

# Stress-Strain Curves

Hot forming Steels - Ductibor® 500 treated



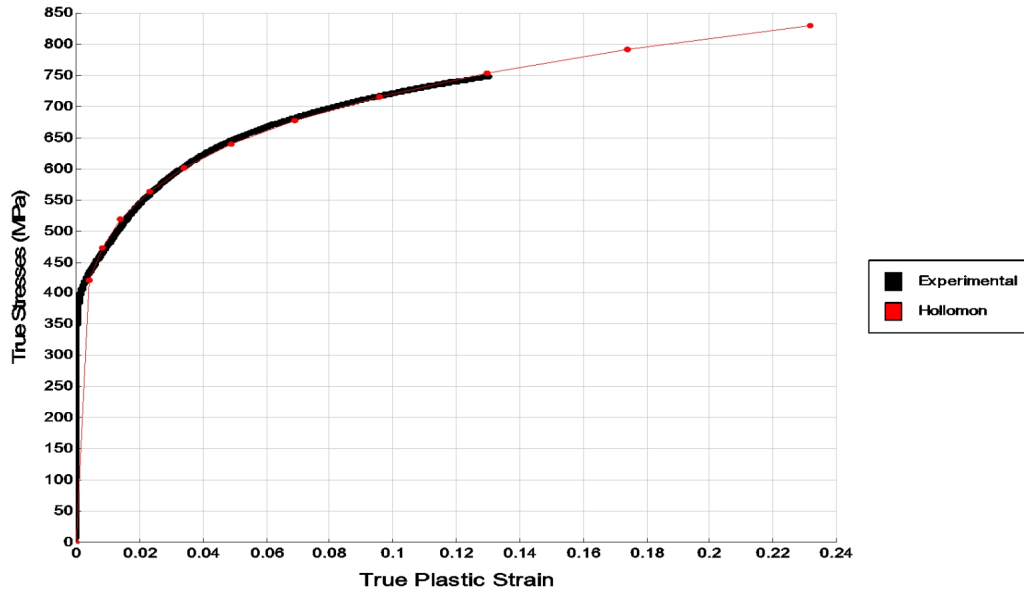
ArcelorMittal

Thickness (mm) 1.3

Coating AS150



## Hollomon law



## Parameters identified between 0.4 and 13.9 %

K (MPa)	1060
n	0.17

$$\sigma = K\varepsilon^n$$

## Test conditions

<b>Test direction</b>	0°	<b>Test temperature</b>	Room Temperature
<b>Test Type</b>	Uniaxial Tensile Test	<b>Initial width of the calibrated zone (mm)</b>	20.0
<b>Test procedure</b>	NF EN ISO 6892-1	<b>Initial thickness (mm)</b>	1.33
<b>Procedure to determine "n"</b>	ISO 10275	<b>Loading rate (MPa/s)</b>	23
<b>Procedure to determine "r"</b>	ISO 10113	<b>Strain rate before yielding (/s)</b>	0.0025
<b>Sample geometry (b0xL0)</b>	20*80	<b>Strain rate after yielding (/s)</b>	0.008
<b>Gauge length (mm)</b>	80		

## Engineering properties

<b>Ultimate Tensile Strength (MPa)</b>	657	<b>Ae (%)</b>	-
<b>Upper Yield Stress (MPa)</b>	-	<b>Ag (%)</b>	13.9
<b>Lower Yield Stress (MPa)</b>	-	<b>A (%)</b>	18.9
<b>Proof stress (MPa)</b>	408	<b>n (3% - 20%/Ag%)</b>	0.16
		<b>r (3% - 20%/Ag%)</b>	0.54

Rheo-TU-2794

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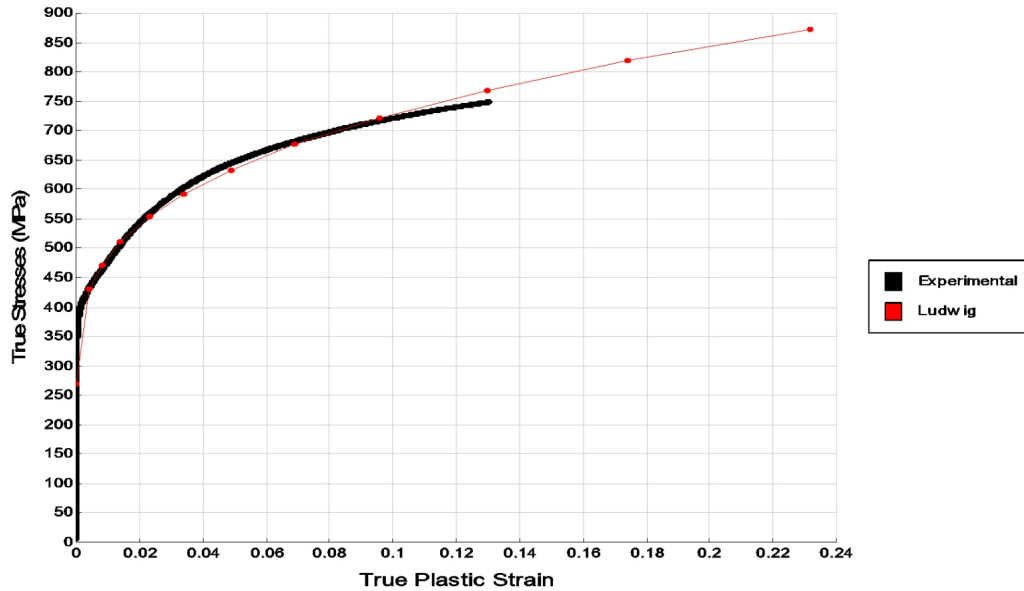
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Thickness (mm) 1.3

