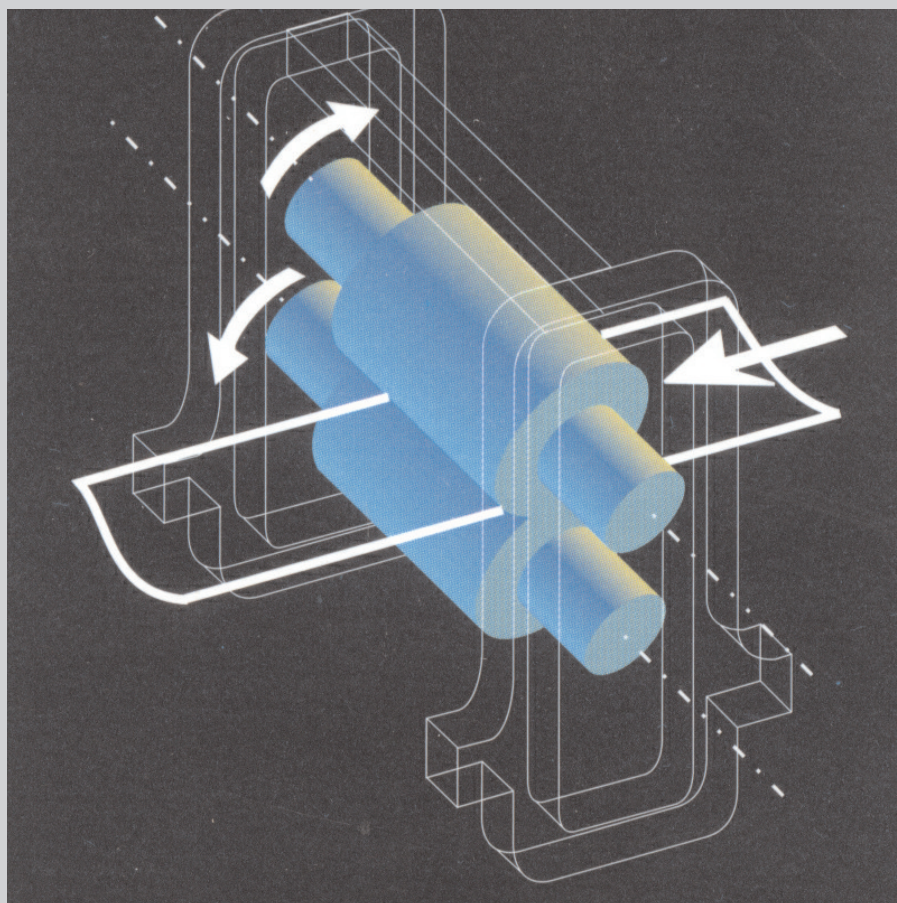
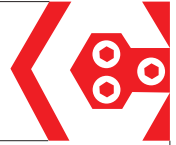




Rolls



06 / 2005



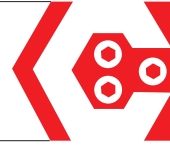
ROLLS



WORK ROLLS FOR COLD ROLLING MILLS

WORK ROLLS FOR HOT ROLLING MILLS

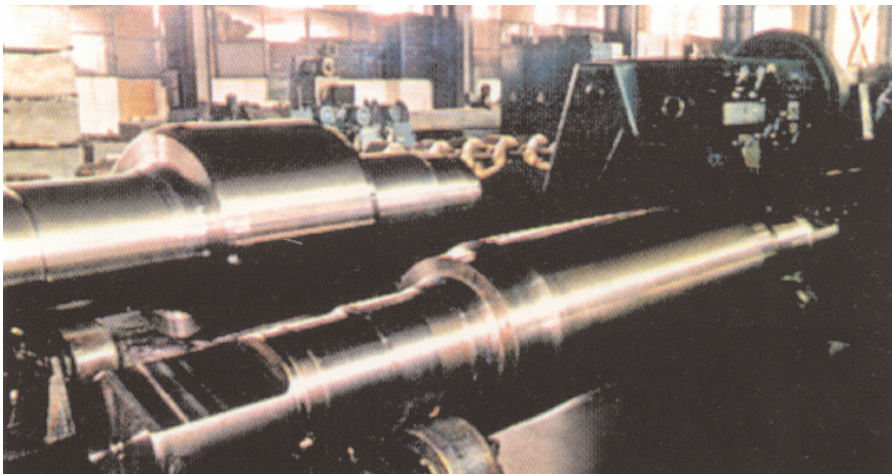
BACK-UP ROLLS

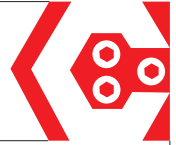


During last years, cold rolling mills
(for Steel, Cooper and Aluminium
thin plate, sheet and strip)
have undergone a large
development toward:

- ⇒ higher rolling speeds,
- ⇒ higher pressures,
- ⇒ larger section reductions.

Forging rolls of high quality with high and uniform
hardness are necessary to meet these requirements.

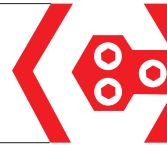




barrel diameters in 300 - 800 mm range,
barrel length max. 3500 mm and
total length max. 5300 mm
for two high, four high and other mills are made of:

90VMoCr18 steel or
80VMoCr30 steel grades





BASIC ARC FURNACE

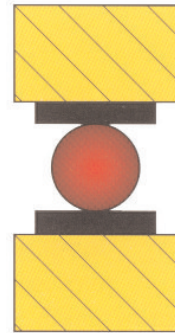


The steel is made by:
basic electric arc furnace process
including vacuum degassing of liquid
steel (VAD and/or vacuum pouring
of liquid steel).

