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SAE J404 JAN89

**Chemical
Compositions of SAE
Alloy Steels**

SAE Standard
Revised January 1989

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Ø CHEMICAL COMPOSITIONS OF SAE ALLOY STEELS

1. INTRODUCTION:

In 1941, the SAE Iron and Steel Division in collaboration with the American Iron and Steel Institute made a major change in the method of expressing composition ranges for the SAE steels. The plan, as now applied, is based in general on narrower ladle analysis ranges plus certain product (check) analysis allowances on individual samples, in place of the fixed ranges and limits without tolerances formerly provided for carbon and other elements in SAE steels (Reference J408). To avoid the possibility of confusion and conflict between SAE and AISI steel designations, all proposed changes in compositions or additions or deletions of numbers will be coordinated between the two organizations.

The compositions in this SAE Standard may apply to open hearth and basic oxygen, or electric furnace steels. Grades shown in Table 1A with prefix letter E are normally made by the electric furnace process with maximum limits of 0.035% phosphorus and 0.040% sulfur. The nominal chemical limits or ranges in the compositions given in Table 1A are subject to standard variations in check analysis given in SAE J409.

Table 1A is applicable to billets, blooms, slabs, and hot-rolled and cold-finished bars. This table is applicable also to wire rods, but there are additional grades in J1249 Table 1 (refer to footnote c) which also are standard for wire rods.

J404 is not applicable to the following product forms:

- structural shapes - not normally furnished to alloy chemistries.
- sheet and strip, hot rolled and cold rolled - refer to ASTM A 506 and A 507.
- seamless and welded mechanical tubing - refer to ASTM A 513 and A 519.

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SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

2. CROSS INDEX TO EQUIVALENT GRADES AND GOVERNMENT SPECIFICATIONS:

Attention is called to the SAE Aerospace Material Specifications (AMS) Index which is published twice a year. This index gives a cross reference to AMS grades. SAE grades, AISI grades, and Government Specifications (MIL, QQS, and so on) for metals, alloys, and nonmetallic materials.

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

TABLE 1A - Alloy Steel Compositions^a

UNS No.	SAE No.	Ladle Chemical Composition Limits, %										Corresponding AISI No.
		C	Mn	P	S	Si	Ni	Cr	Mo	V		
G13300	1330	0.28-0.33	1.60-1.90	0.035	0.040	0.15-0.35	---	---	---	---	1330	
G13350	1335	0.33-0.38	1.60-1.90	0.035	0.040	0.15-0.35	---	---	---	---	1335	
G13400	1340	0.38-0.43	1.60-1.90	0.035	0.040	0.15-0.35	---	---	---	---	1340	
G40230	4023	0.20-0.25	0.70-0.90	0.035	0.040	0.15-0.35	---	---	0.20-0.30	---	4023	
G40270	4027	0.25-0.30	0.70-0.90	0.035	0.040	0.15-0.35	---	---	0.20-0.30	---	4027	
G40280	4028	0.25-0.30	0.70-0.90	0.035	0.035-0.050	0.15-0.35	---	---	0.20-0.30	---	4028	
G40370	4037	0.35-0.40	0.70-0.90	0.035	0.040	0.15-0.35	---	---	0.20-0.30	---	4037	
G40470	4047	0.45-0.50	0.70-0.90	0.035	0.040	0.15-0.35	---	---	0.20-0.30	---	4047	
G41180	4118	0.18-0.23	0.70-0.90	0.035	0.040	0.15-0.35	---	0.40-0.60	0.08-0.15	---	4118	
G41200	4120*	0.18-0.23	0.90-1.20	0.035	0.040	0.15-0.35	---	0.40-0.60	0.13-0.20	---	4120*	
G41210	4121**	0.18-0.23	0.75-1.00	0.035	0.040	0.15-0.35	---	0.45-0.65	0.20-0.30	---	4121**	
G41300	4130	0.28-0.33	0.40-0.60	0.035	0.040	0.15-0.35	---	0.80-1.10	0.15-0.25	---	4130	
G41310	4131	0.28-0.33	0.50-0.70	0.035	0.040	0.15-0.35	---	0.90-1.20	0.15-0.25	---	4131	
G41370	4137	0.35-0.40	0.70-0.90	0.035	0.040	0.15-0.35	---	0.80-1.10	0.15-0.25	---	4137	
G41400	4140	0.38-0.43	0.75-1.00	0.035	0.040	0.15-0.35	---	0.80-1.10	0.15-0.25	---	4140	
G41420	4142	0.40-0.45	0.75-1.00	0.035	0.040	0.15-0.35	---	0.80-1.10	0.15-0.25	---	4142	
G41450	4145	0.43-0.48	0.75-1.00	0.035	0.040	0.15-0.35	---	0.80-1.10	0.15-0.25	---	4145	
G41470	4147	0.45-0.50	0.75-1.00	0.035	0.040	0.15-0.35	---	0.80-1.10	0.15-0.25	---	4147	
G41500	4150	0.48-0.53	0.75-1.00	0.035	0.040	0.15-0.35	---	0.80-1.10	0.15-0.25	---	4150	
G43200	4320	0.17-0.22	0.45-0.65	0.035	0.040	0.15-0.35	1.65-2.00	0.40-0.60	0.20-0.30	---	4320	
G43400	4340	0.38-0.43	0.60-0.80	0.035	0.040	0.15-0.35	1.65-2.00	0.70-0.90	0.20-0.30	---	4340	
G43406	E4340 ^b	0.38-0.43	0.65-0.85	0.025	0.025	0.15-0.35	1.65-2.00	0.70-0.90	0.20-0.30	---	E4340	
G46200	4620	0.17-0.22	0.45-0.65	0.035	0.040	0.15-0.35	1.65-2.00	---	0.20-0.30	---	4620	
G47150	4715***	0.13-0.18	0.70-0.90	0.035	0.040	0.15-0.35	0.70-1.00	0.45-0.65	0.45-0.65	---	4715***	
G47200	4720	0.17-0.22	0.50-0.70	0.035	0.040	0.15-0.35	0.90-1.20	0.35-0.55	0.15-0.25	---	4720	
G48150	4815	0.13-0.18	0.40-0.60	0.035	0.040	0.15-0.35	3.25-3.75	---	0.20-0.30	---	4815	
G48200	4820	0.18-0.23	0.50-0.70	0.035	0.040	0.15-0.35	3.25-3.75	---	0.20-0.30	---	4820	

