



Case-hardening Steel

1 Scope

1.1 Material Description. Alloyed steel for case-hardening.

1.2 Symbols. Not applicable.

1.3 Applicability. This specification describes the requirements for alloyed steels to be case-hardened, which are used in shafts and gears.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

ASTM A534	DIN EN ISO 643	EN 10263-3
DIN EN ISO 642	DIN EN ISO 683-3	EN 10277

2.2 GM Standards/Specifications.

GMW3059	GMW17942
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3 Requirements

Deviations from the requirements specified in this material specification or additional requirements shall have been agreed upon by the GM Design Responsible Engineer, GM Materials Engineer, and supplier. These shall be indicated in the respective engineering drawing, material release and/or terms of delivery.

3.1 Requirements on Delivery. Parts within a single delivery shall not be from more than one heat of steel. A given heat of steel shall be used for sequential batches of parts until that heat has been consumed.

A mixture of heats, i.e., different heats within one-part delivery, is not permissible.

Bar and billets for hot forging or machining shall be delivered as hot rolled or as annealed and free of scale. The treatment condition shall be agreed upon by the GM Design Responsible Engineer, GM Materials Engineer, and the supplier.

Bars and billets for cold extrusion or cold heading shall be delivered in a heat treatment condition agreed upon by the GM Design Responsible Engineer, GM Materials Engineer, and the supplier.

3.1.1 Chemical Requirements. Composition of steel grades are listed in Table 1. Elements not listed shall not be added to the steel, apart from those used for final treatments of the heat prior to casting, without the agreement of the GM Materials Engineer. Provisions shall be made to prevent the addition of such elements from scrap or other materials used in the steel making process which could affect the hardenability, the mechanical parameters and serviceability of the manufactured components.

3.1.1.1 Minor deviations from the limit values for the product analysis are permissible, if the specified mechanical properties and the hardenability are maintained.

3.1.1.2 Compositions in Table 1 have corresponding grades in the following global standards: DIN EN ISO 683-3, EN 10263-3, and EN 10277. Corresponding grades cannot be used without agreement from the GM Materials Engineer and Design Responsible Engineer.

Table 1: Chemical Composition

Element	Grade							
	QS191600	QS192000	QS192000-M	QS192700	QS192700-M	QS432100	QS432100-M	QS341400
C	0.15 to 0.20	0.18 to 0.23	0.20 to 0.23	0.23 to 0.28	0.23 to 0.28	0.18 to 0.23	0.18 to 0.22	0.15 to 0.20
Si	0.20 max	0.20 max	0.15 to 0.25	0.10 to 0.40	0.10 to 0.30	0.20 max	0.20 max	0.20 max
Mn	1.10 to 1.30	1.20 to 1.40	1.30 to 1.40	1.10 to 1.30	1.10 to 1.25	0.70 to 0.90	0.70 to 0.85	0.70 to 0.90
P	0.025 max	0.025 max	0.025 max	0.025 max	0.025 max	0.025 max	0.025 max	0.025 max
S	0.020 to 0.040	0.020 to 0.040	0.020 to 0.040	0.020 to 0.040	0.020 to 0.040	0.020 to 0.040	0.020 to 0.040	0.020 to 0.040
Cr	0.90 to 1.10	1.10 to 1.30	1.20 to 1.30	1.00 to 1.30	1.00 to 1.15	0.70 to 0.90	0.70 to 0.85	0.70 to 0.90
Mo	--	--	0.070 to 0.100	--	--	0.25 to 0.35	0.25 to 0.35	--
Ni	0.25 max	0.25 max	0.15 to 0.25	0.25 max.	0.25 max.	1.50 to 1.70	1.40 to 1.55	3.10 to 3.30
Al	0.015 to 0.050	0.015 to 0.050	0.020 to 0.040	0.015 to 0.050	0.015 to 0.050	0.015 to 0.050	0.015 to 0.050	0.015 to 0.050
Cu	0.25 max	0.25 max	0.25 max	0.25 max	0.25 max	0.25 max	0.25 max	0.25 max
N	--	--	0.008 to 0.012	--	--	--	--	--

max. = maximum

3.1.2 Mechanical Requirements.

3.1.2.1 Hot Deformation (Forging). Bars and billets cold sheared prior to hot forging shall not exceed 255 HBW at the sheared ends. Hot sheared bars shall have a hardness representative of the as-hot rolled bar at the sheared ends.

3.1.2.2 Machining. Bars provided for conventional machining operations shall have a surface hardness as specified in Table 2.

Table 2: Hardness Requirements

Grade	Hardness (HBW)
QS191600	145 to 185
QS192000	155 to 195
QS192700	155 to 195
QS341400	160 to 200
QS432100	160 to 200

3.1.2.3 Cold Deformation. Heat treat condition and hardness for bars provided for cold deformation, such as cold heating, shall be as specified by the blank manufacturer.

3.1.2.4 Requirements to the Hardenability. The hardenability of the steel is calculated by the end quench test (Jominy) according to DIN EN ISO 642 (see Table 3).