Coating AS150



## Ludwig law



### Parameters identified between 0.4 and 13.9 %

$\sigma_0$ (MPa)	270
K (MPa)	971
n	0.33

$$\sigma = \sigma_0 + K\varepsilon^n$$

## Test conditions

Test direction	0°
Test Type	Uniaxial Tensile Test
Test procedure	NF EN ISO 6892-1
Procedure to determine "n"	ISO 10275
Procedure to determine "r"	ISO 10113
Sample geometry (b0xL0)	20*80
Gauge length (mm)	80

Test temperature	Room Temperature
Initial width of the calibrated zone (mm)	20.0
Initial thickness (mm)	1.33
Loading rate (MPa/s)	23
Strain rate before yielding (/s)	0.0025
Strain rate after yielding (/s)	0.008

## Engineering properties

Ultimate Tensile Strength (MPa)	657
Upper Yield Stress (MPa)	-
Lower Yield Stress (MPa)	-
Proof stress (MPa)	408

Ae (%)	-
Ag (%)	13.9
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n (3% - 20%/Ag%)	0.16
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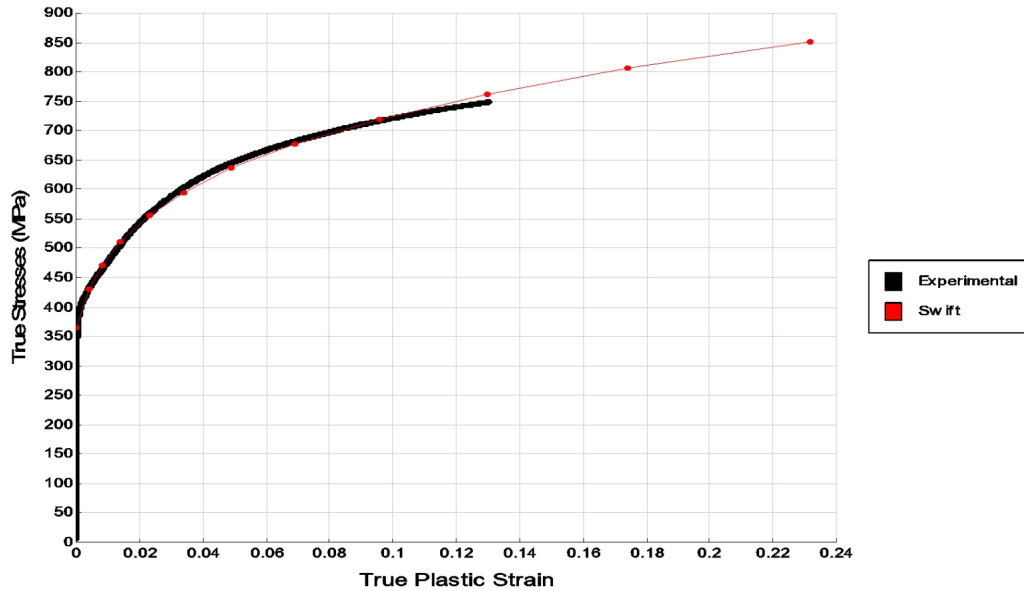
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Thickness (mm) 1.3

Coating AS150



## Swift law



## Parameters identified between 0.4 and 13.9 %

$\epsilon_0$	0.0030
K (MPa)	1128
n	0.19

$$\sigma = K(\epsilon_0 + \epsilon)^n$$

## Test conditions

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Loading rate (MPa/s)	23
Strain rate before yielding (/s)	0.0025
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## Engineering properties

