

## Docol DP

# Cold reduced dual phase steels adapted to car manufacturers standards

### Product

Docol DP 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 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.

Docol DP steels adapted to car manufacturers own standards can be achieved.

### Applications

Typical applications for Docol DP in cars are safety components door beams, bumper reinforcement and seat tracks. Some of the advantages of using Docol DP are weight reduction, increased safety and improved environment.

### Dimension range

Thickness: 0.5 - 2.10 mm

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

### Tolerances

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

### Forming

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

### Bending

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

### Rollforming

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

### Pressing

The high work hardening of DP steels results in good stretchability and drawability. To consider when designing details in Docol DP is to make the radii be a bit larger and optimize the blank shape to help the material "flow" in the tool.

### Shearing and punching

When shearing and punching Docol DP steels it is particularly important to use the right cutting clearance. 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 steels.

**Mechanical properties**  
Toyota standard TSG 3100G

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 440DP	SPC 440	265 - 285*	370 - 390*	440	-	26 - 31*	-
Docol 590DP	SPC 590DU	305 - 325*	450 - 470*	590	-	17 - 21*	-
Docol 780DP	SPC 780DU	400 - 420*	625 - 645*	780	-	11 - 16*	-
Docol 980DP	SPC 980DU	580 - 590*	920 - 930*	980	-	9 - 12*	-
Docol 1180DP	SPC 1180DU <sup>(1)</sup>	825 - 835*	1215 - 1225*	1180	-	5 - 8*	-

Nissan standard NES M2032

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 440DP	SP152 - 440	265 - 285*	370 - 390*	440	-	26 - 31*	-
Docol 590DP	SP153 - 590	305 - 325*	410 - 430*	590	-	17 - 25*	-
Docol 590DP	SP151 - 590 <sup>(2)</sup>	410 - 430*	560 - 580*	590	-	14 - 18*	-
Docol 780DP	SP153 - 780 <sup>(2)</sup>	400 - 420*	625 - 645*	780	-	14 - 18*	-
Docol 1180DP	SP153 - 1180 <sup>(1)</sup>	825 - 835*	1215 - 1225*	1180	-	5 - 8*	-

Honda standard HES C 052 - 00

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 440DP	JSC 440W	265 - 285*	370 - 390*	440	-	26 - 31*	-
Docol 590DP	JSC 590Y	305 - 325*	450 - 470*	590	-	17 - 21*	-
Docol 590DP	JSC 590R <sup>(2)</sup>	410 - 430*	560 - 580*	590	-	17 - 18*	-
Docol 780DP	JSC 780Y	400 - 420*	625 - 645*	780	-	12 - 16*	-
Docol 980DP	JSC 980Y	580 - 590*	920 - 930*	980	-	9 - 12*	-
Docol 1180DP	JSC 1180Y <sup>(1)</sup>	825 - 835*	1215 - 1225*	1180	-	5 - 8*	-

Mazda standard MES MM 106G

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 440DP	SPCN 440W	265 - 285*	370 - 390*	440	-	26 - 31*	-
Docol 590DP	SPCN 590Y	305 - 325*	450 - 470*	590	-	17 - 21*	-
Docol 590DP	SPCN 590R <sup>(2)</sup>	410 - 430*	560 - 580*	590	-	17 - 18*	-
Docol 780DP	SPCN 780Y	400 - 420*	625 - 645*	780	-	12 - 16*	-
Docol 980DP	SPCN 980Y	580 - 590*	920 - 930*	980	-	9 - 12*	-
Docol 1180DP	SPCN 1180Y <sup>(1)</sup>	825 - 835*	1215 - 1225*	1180	-	5 - 8*	-

## Renault standard RNUR 11-04-002

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 500DP	XE 300B	300	370	500	600	-	24
Docol 600DP	XE 360B	360	430	600	750	-	21
Docol 780DP	XE 450B	450	550	780	900	-	15

