CENTER	TOUEN
ii	24	-	6:		
12	23	- 1			
13	23		60		
15	23	-	lat		
15	22		₹ 5:		
16	21		Š		- 1-
			50		
18	21	-	U		
20	20	- 1	07.45		
22	-		S		
24	-	-	ш Z 4 (
26	- "	-	ω		===
28	-	-	¥ 3:		
30	-	-	Ì.		
32	-	- [ع بـ ع		
HEAT TREAT	ING TEMPERATI	PFS	٠,٠		
	ENDED BY SA		₹		
*NORMAL I			70 CK ₹ 5 ¥		
AUSTENI			ö		
			£ 20	2 4 6 8 10 12 14 16 18 20 22 24 26 28	30
forged or	rolled spec	imens only.	_	2 4 6 8 10 12 14 16 18 20 22 24 26 28 DISTANCE FROM QUENCHED END -SIXTEENTHS OF AN INC	30

FIG. 53 Limits for Hardenability Band 8617 H



 $\label{eq:Note-1} Note-1~\text{in.} = 25.4~\text{mm}.$ FIG. 54 Limits for Hardenability Band 8620 H

	SS LIMITS F CATION PURPO			Г	С	i	Mn	1	[Si		Τ	Ni		_	Cr	622	Ϊ	0	Ţ	
* DISTANCE	8622H			0.19	7	0.	60/		0.1	5/		0.3					t	0.15		1	_
IXTEENTHS IF AN INCH	MAX	MIN		1	0.2	25	7	0.95		70	0.35	1	70	.75		7 o	.65	/	0.25		
1	50	143		<u></u>		j	′		1			Ь			-	_				. i.	
2	นุย	39																			
3	47	34		DIAME	TERS	OF R	CUNDS	WIT	H SA	ME A	IS OL	JENCH	ED F	ARDN	253	LOC	ATIO	1 100	ROUND	- 1	OUENC
4	1414	30		3											_				SURFAC		MILE
5	40	26				.0 2	.9 3	3.8	4.8	5.8	9 6	.7			3	/4 F	ADIUS		H CENT		WATE
	37	24		0	7 1	.2 1	.6 2	2.0	2.4	2.8	3 3.	. 2 3	1.6	3.9					CENTER	- 1	QUENC
7	34	22				Ī	Ī	1		\equiv			Ĺ		#					\Rightarrow	
	32	20							3.4	3.1					4				SURFAC		ниц
	31								2.4	2.8		2 3		4.0	_ 3	/4 F	RADIUS		M CENT		OIL
10	30	Ĩ,		-0	2 0	.6 ;	.0	, ¥	1.7	2,0	2 2	.4 2	8	3.1	- 1		,	· '	CENTER	: 1	QUENC
11	29	_	65	\vdash		+		1	+	-	_	-	+-	-	-	_			-	-	+
12	28	_				1	1	1	- 1				Η-		\equiv	_					-
			60		_	-		+	\Rightarrow	#			+	-	_	_			-	-	\pm
13	27	- 1	ш	⊨			‡	1	+	_			1	- ‡-	-				1-	-	==
14	26	- 1	₹ 55			I		\mathbf{L}	1	_			1-	. 1.							\pm
15	26	- 1	3	L.:			·	1					1		\exists	_			1		\pm
16	25	- !	8, 10	F:-		1		-		=			+	#	-		-			=	-
18	25	_	ى 50				-	+	- 1-	-			1	-	-					=	+
20	24	-	_			I	Ŧ ==	Τ	Ŧ	- 1			1	=1=				-			
22	24	_	v) 45	-	\rightarrow	4	-	+-	+	=		-	+ -	-	-	_	_		-		_
24	24	- 1	w	A	-	Λ.	1	-1	100				+	-	7				1		1
	24		Z 40	 -)	-	\perp	I -	1-	\perp				E.	. 1	-		<u> </u>			-	
26	24	_	2 35 ¥ 35	===	Α	‡ ::: `	4	1	#	=		=	+	-	- 1	_				-	-
28 30	24	7	₹ 35	-:-	1	1-	1	1	+	***	==		+	-	-	=	_	==	†	-	-
32	24		1		\perp	1	1->	¥ -		_ [1	1	-			I	Į		\pm
32			730			4	!	1	4-			=	-	4		_	<u> </u>	==			1
HEAT TREA	TING TEMPERATE	URES	441	E	-	Λ-	1	+	\blacksquare	\vee	_	<u> </u>	4	= 1	- 1	- 1			1		=
RECOM	ENDED BY SA	E	₹ 24			$\perp \lambda$		1			-	_	1	<u> </u>	- [E		F	1
"NORMAL	ZE 1700	ok	¥ 25	<u> </u>		1	X	+-		=			1		+		$\vdash \equiv$	=			+
AUSTEN	TIZE 1700	o.f	ŏ	\vdash		1-	1	#	=‡				1-		-				t	<u> </u>	#
r forged or	colled son	leans only	E 20		2	4	6	8	10	12	1	4	16	18	20) 2	2 2	4 2	6 2	8	30