TABLE 1A - Alloy Steel Compositions^a (Continued)

UNS No.	SAE No.	Ladle Chemical Composition Limits, %										Corresponding AISI No.
		C	Mn	P	S	Si	Ni	Cr	Mo	V		
G50461	50B46 ^c	0.44-0.49	0.75-1.00	0.035	0.040	0.15-0.35	—	0.20-0.35	—	—	50B46	
G51200	5120	0.17-0.22	0.70-0.90	0.035	0.040	0.15-0.35	—	0.70-0.90	—	—	5120	
G51300	5130	0.28-0.33	0.70-0.90	0.035	0.040	0.15-0.35	—	0.80-1.10	—	—	5130	
G51320	5132	0.30-0.35	0.60-0.80	0.035	0.040	0.15-0.35	—	0.75-1.00	—	—	5132	
G51400	5140	0.38-0.43	0.70-0.90	0.035	0.040	0.15-0.35	—	0.70-0.90	—	—	5140	
G51500	5150	0.48-0.53	0.70-0.90	0.035	0.040	0.15-0.35	—	0.70-0.90	—	—	5150	
G51600	5160	0.56-0.64	0.75-1.00	0.035	0.040	0.15-0.35	—	0.70-0.90	—	—	5160	
G51601	51B60 ^c	0.56-0.64	0.75-1.00	0.035	0.040	0.15-0.35	—	0.70-0.90	—	—	51B60	
G51986	E51100 ^b	0.98-1.10	0.25-0.45	0.025	0.025	0.15-0.35	—	0.90-1.15	—	—	E51100	
G52986	E52100 ^b	0.98-1.10	0.25-0.45	0.025	0.025	0.15-0.35	—	1.30-1.60	—	—	E52100	
G61500	6150	0.48-0.53	0.70-0.90	0.035	0.040	0.15-0.35	—	0.80-1.10	—	0.15 min	6150	
G86150	8615	0.13-0.18	0.70-0.90	0.035	0.040	0.15-0.35	0.40-0.70	0.40-0.60	0.15-0.25	—	8615	
G86170	8617	0.15-0.20	0.70-0.90	0.035	0.040	0.15-0.35	0.40-0.70	0.40-0.60	0.15-0.25	—	8617	
G86200	8620	0.18-0.23	0.70-0.90	0.035	0.040	0.15-0.35	0.40-0.70	0.40-0.60	0.15-0.25	—	8620	
G86220	8622	0.20-0.25	0.70-0.90	0.035	0.040	0.15-0.35	0.40-0.70	0.40-0.60	0.15-0.25	—	8622	
G86300	8630	0.28-0.33	0.70-0.90	0.035	0.040	0.15-0.35	0.40-0.70	0.40-0.60	0.15-0.25	—	8630	
G86370	8637	0.35-0.40	0.75-1.00	0.035	0.040	0.15-0.35	0.40-0.70	0.40-0.60	0.15-0.25	—	8637	
G86400	8640	0.38-0.43	0.75-1.00	0.035	0.040	0.15-0.35	0.40-0.70	0.40-0.60	0.15-0.25	—	8640	
G86450	8645	0.43-0.48	0.75-1.00	0.035	0.040	0.15-0.35	0.40-0.70	0.40-0.60	0.15-0.25	—	8645	
G87200	8720	0.18-0.23	0.70-0.90	0.035	0.040	0.15-0.35	0.40-0.70	0.40-0.60	0.20-0.30	—	8720	
G88220	8822	0.20-0.25	0.75-1.00	0.035	0.040	0.15-0.35	0.40-0.70	0.40-0.60	0.30-0.40	—	8822	
G92590	9259	0.56-0.64	0.75-1.00	0.035	0.040	0.70-1.10	—	0.45-0.65	—	—	9259	
G92600	9260	0.56-0.64	0.75-1.00	0.035	0.040	1.80-2.20	—	—	—	—	9260	