## 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 450DP	CR450T/250YDP	250	320	450	-	-	27
Docol 500DP	CR490T/290YDP	290	390	490	-	25	24
Docol 590DP	CR590T/340YDP	340	440	590	-	21	21
Docol 590DP	CR590T/280YDP	280	380	590	-	21	22
Docol 590DP	CR590T/420YDP <sup>2)</sup>	420	500	590	-	20	16
Docol 700DP	CR690T/550YDP	550	660	690	-	13	12
Docol 780DP	CR780T/420YDP	420	550	780	-	14	15
Docol 780DP	CR780T/500YDP	500	650	780	-	15	10
Docol 980DP	CR980T/550YDP	550	730	980	-	8	10
Docol 980DP	CR980T/650YDP	650	900	980	-	8	8

## Ford standard WSS-M1A348

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 450DP	A1 <sup>2)</sup>	260	330	450	-	30	-
Docol 500DP	A2	270	350	500	-	27	-
Docol 500DP	A3	300	370	500	-	26	-
Docol 600DP	A4	310	390	600	-	23	-
Docol 600DP	A5	340	410	600	-	22	-
Docol 780DP	A8	420	560	780	-	14	-
Docol 980DP	A9	550	730	980	-	7	-

## Fiat standard 52815

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 450DP	FE 450DPF <sup>2)</sup>	250	330	450	-	-	27
Docol 490DP	FE 500DPF	290	390	490	-	-	24
Docol 590DP	FE 600DPF	340	440	590	-	-	20
Docol 780DP	FE 800DPF	420	550	780	-	-	15
Docol 980DP	FE 1000DPF	550	730	980	-	-	8
Docol 1180DP	FE 1200DPF <sup>1)</sup>	820	1130	1180	-	-	3

### VW standard VW 50060-1 and 3

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 450DP	HC 260X <sup>2)</sup>	260	330	450	550	-	27
Docol 500DP	HC 300X	300	370	500	600	-	24
Docol 600DP	HC 340X	340	410	600	700	-	21
Docol 780DP	HC 450X	450	560	780	900	-	15
Docol 780DP	HC 500C	500	640	780	950	-	10
Docol 780DP	HC 600C	600	750	780	950	-	10
Docol 980DP	HC 600X	600	750	980	1100	-	10
Docol 980DP	HC 660X	660	780	980	1100	-	10
Docol 980DP	HC 700C	700	900	980	1150	-	7

### BMW standard GS 93005-11 and 13

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 450DP	HC 260X <sup>2)</sup>	260	340	450	-	-	27
Docol 500DP	HC 300X	300	380	500	-	-	24
Docol 600DP	HC 340X	340	410	600	-	-	20
Docol 600DP	HC 380X	380	460	600	-	-	18
Docol 780DP	HC 420X	420	550	780	-	-	15
Docol 780DP	HC 500C	500	650	780	-	-	10
Docol 780DP	HC 600C	600	750	780	-	-	10
Docol 980DP	HC 540X	540	700	980	-	-	10

### AvtoVaz standard TTM 1.25.1255-2007

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 450DP	DP450 <sup>2)</sup>	250	330	450	-	-	27
Docol 500DP	DP500	290	370	500	-	-	24
Docol 600DP	DP600	330	410	600	-	-	21
Docol 780DP	DP800	420	550	780	-	-	15
Docol 980DP	DP1000	550	700	980	-	-	10

<sup>1)</sup> Depending on the thickness

1) The steelgrade is in progress of development

2) The steelgrade fulfil the requirements in the specification to some extend

## Chemical composition

(typical values)

### Toyota standard TSG 3100G

Designation SSAB	Standard	C %	Si %	Mn %	P %	S %	Al <sub>tot</sub> %	Nb %
Docol 440DP	SPC 440	0,07	0,20	0,55	0,010	0,010	0,040	-
Docol 590DP	SPC 590DU	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 780DP	SPC 780DU	0,14	0,20	1,50	0,010	0,002	0,040	0,015
Docol 980DP	SPC 980DU	0,15	0,50	1,50	0,010	0,002	0,040	0,015
Docol 1180DP	SPC 1180DU	-	-	-	-	-	-	-