 $$N_{\rm OTE}{-1}$ in. = 25.4 mm. FIG. 55 Limits for Hardenability Band 8622 H



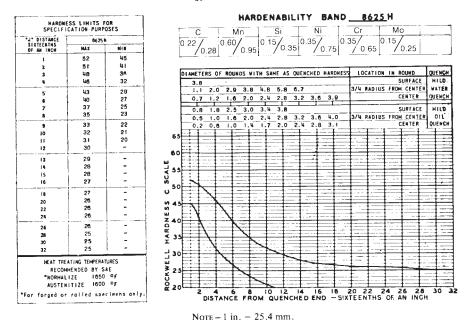


FIG. 56 Limits for Hardenability Band 8625 H

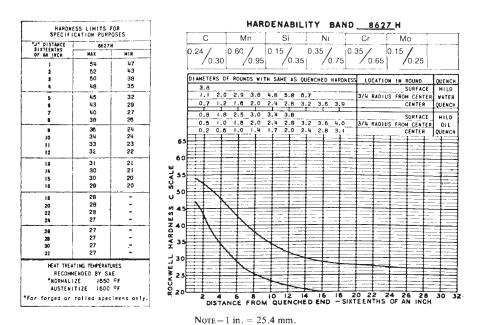
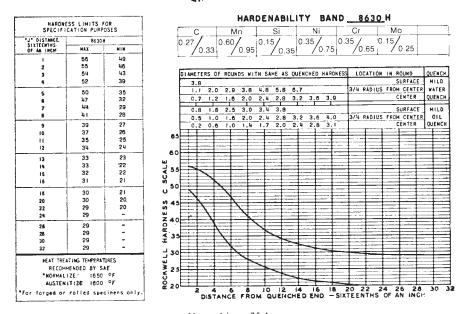
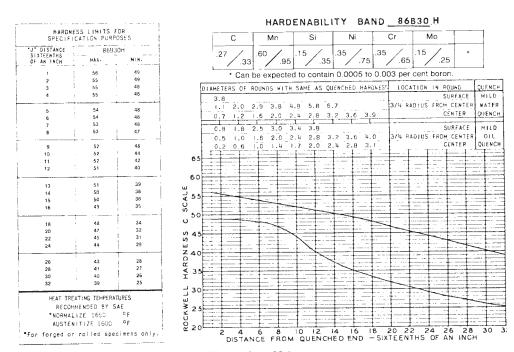


FIG. 57 Limits for Hardenability Band 8627 H





 $N_{OTE} - 1 \ in. = 25.4 \ mm.$ FIG. 58 Limits for Hardenability Band 8630 H



Note-1 in. = 25.4 mm.

FIG. 59 Limits for Hardenability Band 86B30 H



HARDENABILITY BAND 8637 H MARDNESS LIMITS FOR SPECIFICATION PURPOSES C Mn Si Ni Cr Mo 0.34/0.41 0.70/1.05 0.15/0.35 0.35/0.75 0.35/0.65 0.15/0.25 58 58 57 51 50 48 55 54 53 42 39 36 0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9 0.8 1.8 2.5 3.0 3.4 3.8 SURFACE MILD 3/4 RADIUS FROM CENTER OIL CENTER QUENCH 49 47 48 30 28 27 26 37 36 36 25 24 20 22 24 24 23 23 35 35 35 28 30 32 HEAT TREATING TEMPERATURES RECOMMENDED BY SAE *NORMALIZE 1800 °F AUSTENITIZE 1550 °F For forged or rolled specimens only

 $\label{eq:Note-1} Note-1 \ in. = 25.4 \ \text{mm}.$ FIG. 60 Limits for Hardenability Band 8637 H

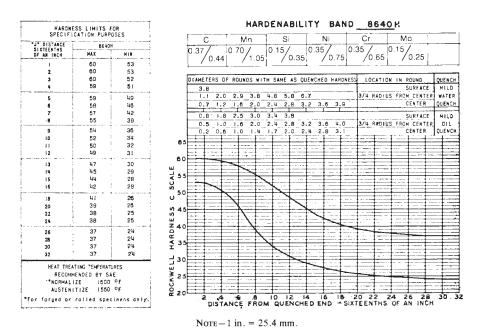


FIG. 61 Limits for Hardenability Band 8640 H



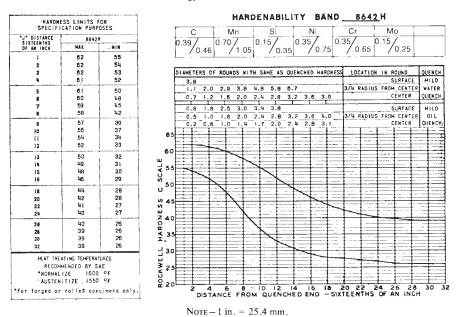


FIG. 62 Limits for Hardenability Band 8642 H

"J" DISTANCE	CATION PURP]	C Mn Si Ni Cr Mo	1
SIXTEENTHS OF AK INCH	MAX	MIM	1	0.42/ 0.70/ 0.15/ 0.35/ 0.35/ 0.15/	
ı	63	56		/0.49 /1.05 /0.35 /0.75 /0.65 /0.25	
2	63	58			
3	63	55		DIAMETERS OF ROUNDS WITH SAME AS QUENCHED HARDNESS LOCATION IN ROUND	QUENC
	63	54		3.8 SURFAC	E MILC
5	62	52		1.1 2.0 2.9 3.8 4.8 5.8 6.7 3/4 RADIUS FROM CENT	ER WATE
	51	50		0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9 CENTER	QUENC
7	81	48		0.8 1.8 2.5 3.0 3.4 3.8 SURFAC	
	60	45		0.8 1.8 2.5 3.0 3.4 3.8 SURFAC 0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.6 4.0 3/4 RADIUS FROM CENT	
9	59	1 41		0.2 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1 CENTER	
10	58	39		0.2 0.8 7.0 1.4 7.7 2.0 2.4 2.0 3.1	
11	56	37	-65		
12	55	35			
		34	60		
13	54	34	ш		
14	.52	32	U 55		==
15 16	ήα βl	31	ũ		
10	49	3,	50		
18	47	30	0		
20	45	29	9 45		
22	43	28	v)		
24	45	28	ш Z 4.0		
26	42	27	Δ		
28	.41	27	¥ 35		
30	и	27	<u>≨</u> 35		
32	. #1	27			
UE 47 705	TIME TELEFORE	n.ore	7 30		
	ITING TEMPERAT		ROCKWEI 50		
	KENDED BY S		₹ 2.5		
*NORMAL	IZE 1600 ITIZE 15 50		บั		=

Note – 1 in. = 25.4 mm.

FIG. 63 Limits for Hardenability Band 8645 H



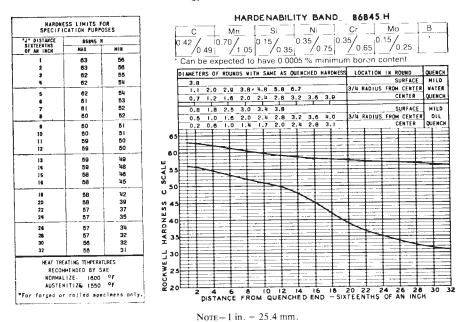
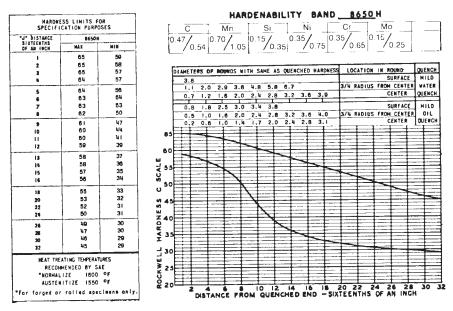


FIG. 64 Limits for Hardenability Band 86B45 H



Note - 1 in. = 25.4 mm.