^aFor standard variations in composition limits, see Table 4 of SAE J409. Small quantities of certain elements which are not specified or required may be found in alloy steels. These elements are to be considered as incidental and are acceptable to the following maximum amount: copper to 0.35%, nickel to 0.25%, chromium to 0.20%, and molybdenum to 0.06%.

^bElectric furnace steel.

^cBoron content is 0.0005-0.003%.

^dLead - Standard carbon steels can be produced with a range of 0.015-0.35% to improve machinability. Such steels are identified by inserting the letter "L" between the second and third numerals of the grade number, for example, 10L45. The UNS designation is also modified by changing the last digit to "4" to indicate lead, for example, G10454. Lead is generally reported as a range of 0.15/0.35%.

*Formerly EX15

**Formerly EX24

***Formerly EX30

TABLE 1B - Alloy Steel Plate Compositions a, b, c
(Open Hearth and Basic Oxygen)

UNS No.	SAE No.	Ladle Chemical Composition Limits, %									
		C	Mn	P max	S max	Si ^d	Ni	Cr	Mo	V	
G13300	1330	0.27-0.34	1.50-1.90	0.035	0.040	0.15-0.35	---	---	---	---	
G13350	1335	0.32-0.39	1.50-1.90	0.035	0.040	0.15-0.35	---	---	---	---	
G13400	1340	0.36-0.44	1.50-1.90	0.035	0.040	0.15-0.35	---	---	---	---	
G13450	1345	0.41-0.49	1.50-1.90	0.035	0.040	0.15-0.35	---	---	---	---	
G41180	4118	0.17-0.23	0.60-0.90	0.035	0.040	0.15-0.35	---	0.40-0.65	0.08-0.15	---	
G41300	4130	0.27-0.34	0.35-0.60	0.035	0.040	0.15-0.35	---	0.80-1.15	0.15-0.25	---	
G41350	4135	0.32-0.39	0.65-0.95	0.035	0.040	0.15-0.35	---	0.80-1.15	0.15-0.25	---	
G41370	4137	0.33-0.40	0.65-0.95	0.035	0.040	0.15-0.35	---	0.80-1.15	0.15-0.25	---	
G41400	4140	0.36-0.44	0.70-1.00	0.035	0.040	0.15-0.35	---	0.80-1.15	0.15-0.25	---	
G41420	4142	0.38-0.46	0.70-1.00	0.035	0.040	0.15-0.35	---	0.80-1.15	0.15-0.25	---	
G41450	4145	0.41-0.49	0.70-1.00	0.035	0.040	0.15-0.35	---	0.80-1.15	0.15-0.25	---	
G43400	4340	0.36-0.44	0.55-0.80	0.035	0.040	0.15-0.35	1.65-2.00	0.60-0.90	0.20-0.30	---	
G43406	E4340	0.37-0.44	0.60-0.85	0.025	0.025	0.15-0.35	1.65-2.00	0.65-0.90	0.20-0.30	---	
G46150	4615	0.12-0.18	0.40-0.65	0.035	0.040	0.15-0.35	1.65-2.00	---	0.20-0.30	---	
G46170	4617	0.15-0.21	0.40-0.65	0.035	0.040	0.15-0.35	1.65-2.00	---	0.20-0.30	---	
G46200	4620	0.16-0.22	0.40-0.65	0.035	0.040	0.15-0.35	1.65-2.00	---	0.20-0.30	---	
G51600	5160	0.54-0.65	0.70-1.00	0.035	0.040	0.15-0.35	---	0.60-0.90	---	---	
G61500	6150	0.46-0.54	0.60-0.90	0.035	0.040	0.15-0.35	---	0.80-1.15	---	0.15 min	