Ultimate Tensile Strength (MPa)	657
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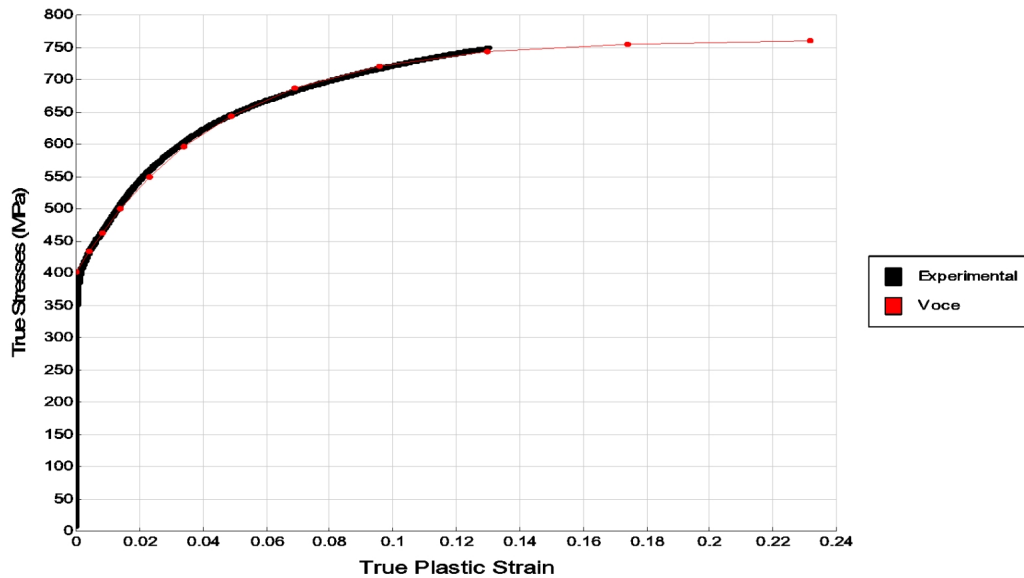
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Thickness (mm) 1.3

Coating AS150



## Voce law



## Parameters identified between 0.4 and 13.9 %

$\sigma_0$  (MPa)

402

m

22.86

$$\sigma = \sigma_0 + \sigma_{sat} (1 - \exp(-m\varepsilon))$$

$\sigma_{sat}$  (MPa)

360

## Test conditions

Test direction	0°
Test Type	Uniaxial Tensile Test
Test procedure	NF EN ISO 6892-1
Procedure to determine "n"	ISO 10275
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Sample geometry (b0xL0)	20*80
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## Engineering properties

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Upper Yield Stress (MPa)	-
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Proof stress (MPa)	408

Ae (%)	-
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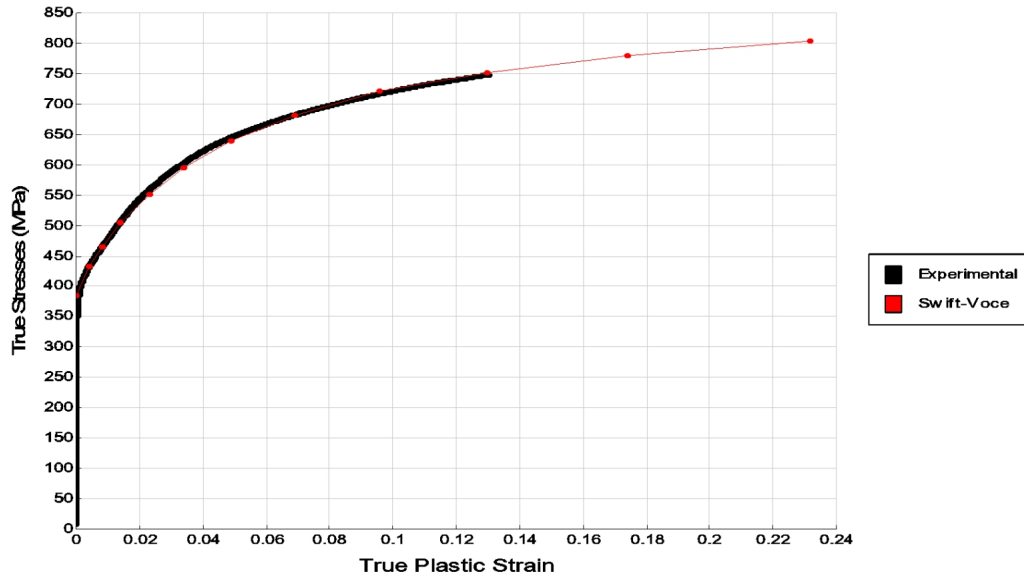
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Thickness (mm) 1.3

Coating AS150



## Swift-Voce law (Recommended model)



## Parameters identified between 0.4 and 13.9 %

$\epsilon_0$	0.0030
K (MPa)	1128
n	0.19
$\sigma_0$ (MPa)	402

$\sigma_{sat}$ (MPa)	360
m	22.86
$\alpha$	0.52

$$\sigma = (1 - \alpha)K(\epsilon + \epsilon_0)^n + \alpha [\sigma_0 + \sigma_{sat}(1 - \exp(-m\epsilon))]$$

## Test conditions

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