FIG. 65 Limits for Hardenability Band 8650 H



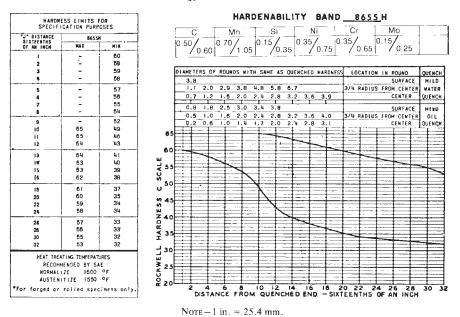


FIG. 66 Limits for Hardenability Band 8655 H

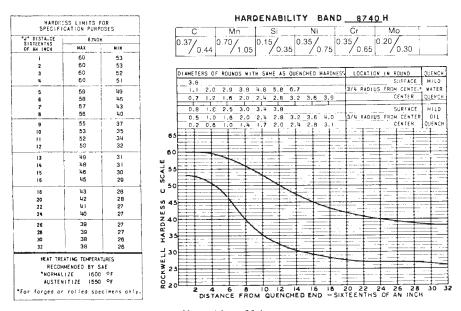
	SS LIMITS F CATION PURP				0	T	Mn		S	ABIL		Ni.	_	Cr		- м	n	Т.	
I DISTANCE	8660			0.55	7	10.7	70.7						10.		r			+	
BIXTEENTHS. DF AR INCH	MAI	HIN		10.00	0.6	5 ```	71.	.05	/	/ 0.35	0.00	/0.7	5	γ_0	65	//	0.25		
1		60				1	,				1		. L.	, .	1	′		<u></u>	-
2	- 1	60																	
2	-	60		DIAM	TERS	OF R	DUNDS	WITH	SAHE	AS O	UENCH	ED HA	RDNESS	1.00	CATIO	I IN F	OUND	Oil	ENG
	- 1	60			. в								-				URFAC		ILL
						.0 2	.9 3	.в 4	.в :	5. R 6	.7			3/14	RADIUS		CENT		
5	- 1	60		-							.2 3	6 2	0				ENTER		EN
	_	59		ڪ	· ·	· · ·	Ī	\mathbf{I}	1	T	i	i J	i			`	ENTER	100	£ m
7	-	58 57		0	.8 1	.8 2	.5 3	.0 3	.4 3	3.8				1 .			URFAC	E M	1111
				0	.5 1	.0 1	.6 2	.0 2			1.2 3			3/4 1	RADIUS	FROM	CENT	ER] (0 ł L
9	-	55		0	.2 0	.6	.0 1	.4 1	.7 2	2.0 2	. 4 2	.8 3	.1.			(ENTER	Ou	ENC
10	-	53	6:	Œ	\mathbf{F}	=	=	1	1	1	ł	I	1	===	1		-		F
14	- !	50		Œ	-		Ε.		Ι	1	T	I							
12	- 1	47			ŧ			\vdash		1	1	+-	+- -		-	_		_	
13		45	60	' 	=	$\overline{}$	_	1	-					-		_			$\overline{}$
14		44	wį			-			1	1	1		1						F
15	_	143	`₹ 5	:	 				1	1	1 -				-				\equiv
16	65	42	SCAL SCAL	1		!	-	<u>† </u>	X	·	1			1					Ė
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16	64	40	U	==	-			1		4	+	-	ļ	-					F
20	64	39	0.4	E		-			1	\sim	I	Ι.	I	1					
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24	62	37	₩ -	==	1		-	!	+	1	10.00	*-		‡ ~	-			\Rightarrow	
26	62	36	240	<u>'</u>				=	=			Ё		-				=	
28	61	36	æ								1	1:	Ε.		_	_		1	
30	60	35	¥ 3:	+	=	=	†		İ	1	=	-		-	-			-	
32	60	35	-	\Rightarrow	1	=	-	-	1	+=	-	1-	-	-	-				=
			ქ აი		<u> </u>	_	1	-	i –	1	1 -					-			=
HEAT TREA	TING TEMPERATI	JRES	141	=				<u> </u>	1-	-		I		_				-	\equiv
* RECOMM	ENDED BY SA	E	₹ 25	<u> </u>	-	=	<u> </u>		\vdash	+	=	+	=	=					=
"NORMAL I	ZE 1600	ok	¥ 25	-	1	-	-	-	+ =	-	1 =	+						=	_
AUSTEN	TIZE 1550	oŁ .	ŏ,	=		-	-	1	ŧ	1	-	-	-	-				==	=
r forged or	!!		# 2C	_	2 4	4	6	8	10	12 1	14	6	8 2	0 2	2	4 2	6 2	3	0

 $\label{eq:Note-1} \mbox{Note-1 in.} = 25.4 \mbox{ mm}.$ FIG. 67 Limits for Hardenability Band 8660 H



HARDENABILITY BAND 8720 H HARDNESS LIMITS FOR SPECIFICATION PURPOSES C Mn Si Ni Cr Mo 0 17/0.23 0.60/0.95 0.15/0.35/0.75 0.35/0.65 0.20/0.30 48 47 45 42 38 35 30 | DIAMETERS OF POUNDS WITH SAME 45 QUENCHED HARDNESS | LOCATION IN ROUND | QUENCH | 3.8 | SUPFACE | MILD | SUPFACE | MILD | SUPFACE | MILD | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | QUENCH | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MATER | CONTROL OF THE MAT 38 35 33 31 26 24 22 21 1.1 2.0 2.9 3.6 4.8 5.8 5.7 0.7 1.2 1.8 2.0 2.4 2.8 3.2 5.6 3.9 0.8 1.8 2.5 3.0 3.4 3.8 0.5 1.0 1.6 2.0 2.4 2.8 3.2 3.6 4.0 0.2 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1 SURFACE MILD 3/4 RADIUS FROM CENTER OIL CENTER QUENCH 30 29 28 27 20 26 26 25 25 14 15 16 o 50 24 24 23 23 23 23 22 22 25 HEAT TREATING TEMPERATURES RECOMMENDED BY SAE "NORMALIZE 1700 °F AUSTENITIZE 1700 °F For forged or rolled specimens only.

Note-1 in. = 25.4 mm. FIG. 68 Limits for Hardenability Band 8720 H



Note - 1 in. = 25.4 mm.