TABLE 1B - Alloy Steel Plate Compositions^{a,b,c} (Continued)
(Open Hearth and Basic Oxygen)

UNS No.	SAE No.	Ladle Chemical Composition Limits, %									
		C	Mn	P max	S max	Si ^d	Ni	Cr	Mo	V	
G86150	8615	0.12-0.18	0.60-0.90	0.035	0.040	0.15-0.35	0.40-0.070	0.35-0.60	0.15-0.25	---	
G86170	8617	0.15-0.21	0.60-0.90	0.035	0.040	0.15-0.35	0.40-0.070	0.35-0.60	0.15-0.25	---	
G86200	8620	0.17-0.23	0.60-0.90	0.035	0.040	0.15-0.35	0.40-0.070	0.35-0.60	0.15-0.25	---	
G86220	8622	0.19-0.25	0.60-0.90	0.035	0.040	0.15-0.35	0.40-0.070	0.35-0.60	0.15-0.25	---	
G86250	8625	0.22-0.29	0.60-0.90	0.035	0.040	0.15-0.35	0.40-0.070	0.35-0.60	0.15-0.25	---	
G86270	8627	0.24-0.31	0.60-0.90	0.035	0.040	0.15-0.35	0.40-0.070	0.35-0.60	0.15-0.25	---	
G86300	8630	0.27-0.34	0.60-0.90	0.035	0.040	0.15-0.35	0.40-0.070	0.35-0.60	0.15-0.25	---	
G86370	8637	0.33-0.40	0.70-1.00	0.035	0.040	0.15-0.35	0.40-0.070	0.35-0.60	0.15-0.25	---	
G86400	8640	0.36-0.44	0.70-1.00	0.035	0.040	0.15-0.35	0.40-0.070	0.35-0.60	0.15-0.25	---	
G86550	8655	0.49-0.60	0.70-1.00	0.035	0.040	0.15-0.35	0.40-0.070	0.35-0.60	0.15-0.25	---	
G87420	8742	0.38-0.46	0.70-1.00	0.035	0.040	0.15-0.35	0.40-0.070	0.35-0.60	0.20-0.30	---	

^aSmall quantities of certain elements not required may be found. These elements are to be considered as incidental and are acceptable to the following maximum amounts: copper to 0.35%, nickel to 0.25%, chromium to 0.20%, and molybdenum to 0.06%.

^bWhen electric furnace steel is ordered, the carbon range is restricted 0.01%, manganese 0.05%, chromium 0.05% up to 1.25% incl. and 0.10% over 1.25%.

The maximum phosphorus and sulfur is 0.025% each.

^cBoron or lead may be added to these compositions.

^dSilicon available in ranges of 0.10-0.20%, 0.20-0.30%, and 0.35% maximum (when carbon deoxidized) when so specified by the purchaser.

RATIONALE:

Not applicable.

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

REFERENCE SECTION:

SAE J408 DEC83, Methods of Sampling Steel for Chemical Analysis

SAE J409 DEC88, Product Analysis - Permissible Variations from Specified Chemical Analysis of a Heat or Cast of Steel

SAE J1249 JAN89, Former SAE Standard and Former SAE Ex-Steels

ASTM A 506

ASTM A 507

ASTM A 513

ASTM A 519

APPLICATION:

In 1941, the SAE Iron and Steel Division in collaboration with the American Iron and Steel Institute made a major change in the method of expressing composition ranges for the SAE steels. The plan, as now applied, is based in general on narrower ladle analysis ranges plus certain product (check) analysis allowances on individual samples, in place of the fixed ranges and limits without tolerances formerly provided for carbon and other elements in SAE steels (Reference J408). To avoid the possibility of confusion and conflict between SAE and AISI steel designations, all proposed changes in compositions or additions or deletions of numbers will be coordinated between the two organizations.