### Nissan standard NES M2032

Designation SSAB	Standard	C %	Si %	Mn %	P %	S %	Al <sub>tot</sub> %	Nb %
Docol 440DP	SP152 - 440	0,07	0,20	0,55	0,010	0,010	0,040	-
Docol 590DP	SP153 - 590	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 590DP	SP151 - 590	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 780DP	SP153 - 780	0,14	0,20	1,50	0,010	0,002	0,040	0,015
Docol 1180DP	SP153 - 1180	-	-	-	-	-	-	-

### Honda standard HES C 052-00

Designation SSAB	Standard	C %	Si %	Mn %	P %	S %	Al <sub>tot</sub> %	Nb %
Docol 440DP	JSC 440W	0,07	0,20	0,55	0,010	0,010	0,040	-
Docol 590DP	JSC 590Y	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 590DP	JSC 590R	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 780DP	JSC 780Y	0,14	0,20	1,50	0,010	0,002	0,040	0,015
Docol 980DP	JSC 980Y	0,15	0,50	1,50	0,010	0,002	0,040	0,015
Docol 1180DP	JSC 1180Y	-	-	-	-	-	-	-

### Mazda standard MES MM 106G

Designation SSAB	Standard	C %	Si %	Mn %	P %	S %	Al <sub>tot</sub> %	Nb %
Docol 440DP	SPCN 440W	0,07	0,20	0,55	0,010	0,010	0,040	-
Docol 590DP	SPCN 590Y	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 590DP	SPCN 590R	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 780DP	SPCN 780Y	0,14	0,20	1,50	0,010	0,002	0,040	0,015
Docol 980DP	SPCN 980Y	0,15	0,50	1,50	0,010	0,002	0,040	0,015
Docol 1180DP	SPCN 1180Y	-	-	-	-	-	-	-

#### Renault standard RNUR 11-04-002

Designation SSAB	Standard	C %	Si %	Mn %	P %	S %	Al <sub>tot</sub> %	Nb %
Docol 500DP	XE 300B	0,05	0,20	1,50	0,010	0,002	0,040	-
Docol 600DP	XE 360B	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 780DP	XE450B	0,14	0,20	1,50	0,010	0,002	0,040	0,015

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

Designation SSAB	Standard	C %	Si %	Mn %	P %	S %	Al <sub>tot</sub> %	Nb %
Docol 450DP	CR450T/250YDP	0,05	0,20	1,50	0,010	0,002	0,040	-
Docol 500DP	CR490T/290YDP	0,05	0,20	1,50	0,010	0,002	0,040	-
Docol 590DP	CR590T/340YDP	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 590DP	CR590T/280YDP	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 590DP	CR590T/420YDP	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 700DP	CR690T/550YDP	0,13	0,20	1,50	0,010	0,002	0,040	0,015
Docol 780DP	CR780T/420YDP	0,14	0,20	1,50	0,010	0,002	0,040	0,015
Docol 780DP	CR780T/500YDP	0,13	0,20	1,50	0,010	0,002	0,040	0,015
Docol 980DP	CR980T/550YDP	0,15	0,50	1,50	0,010	0,002	0,040	0,015
Docol 980DP	CR980T/650YDP	0,15	0,50	1,50	0,010	0,002	0,040	0,015

#### Ford standard WSS-M1A348

Designation SSAB	Standard	C %	Si %	Mn %	P %	S %	Al <sub>tot</sub> %	Nb %
Docol 450DP	A1	0,05	0,20	1,50	0,010	0,002	0,040	-
Docol 500DP	A2	0,05	0,20	1,50	0,010	0,002	0,040	-
Docol 500DP	A3	0,05	0,20	1,50	0,010	0,002	0,040	-
Docol 600DP	A4	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 600DP	A5	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 780DP	A8	0,14	0,20	1,50	0,010	0,002	0,040	0,015
Docol 980DP	A9	0,15	0,50	1,50	0,010	0,002	0,040	0,015