FIG. 69 Limits for Hardenability Band 8740 H



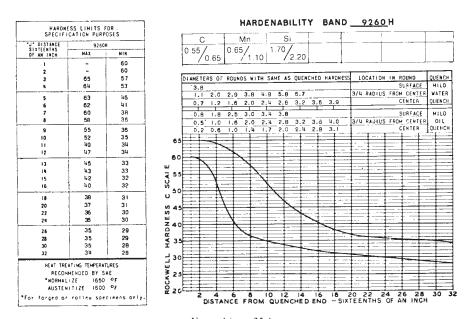
HARDENABILITY BAND * 8822H HARDNESS LIMITS FOR SPECIFICATION PURPOSES Si | Ni "J" DISTANCE SIXTEENTHS OF AM INCH 8822 H 0.70/1.05 0.35 0.15 0.35 0.75 43 42 39 33 50 49 48 46 2.9 3.8 4.8 5.8 6.7

0.7 1.2 1.6 2.0 2.4 2.8 3.2 3.6 3.9

0.3 1.8 2.5 3.0 3.4 3.8

0.5 1.0 1.6 2.0 2 4 29 27 25 24 143 140 37 35 SURFACE MILD OM CENTER OIL CENTER QUENCH 34 33 32 31 24 23 23 22 31 30 30 29 22 13 14 15 16 22 21 21 29 28 27 27 20 .18 20 22 25 27 27 27 27 HEAT TREATING TEMPERATURES
RECOMMENDED BY SAE
"NORMALIZE 1700 °F
AUSTENITIZE 1700 °F For forged or rolled specimens only 4 6 8 10 12 14 16 18 20 22 24 26 28 DISTANCE FROM QUENCHED END - SIXTEENTHS OF AN INCH

 $Note-1 \ in. = 25.4 \ mm.$ FIG. 70 Limits for Hardenability Band 8822 H



Note -1 in. = 25.4 mm.

FIG. 71 Limits for Hardenability Band 9260 H



	SS LIMITS FO			HARDENABILITY BAND 9310 H C Mn Si Ni Cr Mo	
J" DISTANCE SIXTEENTHS	9310#			0.07/ 0.40/ 0.15/ 2.95/ 1.00/ 0.08/	
OF AN INCH	MAX	MIN		/0.13 /0.70 /0.35 /3.55 /1.45 /0.15	
1	143	36			
2	43	35		/	
3	43	35		DIAMETERS OF ROUNDS WITH SAME AS QUENCHED HARDNESS LOCATION IN ROUND	QUENC
4	142	34		3.8 SURFAC	
5	42	32		1.1 2.0 2.9 3.8 4.8 5.8 6.7 3/4 RADIUS FROM CENT	
5	42	31		0.7 1.2 1.5 2.0 2.4 2.8 3.2 3.6 3.9 CENTER	QUENC
	42	30		0.8 1.8 2.5 3.0 3.4 3.8 SURFAC	HILI
	41	29		0.0	
				0.0	QUEN
9	40	28		0.2 0.6 1.0 1.4 1.7 2.0 2.4 2.8 3.1 CENTER	L
10	10	27	6.5		
11	39	27			
12	38	26	60		
13	37	26			12.0
14	36	26	٠. ت		
15	36	26	₹ 55		i . i
16	35	26	S		
	35	26	; 50		
18	35	25			
20	35	25	9 45		
22	34	25	5		E
24	.34	20	Z 40		
26	34	25	5		
28	34	25	∝ ≼ 3.5		
30	33	24	£ 35		-1-
32	33	24	-1 20		
			730		
	TING TEMPERATI		ω >		
	MENDED BY SA				
*NORMAL			¥ 2 5		
AUSTEN	ITIZE 1550	· · ·	₽ 20	2 4 6 8 10 12 14 16 18 20 22 24 26 2	8 30

 $\label{eq:Note-1} Note-1~in. = 25.4~mm.$ FIG. 72 Limits for Hardenability Band 9310 H

	SS LIMITS F CATION PURP			С	Mn	Si	Ni	Cr	Мо	В
J' DISTANCE	948158			0.12/	0.70/	0.15	0.25/	0.25	0.08	٠
OF AM INCH	HAX	MIN		/ 0.18	/ 1.05	/0.35	/ 0.65	0.55	7 0.15	
1	նը	38		* Can be	expected	to have 0.	0005 % mi	nimum bo	ron content.	
2	มูธ	38								
3	มน	37		DIAMETERS O	F ROUNDS WIT	'H SAME AS QI	JENCHED HARD	NESS LOCATI	ON IN ROUND	QUENC
	դս	36		3.8					SURFACE	MILO
	110	32			2.9 3.8	4.8 5.8 6	.7	3/4 RAD	US FROM CENTER	MATE
5	из						.2 3.6 3.9		CENTER	QUENC
•	42	28		J. , , , , , , , , , , , , , , , , , , ,	I I		I. I			
7	40	25		0.8 1.8	3 2.5 3.0	3.4 3.8			SUBFACE	1 WIFE
8	38	23		0.5 1.0	1.6 2.0	2.4 2.8 3	.2 3.6 4.0	3/4 RAD	IUS FROM CENTER	
9	36	21		0.2 0.6	1.0 1.4	1.7 2.0 2	,4 2.8 3.1	I	CENTER	QUENC
10	34	20					F T - E		1 -1	
D	33	-	65				I I I			
12	31	-				- F = T	III	- <u>-</u>		
			50						T	
13	30	-	ш			1 1				
14	29	i - [₹ 55				1			
15	26	-		1-1-1-1			1 1		-11-	- 1
16	27	-	S			1	1			
18	26		50							
20	25	1 - 1		<u>⊨</u> ::::::::::::::::::::::::::::::::::::		1	1 1 == 1	TT		- -
22	24		\$ 45							- [:
26	23	_	Ψ̈́	F			1			1.1.
47			Z 40							
26	23	-	5		1 1					
28	22	- 1			<u>+ +-></u>	\				==
30	22	-	₹ 3:	1-: :	\		1			
32	22	-	رو بـ							
MEAT TOE	ATING TEMPERAT	nipre	7,20		V			T T		
			₩ >	t militar i		=======================================				
	MENDED BY S		₹ 2:	`			1 1 1			-
PNORMAL			ROCK W				1			
AUSTEN	ITIZE 17CC	· · ·	₽ 20	2 4	6 8	10 12	4 16 18	20 22	24 26 28	30

Note -1 in. = 25.4 mm.

