

Docol DP/DL

Cold reduced dual phase steels

Product

Docol DP and Docol DL are cold reduced dual phase steels. The steels are subjected to special heat treatment in the continuous annealing line, which produces a two-phase structure in which the ferrite that imparts unique forming properties is one of the phases, and martensite that accounts for the strength is the other. The strength increases with increasing proportion of the hard martensite phase.

Docol DP/DL are characterized by a very good formability compared to the strength and also good weldability. All conventional welding methods can be used because of a very lean chemical composition.

Some of the advantages of using Docol DP/DL are:

- Weight reduction
- Simplified manufacturing
- Increased safety
- Improved environment
- Longer lifecycle
- Increased payload
- Increased load capacity
- Reduced total cost

Applications

Typical applications for Docol DP/DL are

- Safety components in cars - door beams, bumper reinforcement, seat tracks
- Tube applications - baby rams, furnitures, bicycles

Dimension range

Thickness: 0.5 - 2.10 mm

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

Mechanical properties

Steel grade	Yield Strength		Yield strength after bake hardening ¹⁾	Tensile strength		Elongation A ₈₀ %	Min. bending radius for 90°
	R _{p0.2} (N/mm ²) min	max		R _m (N/mm ²) min	max		
Docol 500DP	290	370	400	500	600	20	0xt
Docol 500DL	230	300	350	500	600	24	0xt
Docol 600DP	350	450	500	600	700	16	0xt
Docol 600DL	280	360	450	600	700	20	0xt
Docol 800DP	500	650	600	800	950	10	1,0xt
Docol 800DL	390	540	550	800	950	13	1,0xt
Docol 1000DP	700	950	850	1000	1200	7	2,0 xt

The mechanical properties are valid in transverse direction of rolling

t = Sheet thickness

1) BH = bake hardening after 2% plastic deformation and heated to 170° C

Tolerances

Docol DP/DL are supplied to tolerances in accordance with EN 10131.

Chemical Composition

(typical values)

Steel grade	C %	Si %	Mn %	P %	S %	Al _{tot} %	Nb %
Docol 500DP	0,08	0,30	0,65	0,010	0,010	0,040	-
Docol 500DL	0,05	0,20	1,50	0,010	0,002	0,040	-
Docol 600DP	0,10	0,20	0,80	0,010	0,002	0,040	0,015
Docol 600DL	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 800DP	0,13	0,20	1,50	0,010	0,002	0,040	0,015
Docol 800DL	0,14	0,20	1,50	0,010	0,002	0,040	0,015
Docol 1000DP	0,15	0,50	1,50	0,010	0,002	0,040	0,015

Forming

Docol DP/DL are meant for cold forming, and even the ultra high strength qualities can be formed in a traditional way.

Bending

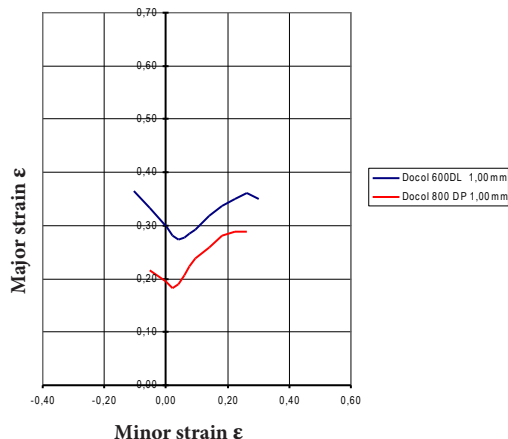
The bendability of DP/DL steels is good even at higher strength levels. At advanced bending it is important if possible to bend transverse to the rolling direction, where the bendability is somewhat better than in the longitudinal direction.

Rollforming

Roll forming is very suitable for DP/DL steels and this also permits smaller radii compared to bending.

Pressing

The high work hardening of DP/DL steels results in good stretchability and drawability. To consider when designing details in Docol DP/DL is to make the radii be a bit larger and optimize the blank shape to help the material "flow" in the tool. Below some formability limit curves (true strain) are shown as example of the formability of two DP/DL grades.



Shearing and punching

When shearing and punching Docol DP/DL 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 shape. A cutting clearance of 10-12% of sheet thickness is recommended for Docol DP/DL steels.

Welding

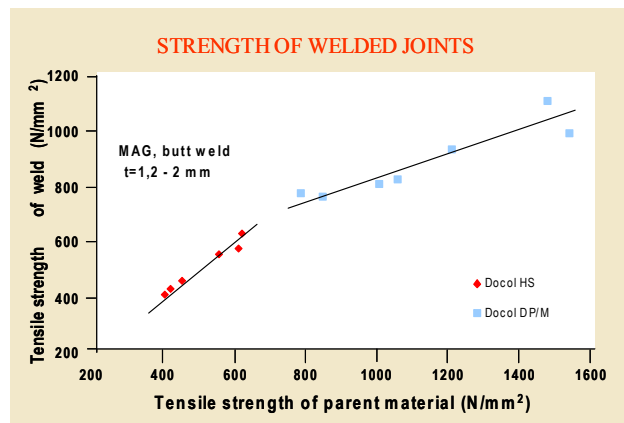
The weldability of Docol DP/DL is very good. The reason to this is that Docol DP/DL steels have very low contents of alloying elements in relation to the high strength of the steels.

When Docol DP/DL 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 DP/DL are shown in table 1. If the welds can be placed in areas with low stresses also 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

Table 1: Recommended filler metals for Docol UHS.

The strength of welded joints for Docol DP/DL is higher than the corresponding strength of conventional high strength steels.



Other welding methods which can be used for Docol DP/DL are electrical resistance welding and high frequency welding. Spot welding is the most common welding method for Docol DP/DL. When Docol DP/DL 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 DP/DL is spot welded to itself it is recommended that the electrode force is increased by 40-50% and that the welding time is slightly increased.

Technical service and information

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

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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