

# Docol M

## Cold reduced martensitic steels adapted to car manufacturers standards

### Product

Docol M are cold reduced fully martensitic steels. These steels are manufactured using special heat treatment in a continuous annealing line. The ultra high strength is produced by extremely fast water quenching from an elevated austenitic temperature range.

Docol M grades are characterized by good formability at these high strength levels combined with good weldability. All conventional welding methods can be used due to the lean chemical composition.

Some of the advantages of using Docol M are weight reduction improved safety and environment. Docol M steels adapted to car manufacturers own standards can be achieved.

### Applications

Typical applications for Docol M are safety components in cars e.g. door beams, bumper reinforcements.

### Dimension range

Thickness: 0.5 - 2.10 mm

Width: 800 - 1500 mm, depending on steel grade and thickness

### Tolerances

Docol M are supplied to tolerances in accordance with EN 10131.

### Mechanical properties

GM standard GMW 3399M-ST-S

Designation		Yield strength $R_{el}$ (N/mm <sup>2</sup> )		Tensile strength $R_m$ (N/mm <sup>2</sup> )		Min elongation	
SSAB	Standard	min	max	min	max	A50	A80
Docol 900M	CR900T/700YMS	700	1000	900	-	3	6
Docol 1100M	CR1100T/860YMS	860	1100	1100	-	3	5
Docol 1300M	CR1300T/1030YMS	1030	1300	1300	-	2	3
Docol 1500M	CR1500T/1200YMS	1200	1500	1500	-	2	2

Fiat standard 52815

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SSAB	Standard	min	max	min	max	A50	A80
Docol 900M	FE 900MS	700	1000	900	-	-	6
Docol 1100M	FE 1100MS	860	1100	1100	-	-	5
Docol 1300M	FE 1300MS	1030	1300	1300	-	-	3
Docol 1500M	FE 1500MS	1200	1500	1500	-	-	3

## Chemical composition

(typical values)

### GM standard GMW 3399M-ST-S

Designation SSAB	Standard	C %	Si %	Mn %	P %	S %	Al <sub>tot</sub> %	Nb %	Ti %
Docol 900M	CR900T/700YMS	0,05	0,20	1,90	0,010	0,002	0,040	0,015	0,025
Docol 1100M	CR1100T/860YMS	0,09	0,20	1,70	0,010	0,002	0,040	0,015	0,025
Docol 1300M	CR1300T/1030YMS	0,20	0,20	1,50	0,010	0,002	0,040	0,015	0,025
Docol 1500M	CR1500T/1200YMS	0,21	0,20	1,00	0,010	0,002	0,040	0,015	0,025

### Fiat standard 52815

Designation SSAB	Standard	C %	Si %	Mn %	P %	S %	Al <sub>tot</sub> %	Nb %	Ti %
Docol 900M	FE 900MS	0,05	0,20	1,90	0,010	0,002	0,040	0,015	0,025
Docol 1100M	FE 1100MS	0,09	0,20	1,70	0,010	0,002	0,040	0,015	0,025
Docol 1300M	FE 1300MS	0,20	0,20	1,50	0,010	0,002	0,040	0,015	0,025
Docol 1500M	FE 1500MS	0,21	0,20	1,00	0,010	0,002	0,040	0,015	0,025

## Forming

Docol M is designed for conventional cold forming techniques such as stamping, roll forming and tube making.

### Bending

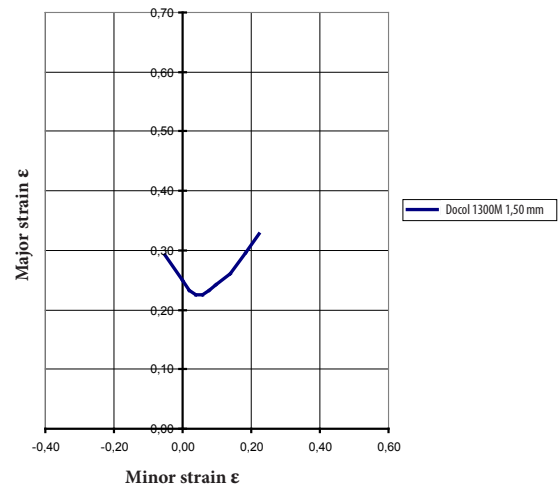
The bendability of M steels is good. At tight bend radii it is important if possible to do the bending transverse to the rolling direction where the bendability is somewhat better than in the longitudinal direction.

### Roll forming

Roll forming is widely used for M steels and this also permits smaller radii compared to those achieved when bending.

### Pressing

The high work hardening of M steels results in good stretchability and drawability. Usual consideration when designing details in Docol is to make the radii slightly larger and optimize the blank shape to help the material "flow" in the tool. The forming limit curves below, for Docol 1300 M in thickness 1,50 mm, show a material that can withstand at least 14% deformation at forming.



Shearing and punching

When shearing and punching Docol M steels it is particularly important to use the right cutting clearances. Factors ruling this are sheet thickness, strength and the demand on the cut surface appearance. We rec-ommed a cutting clearance of 10-12% of the sheet thickness for Docol M steels.

Welding

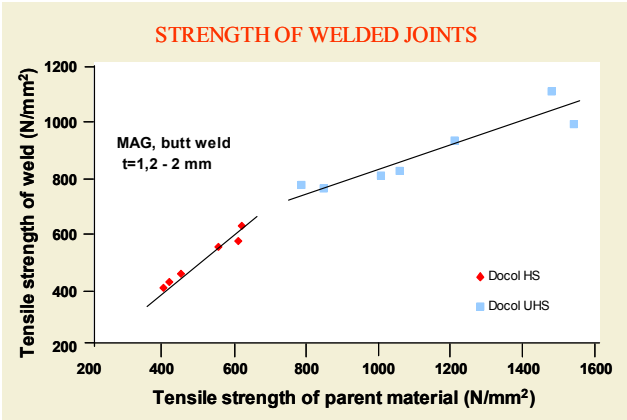
The weldability of Docol M is very good. The reason for this is that Docol M steels have very low contents of alloying elements in relation to the high strength of the steels.

When Docol M is fusion welded all the common welding methods can be used as e.g. gas metal arc welding (GMAW), manual metal arc welding (MMA), TIG-welding, plasma welding and laser welding. The recommended filler metals for Docol M are shown in table 1. If the weldments can be placed in areas of low stresses, then filler metals of lower strength than in table 1 can be used.

GMAW (MAG) Gas metal arc welding	MMA Manual metal arc welding
AWS: A5.28 ER 10XS-X AWS: A5.28 ER 11XS-X AWS: A5.28 ER 12XS-X	AWS: A5.5 E10X18 AWS: A5.5 E11X18 AWS: A5.5 E12X18

Tabell 1: Rekommenderade tillsatsmaterial

The strength of welded joints with Docol M is higher than when conventional high strength steels are welded.



Another welding method, which can be used for Docol M, is electrical resistance welding. Spot welding is the most common welding method for Docol M. When Docol M is spot welded to another soft steel it is recommended that the electrode force is increased by 20-30%. To ensure good welding results when Docol M is spot welded to itself it is rec-ommended that the electrode force is increased by 40-50% and that the welding time is slightly increased.

Teknisk service och information

Knowledge Service Center will be pleased to assist with additional information concerning this product from SSAB Tunnpålat.

The particulars in this data sheet are correct at the time of going to print and are intended to give general guidance for the use of the product. Subject to changes arising from continual product development. The information and data must not be regarded as guaranteed values, unless specially confirmed in writing.

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