FIG. 73 Limits for Hardenability Band 94B15 H



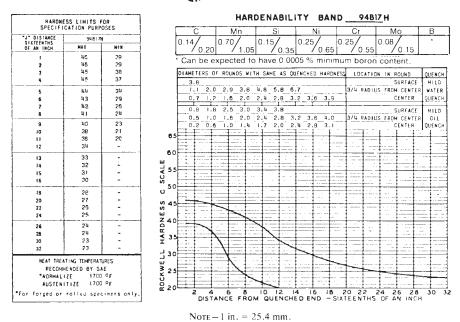


FIG. 74 Limits for Hardenability Band 94B17 H

	SS'LIMITS FI CATION PURPO			C	Mn	DENABI	I Ni	-	Cr		Mo		В	
* DISTANCE	94B30 H			0.27/	t	1	1			0.0		+	,	_
IXTEENTHS F AN INCH	HAX	MIN		0.27/0.33	0.70/	0.15	0.25	0.2	5/ _{0.5}			.15		
,	56	49			expected t									
2	56	49		Can be	expected	o nave ou	J005 % III	mmu	111 00	TOTIC	JUILLE	31II.		
3	55	48		DIAMETERS	OF ROUNDS WI	TH SAME AS	QUENCHED H.	RDNES	LOC	ATION	IN R	OUND .	01	JENO
4	55	¥8		3.8					T		S	URFAC		411.0
	54	47		1.1 2.	0 2.9 3.8	4.B 5.8	6.7		3/4 R	ADIUS	FROM	CENT	ER W	ATE
	54	46		0.7 1.	2 1.6 2.0	2.4 2.8	3.2 3.6	3.9	1		C	ENTER	" for	JEN:
7	53	44					T	Ι					-1,	_
8	53	42		0.8		3.4 3.9			ł			URFAC		4111
9	52	39		0.5 1.		2.4 2.8		4.0 3.1	3/4 R	ADIUS		ENTER		110
10	52	37		1 1 1	5 1.0 1.4	1.7 2.0	<u>-1 z. B</u>	I .	1	r	1	ENIER	Lá	JENO T
ii l	51	34	65		-1-1							-		
12	51	32		1 1 1		1 1	4	1	+ -:					‡
13	50	30	60)				+		\vdash				
14	นด	29	w	1 : : : : : :		574 2 172		- ‡	1 -1			; ;	* .	‡ ·
5	48	28	₹ 55	3		- 1 - 1 -		-	$\overline{1}$		-	\vdash		-
16	46	27	3 C			—		1	ļ					ŧ
			ິ 50				- - - - - - - - - - 	1						-
18	44	25 24	0		<u> </u>	. † † ·	7	‡	1===	1. ‡		- 1	-	1 ::
20	42	23	S 4	\$ 	1	- I - I		1	1					-
22	38	23	E S				‡ ‡	-						†
			Z 40				-1-1-	+-	\rightarrow			\vdash		\vdash
28	37	55	0.0			X		1	‡					ļ
28' 30	35 34	21	₹ 3:	+ = -1		-1		1	1				_	▙
30	34	20	*			1 3		1	1 - 3					1
			- ∃30			1 1	\leftarrow	+	1					-
	TING TEMPERATL		61					£	1					ŧ
	ENDED BY SA		₹25	5 1 1				*		-				1
*NORMAL (ROCK W			-1	- 1 1	+						-
AUSTENI	T17E 1600	°F	اد چ		+ +		14 15	<u> </u>	20 2	2 2	1 2		_	-

Note -1 in. = 25.4 mm.

FIG. 75 Limits for Hardenability Band 94B30 H



J" DISTANCE		н -	· —
SIXTEENTHS OF AN INCH	MAX.	HIN-	0.34/0.
1	58	51	
1.5	56	42	
2 .	55	. 34	DIAMETERS 0
2.5	53	29	3.8
3	49	26	1.1 2.0
3.5	43	. 24	0.7 1.2
4	37	23	0.8 1.8
4.5	33	22	0.5 1.0
5	30	22	0.2 0.6
5.5	29	21	65
6	28	2 '	~ 1 ÷ ‡ ÷‡
6.5	. 27	20	80
7	27	-	
7.5	26	-	
8	26	-	5.5 S
9	25		. 50 -1-1-1-1
	25		_ v ~ 1 ‡ 1 ‡
12	24	_	v 45
14	23	-	ο : : ! ‡ . # ‡
16	21	1	- + Z40 + +
			α ≰ 35
			± ~~
			;30
HEAT TRE	ATING TEMPER	ATURES	
	MENDED BY		¥ 25 × 25 × 20 20
"NORMAL		-	* - * - * - * - *

	HARDE	NABILIT	Y BANE	10	3 <u>8</u> H	
С	Mn	Si	Ni	Cr	Мо	
0.34/0.43	0.50/1.00	0.15/0.35				

1	DIAM	ETE	RS C	F R	OUNI	DS N	ŧ1∓	H S	AME	AS	QU	ENG	CHE	D	ARI	ONESS	1.9	ос.	ATION				\rightarrow		NCH
		3.8	2.0		2.9	3.		4.8			6.					-		R	ADIUS			REAC	- 1		LD TER
		7.7	1.2		.6	2.		2.1	_ 2	8.8	_3	. 2	3.	6	3. I	9	_					TER	\equiv		ENCH
		0.8	1.1		2.5	3.		3.1		3.8	3	. 2	3.	6	4.	0	3/4	R	ADIUS			REAC CENT			ILD ILL
		0.2	0.1		0_	.ا .ا		1.7		2.0		. 4 T	?.		3.	1			1			TER		— 1	ENCH
55	1	+			+		-		-		-					- 1					Ī				= =
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		-	1		1			-		1				1							1				
1.5		1	1	-	1		-			-	==				-			-		=		-		Ξ	=
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3 0	Ē	1		1	1					-	=	-		1	_	=	F	_	=		+	=_	F	==	F
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2 5	Ē	I	7			= -		_]		1		+	_		-	-	1		=	-	1		E	_	
2 (بت	2	DI5		6		8	. 1	0	12	I CH	14		16		8	20	2	2 2 THS		26		2.8 1.0.1		30

Note - 1 in. = 25.4 mm.