#### Fiat standard 52815

Designation SSAB	Standard	C %	Si %	Mn %	P %	S %	Al <sub>tot</sub> %	Nb %
Docol 450DP	FE 450DPF	0,05	0,20	1,50	0,010	0,002	0,040	-
Docol 490DP	FE 500DPF	0,05	0,20	1,50	0,010	0,002	0,040	-
Docol 590DP	FE 600DPF	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 780DP	FE 800DPF	0,14	0,20	1,50	0,010	0,002	0,040	0,015
Docol 980DP	FE 1000DPF	0,15	0,50	1,50	0,010	0,002	0,040	0,015
Docol 1180DP	FE 1200DPF	-	-	-	-	-	-	-

#### VW standard VW 50060-1 and 3

Designation SSAB	Standard	C %	Si %	Mn %	P %	S %	Al <sub>tot</sub> %	Nb %
Docol 450DP	HC 260X	0,05	0,20	1,50	0,010	0,002	0,040	-
Docol 500DP	HC 300X	0,05	0,20	1,50	0,010	0,002	0,040	-
Docol 600DP	HC 340X	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 780DP	HC 450X	0,14	0,20	1,50	0,010	0,002	0,040	0,015
Docol 780DP	HC 500C	0,13	0,20	1,50	0,010	0,002	0,040	0,015
Docol 780DP	HC 600C	0,13	0,20	1,50	0,010	0,002	0,040	0,015
Docol 980DP	HC 600X	0,15	0,50	1,50	0,010	0,002	0,040	0,015
Docol 980DP	HC 660X	0,15	0,50	1,50	0,010	0,002	0,040	0,015
Docol 980DP	HC 700C	0,15	0,50	1,50	0,010	0,002	0,040	0,015

#### BMW standard GS 93005-11 and 13

Designation SSAB	Standard	C %	Si %	Mn %	P %	S %	Al <sub>tot</sub> %	Nb %
Docol 450DP	HC 260X	0,05	0,20	1,50	0,010	0,002	0,040	-
Docol 500DP	HC 300X	0,05	0,20	1,50	0,010	0,002	0,040	-
Docol 600DP	HC 340X	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 600DP	HC 380X	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 780DP	HC 420X	0,14	0,20	1,50	0,010	0,002	0,040	0,015
Docol 780DP	HC 500C	0,13	0,20	1,50	0,010	0,002	0,040	0,015
Docol 780DP	HC 600C	0,13	0,20	1,50	0,010	0,002	0,040	0,015
Docol 980DP	HC 540X	0,15	0,50	1,50	0,010	0,002	0,040	0,015

#### AvtoVaz standard TTM 1.25.1255-2007

Designation SSAB	Standard	C %	Si %	Mn %	P %	S %	Al <sub>tot</sub> %	Nb %
Docol 450DP	DP450	0,05	0,20	1,50	0,010	0,002	0,040	-
Docol 500DP	DP500	0,05	0,20	1,50	0,010	0,002	0,040	-
Docol 600DP	DP600	0,10	0,40	1,50	0,010	0,002	0,040	-
Docol 780DP	DP800	0,14	0,20	1,50	0,010	0,002	0,040	0,015
Docol 980DP	DP1000	0,15	0,50	1,50	0,010	0,002	0,040	0,015

## Welding

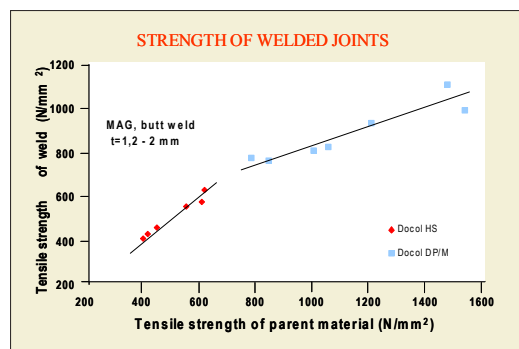
The weldability of Docol DP is very good. The reason to this is that Docol DP steels have very low contents of alloying elements in relation to the high strength of the steels.

When Docol DP 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 are shown in table 1. If the weldments can be placed in areas of low stresses also filler metals of lower strength than in table 1 can be used.

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 DP.

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



Other welding methods which can be used for Docol DP are electrical resistance welding and high frequency welding. Spot welding is the most common welding method for Docol DP. When Docol DP 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 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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