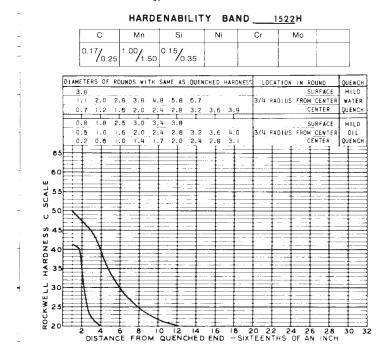
FIG. 76 Limits for Hardenability Band 1038 H

SPECIFI	SS LIMITS F CATION PURP	OSES		C .	Mn	Si	Ni	Cr	Мо	
J" DISTANCE SIXTEENTHS OF AN INCH	HAX-	H HIN.		0.42/0.51	.50/	0.15/0.35				
1	62	55			,				<u>' </u>	
1.5	61	52						uree 1001	TION IN ROUND	QUENC
2	59	42 ;	Į	DIAMETERS OF ROU	NDS WITH	SAME AS QU	ENCHED HARL	NESS EUCA	SURFACE	MILD
2.5	56	34	ĺ	3.8						4
3	52	31		1.1 2.0 2.9	3.8 4.				DIUS FROM CENTE CENTER	QUENC
-	46	29	[0.7 1.2 1.8	3 2.0 2.	4 2.8 3.	2 3.6 3.9	9 +	CENTER	YUENG
3.5 u	38	28		0.8 1.8 2.	5 3.0 3.	4 3.8			SURFACE	MILE
4.5	34	27		0.5 1.0 1.6			2 3.6 4.	0 " 3/4 RA	DIUS FROM CENTE	R OIL
	. — ::			0.2 0.6 1.0					CENTER	QUENC
5	. 33	26		0.2 0.6 1.0	1 1		- I- I			
5.5	32	26	65			-		- -		
6	. 32	25 1			- " == " ==	1 -1 -		_ 1_ :1	‡ ‡ ‡	-==
6.5	31		60							_ [
7	. 31	25	ш		+				$\exists \exists \exists$	\equiv
7.5	30	24	₹ 55			-	1-1-1			-
8	30	. 24		= + + + = +	= ==	1 = - =	$= \pm = \pm$			
9	29	23	ပ္တ 50				+ + -			
	+	22				+ + -	‡ ‡ ‡	_1 _1		
10	29	21		F=#-\F-#		# - 1				_=
12	28 27	20 1	v 45			1	1 = 1		- t = E	- F
14	. 26		ш			+	‡ = ‡ = 寸			
		÷ - 1	Z 40							
18	25	- '	Σ. O		-	$= \pm =$	1			
20	23	. –	₹ 35			<u> </u>				===
22	22		I	$\vdash \vdash $		+			======	==
24	21	ســـــــــــــــــــــــــــــــــــــ	- 30						- + + +	\rightarrow
	ATING TEMPERA		E L							-
*NORMA			¥ 2.5 V	$\vdash \bot = \bot$		= == -	I I		\sim $+$ $+$ $+$ $+$	_ +

Note—1 in. = 25.4 mm.

FIG. 77 Limits for Hardenability Band 1045 H





 $No{\mbox{\scriptsize TE}}{-1} \ \ in. = 25.4 \ \ mm.$ FIG. 78 Limits for Hardenability Band 1522 H

	SS LIMITS CATION PURP			С	Mn	Si	Ni		Or	N	10	
"J" DISTANCE SIXTEENTHS - OF AN INCH	MAX.	H HIN-		0.18.4	1.25/	0.15/					- +	
		•		0.18	1.25/	0.15/0.	35	1			j	
	51	42					-	+		J		
1.5	49	42	_					—т				
2.5	48 47	38 34	D1.		COUNDS WITH	SAME AS	QUENCHED HA	RDNESS	LOCA	TION	IN ROUNE	
2.5		. 34		3.8				1	-		SURF	
3	45	29	<u></u>	1.1 2.0 2				+	3/4 R	ADIUS	FROM CEN	
3.5	43	25 .	└	0.7 .2	.6 2.0 2	4 2.8	3.2 3.6 3	.9			CENTE	R QUEN
4	39	22	-	0.8 1.8 2	2.5 3.0 3	.4 3.B		1			SURF	ICE MIL
4.5	38	20	·	· · · · · · · · · · · · · · · · · ·			3.2 3.6 4	.o ta	3/4 R	ADTUS	FROM CEN	
5	35	-					2.4 2.8 3				CENTE	
5.5	34	-		H	T 1"	H-+	-4- +	; ;	Ŧ	. 4		1 1
6	32	- !	65					- I		I		1
6.5	30	-						Ŧ . Ŧ	· Į	I		Ŧ F :
7	29		60		+			1			===	+ +
7.5	28	1 1	ш 🗀		+		++-					
8	27		₹ 55							_		
9	26	_	SC	: +						-		1 1
		•	50⊢									
10	25	-	٠ -	- L	<u> </u>	 			-			+
12	23 22	-	v 45		+ + +		1 1 1	 		- 1		
16	20	-	ES	~ \	+ +					-		+
			Z 40	- V - V -	+			1 1	-		_	+ +
			¥ 35	-I	± ±				= ‡			
		: "	₹ 35	$X \vdash A$	+ +		\bot	\vdash		-	_	+ +
!		ļ	# T-	- 11 - 1						- 1		+
<u> </u>			∃ 30		X							1
HEAT TREAT	ING TEMPERAT	URES	≓ د ا	$\Rightarrow \downarrow \downarrow$	1				- +			+
	ENDED BY S		25 WE	- + + -								-
*NORMAL I	ZE 1650	0 F	× * * * =	- V -								1 - 1
AUSTEN	TIZE 1600	°F	გ "⊨		‡ ‡			† †		==		
ir forged or			ac ≥0 —	2 4	6 8	0 12	14 16 !	B 20	0 22	24	26	28 30

FIG. 79 Limits for Hardenability Band 1524 H



	SS LIMITS I				HARDI	NABILITY				
J" DISTANCE		H		С	Mn	Si	Ni	Cr	Mo	
SIXTEENTHS OF AM INCH	MAX-	MIN-		0.21/0.30	1.00/	0.15				İ
1	53	44		/ 0.30	71.50	/0.35				
1.5	50	42	_							- 1 -
2	49	38	D	AMETERS OF RO	DUNDS WITH	SAME AS QUENC	HED HARDN	ESS LOCAT	TION IN ROUND	QUEN
2.5	47	33		3.8					SURFA	CE MIL
3	46	26		1,1 2.0 2	.9 3.8 4.	8 5.8 6.7	_	3/4 RAD	TUS FROM CEN	
3.5	42	25	[0.7 1.2 +	.6 2.0 2.	4 2.8 3.2	3.6_3.9		CENTE	R QUEN
4	39	2	F	0.8 1.8 2	.5 3.0 3	4 3.B			SURFA	CE MIL
4.5	37	20	-			4 2.8 3.2	3.6 4.0	3/11 841	DIUS FROM CEN	
5	33	· - ·	-		.0 1.4 1.		2.8 3.1		CENTE	
5.5	3	1 - 1		1 1 1	Ţ+	T T	++	-	F	+ ~_—
6	30	- !	65				- 1-			
6.5	28	- 1		<u> </u>			1			1
7	27		60							
7.5	26	- '	"	: : ====	!	+	-			1 1
8	26	- 1	₹ 55		-		1			
9	24	- '	sc.					= + - + -	-	‡· =‡
10	24		ე 50				= ==			1
12	. 23			: \	+ +	:	4 1-			Ŧ Ŧ
14	22	1 - 2	S 45	$\mathbf{x} \perp \mathbf{X}$	1 1					ŧ
16	21	- 1	ш -	\	<u> </u>		-1-	-	* * *	1 -
18	20		Z 40	: V - V	 					
10		!	α <u> </u>	: 1 A	I I		\pm	- 1		1
	:		∮ 35	- 1 - 1	+ + -		+	+=+	===	
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			' ∃30 <u></u>				+ +			1 1
	AT ING TEMPERA		ш 🗀	:			7 1			<u> </u>
	MENDED BY S		₹ 25				-	- - 	- - - 	1 1
"NORMAL			ି ହୁଁ F.	: \	+ 1 7					1
	1 T 1 Z E 1600		≱ 25 25 20 20	<u> </u>	<u> </u>			20 22	24 26 2	28 30
or forged or	rolled sp	ecimens only.		2 4	6 8	0 12 14 QUENCHED	16 18 END - 9	20 22	45 OF AN IN	
			•	DIS I MIN	LINOM	WO ELICITED				

FIG. 80 Limits for Hardenability Band 1526 H

SPECIFIC	SS LIMITS F CATION PURP			С	Mn	Si	Ni	Cr	Mo	
J" DISTANCE SIXTEENTHS OF AN INCH	MAX.	H HIH-		0.35/	1.25	0.15/				
OT AN INCH	60	53		0.45	/ 1.75	0.35	l			
1.5	59	52								
2	59	50	DIA	AMETERS OF RO	DUNDS WITH	SAME AS DUE	CHED HARD	NESS LOCA	TION IN ROL	ND QUE
2.5	58	47		3.8				-	SUF	FACE MII
	57	1	1		.9 3.8 4.	.8 5.8 6.7		3/4 RA	DIUS FROM C	ENTER WAT
3	56	. 41	ŀ	0.7 1.2		4 2.8 3.2	3.6 3.9			TER QUE
3.5	56 55	38						-		
4.5	53	35 1	<u> </u>		.5 3.0 3.					FACE MIL
4.5		·	Į.		.6 2.0 2.				DIUS FROM C	
5	52	32		0.2 0.6 1	.0 1.4 1	.7 2.0 2.4	2.8 3.	' 1 .	I I	TER QUEN
5.5	50 i 48	29	6.5				1 1		1 1	
6	46	26				1 - +===			‡	
6.5	+		60	-						1 1
7	44	25	w ===		1 1					+
7.5	41	24	₹ 5.5			+ + +				
8	39	23	3	, - N	‡ ‡ `				= ±	1
9	35	23	v 50⊢	\mathcal{L}						+ +
10	33	22	υ J	: \	4	‡ : <u> </u>	+ +	= +		
12	32	21	V 45		$A \perp =$	1	I			
14	31	20	°S ₹3							
16	30		# 	:	+ \	1	-1-1			
18	30		Z 40						- I	
20	29	-	۳ :	: + \	1	 	-		+=+	
22	28	1 -	∮ 35							\mp
24	26	- 1	E	$: \vdash \vdash \vdash \bigvee$	+ 1					1 1
RECOM *NORMAL	ATING TEMPERA MENDED BY S IZE 1600 ITIZE 1550	OF	30 25 25 20	2 4	6 8	0 12 14	16 18	3 20 22	24 26	28 30

 $N_{\text{OTE}}{-1} \text{ in.} = 25.4 \text{ mm}.$ FIG. 81 Limits for Hardenability Band 1541 H



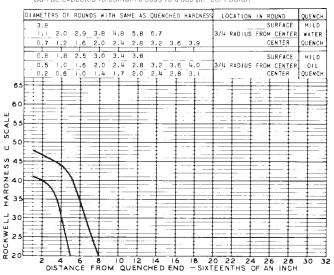
J" DISTANCE SIXTEENTHS		н
OF AN INCH	HAX.	MIN-
1 1 5 2 2 5	48 48 47 47	41 41 40 39
3 3.5 4 4.5	46 45 44 42	38 36 30 23
5 5 5 6 6 5	40 38 35 32	20
, 7 7 5 8 9	27 22 20	:
10 12 14 16	-	

*For forged or rolled specimens only.

			45D01
HARDENARII	ITY	BAND	15B21 H

С	Mn	Si	Ni	Cr	Мо	
0.17/0.24	0.70/	0.15/0.35				

Can be expected to contain 0 0005 to 0.003 per cent boron



Note -1 in. = 25.4 mm.

FIG. 82 Limits for Hardenability Band 15B21 H

J" DISTANCE		Н
SIXTEENTHS -	MÁX.	MIN-
1	58	. 51
2	56	50
3	55	49
4	54	: 48
5	53	39
6	51	28
7	47	24
8	41	22
9	-	-
10	30	20
H	-	_
12	27	-
13	-	' -
14	26	-
15	-	-
16	25	-
18	-	-
20	24	
22	-	
24	22	
26	-	-
28	20	-
30	-	
32	-	
HEAT TREA	TING TEMPERAT	URES

HARDENABILITY BAND 15835H

С	Mn	Si	Ni	Cr	Мо	В
0.31/0.39	0.70/	0.15/0.35				*

Can be expected to contain 0.0005 to 0.003 per cent boron.

۲	3.8	KS UF	RUUI	105 1	HILL	SAME	: A3	, QU	ENC	HED	HAR	DNES	L	CATIO		SURFA		QUENC MILD
L	1.1	2.0	2.9				5.8						3/4	RADIU	S FRC	M CEN	TER	WATE
<u> </u>	0.7	1.2	1.6	2.1	0 2	- 4	2.8	3.	2	3.6	3.	9	↓			CENTE	R	QUENC
	0.8	1.8	2.5	3.4	0 3	.4	3.8									SURFA	CE	MILD
	0.5	1.0	1.6				8 · B	3.		3.6	ц.	0	3/4	RADIU	S FRO			
1	0.2	0.6	1.0	_ 1;1	4!	.7	2.0	. 2.	4	2.8	3.	I .			.	CENTE	R	QUENC
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5.5	→			_		-	+		_	+	- +				+	-	1	
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3 A E	T 1	1	\pm	- }	_	<u> </u>	\pm			1				1	_	-	<u> </u>	-
-0-	2	4	6	8	-	10	12	14	4	16	18	1 2	20 2	22 2	24 :	26 2	28	30

Note -1 in. = 25.4 mm.

FIG. 83 Limits for Hardenability Band 15B35 H



HARDNESS LIMITS FOR SPECIFICATION PURPOSES

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-

HEAT TREATING TEMPERATURES

RECOMMENDED BY SAE

*NORMALIZE 1600 OF

AUSTENITIZE 1550 OF

*For forged or rolled specimens only.

> -

-

HARDENABILITY BAND 15837H

С	Mn	Si	Ni	Cr	Мо	В
0.30	1.00/	0.15/0.35				*

Can be expected to contain 0.0005 to 0.003 per cent boron.

DI		RS 0	ROUN	DS W	TH SA	IME A	S Q	JENC	HED	HARDN	ESS	LC	CATION			QUENC
	3.8		_								_	ļ			SURFACE	MILE
	1.1	2.0	2.9	3.8	4.8	5.8		. 7				3/4	RADIUS		M CENTER	1
\vdash	0.7	1.2	1.8	2.0	2.4	2.8	3	. 2	3.6	3.9		-		-	CENTER	QUENC
	0.8	1.8	2.5	3.0	3.4	3.8	_	_							SURFACE	MILE
	0.5	1.0	1.6	2.0	2.4	2.8	3	. 2	3.6	4.0		3/4	RADIUS		4 CENTER	
	0.2	0.6	1.0	1.4	1.7	2.0	2	. 4	2.8	3.1		1			CENTER	QUEN
65	+ +	Į-	-	=				_	_	_ [_	<u> </u>	1			+
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Note - 1 in. = 25.4 mm.

FIG. 84 Limits for Hardenability Band 15B37 H

	SS LIMITS F ATION PURP			С	Mn	Si	Ni	Cr	Mo]
J" DISTANCE SIXTEENTHS — OF AN INCH	MAX.	MIN-		0.35/0.45	1.25/	0.15/0.35					
1 2 3	60 59 59	53 52 52					to 0 003 per :				
4 .	58	51	011	3.8	OUNDS WITH	SAME AS QU	ENCHED HARDNES	s roc	ATION IN E	ROUND SURFACE	QUE
5 6 7	58 57 57	51 50 49	<u>}</u>	0.7 1.2 I	.6 2.0 2		7 2 3.6 3.9	3/4 R	ADIUS FROM		
8	56	48 !				.4 3.8				SURFACE	MI
9 10 11 12	55 55 54 53	44 37 32 28	6.5		0 1.4 1.			3/4 R	ADIUS FROM	M CENTER CENTER	QUE
			60		<u> </u>		• • ‡. • ‡	1		1 1	- ‡
13 14 15 16	52 51 50 49	26 25 25 24	5.5 E								-
18 20	46 42	23 22	y 50					+ +	-		-
22 24	39 36	21 21	S 45					•	-		+
26 28	34 33	20	Z 40								1
30 32	31 31		± 35					\vdash			=
	ING TEMPERATUR	RES	30								1
*NORMALI AUSTENI			₹ 25 ₩ 20								1

Note -1 in. = 25.4 mm.

FIG. 85 Limits for Hardenability Band 15B41 H



SPECIF	ESS LIMITS ICATION PUR	POSES		С	Mn	Si	Ni	Cr	Мо		7
DISTANCE CTEENTHS AM INCH	MAX.	H MIN.		0.43/	1.00/	0.15	5				1
1 2 3 4	63 62 62 61	56 56 55 54	DIA	METERS OF RO					ATION IN R		QUEN
5 6 7 8	60 59 58 57	53 52 42 34		0.7 1.2 1. 0.8 1.8 2.	.6 2.0 2.		.2 3.6 3. I I I	9	ADIUS FROM	CENTER ENTER (URFACE	TAW MBUÇ JIM
9 10 11 12	56 55 53 51	31 30 29 28	man a	0.5 0.0 0.2 0.6 1.			.2 3.6 4.		ADIUS FROM		OI QUEI
13 14 15 16	48 45 41 38	27 27 26 26	8CA∟E								
18 20 27 24	34 32 31 30	25 24 23 22	5 50 5 45								
26 28 30 32	29 29 28 28	2; 20	Z 40 Q ¥ 35 I								
	ATING TEMPERATU		⊒ 30 ⊒								\blacksquare
"NORMAL AUSTEN	.IZF 1600 °	•F	25 ¥ 00 20								-
*For forged o	or rolled specimen	s only	₩ 20 	2 4 6	8 I	0 12 I		20 22 SIXTEEN		6 28	30

FIG. 86 Limits for Hardenability Band 15B48 H

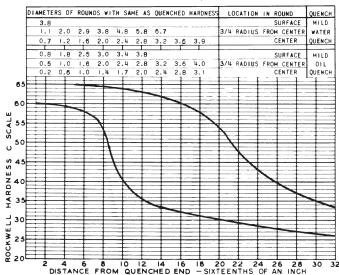


*For forged or rolled specimens only

HARDENABILITY	BAND	15R62 µ
MAKUENABILIT	BAND	10002 H

С	Mn	Si	Ni	Cr	Мо	
0.54/0.67	1.00/1.50	0.40 (0.60				

Can be expected to contain 0.0005 to 0.003 per cent boron



Note - 1 in. = 25.4 mm.

FIG. 87 Limits for Hardenability Band 15B62 H

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