VACUUM DEGASSING

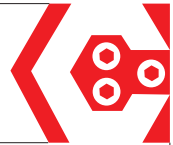


FORGING

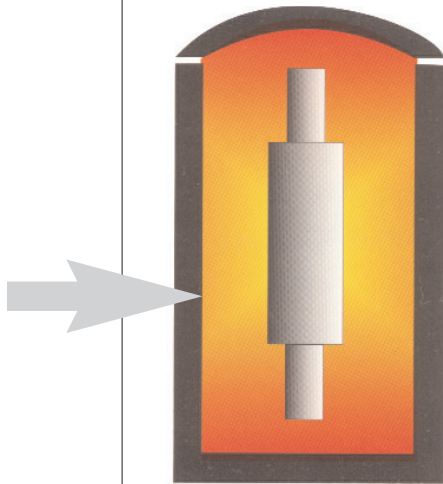


All forging work is done on a press
of sufficient power to work the
metal throughout the forging cross
section. The bottom and top of each
ingot are cut for disposing the useless
parts and remove the impurities.
The actual forging ratio is about
4-6 for roll barrel.

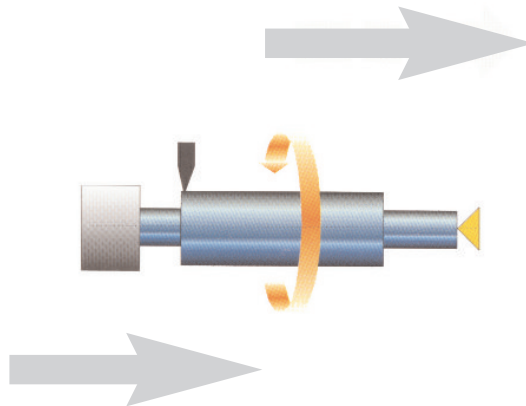




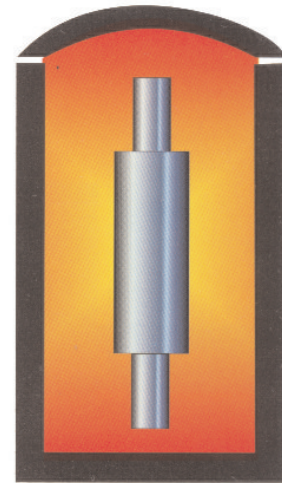
PRELIMINARY HEAT TREATMENT → ROUGH MACHINING → QUALITY HEAT TREATMENT



Preliminary heat treatment (normalizing and spheroidal annealing) is performed in order to improve machinability and ultrasonic transparency. So, Brinell hardness lower than 285 HB can be obtained.

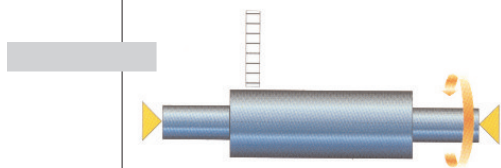


A uniform structure with dispersed fine carbides is to be got after the preliminary heat treatment to be rough machined with sufficient stock allowance to avoid surface defects and decarburization.

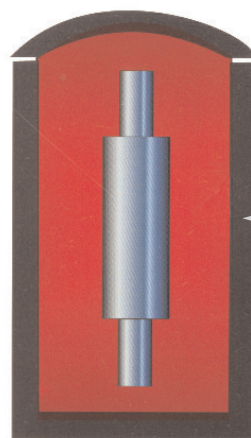


The rough-machined forging is heat treated through its section by: austenitizing heating and oil or water spray quenching followed by high tempering in order to obtain a 300 HB hardness and a good toughness.

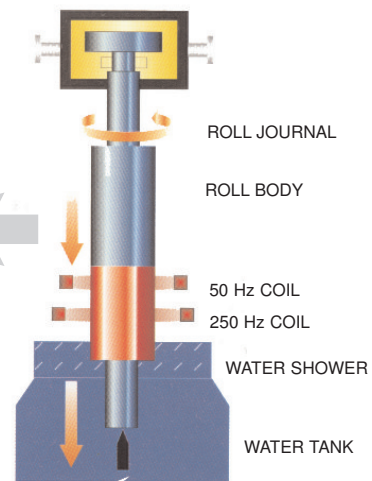
FINISSHING ← LOW TEMPERING ← SUPERFICIAL HARDENING



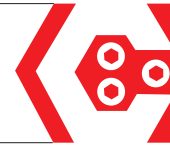
The surface of rolls is finished by careful grinding.



Superficial hardening is followed by low tempering in order to reach the required hardness and stress relief the roll.



After finish-machining, the barrel surface of the rolls is progressively superficial hardened by induction heating and water spray plus water immersion quenching.



Chemistry must correspond to the prescribed steel grade (please refer to the table below).

STEEL GRADE	C H E M I S T R Y (l a d l e) % w t .							
	C	Mn	Si	P	S	Cr	Mo	V
90VMoCr18	0.85 -	0.30 -	0.20 -	max.	max.	1.70 -	0.20 -	0.10
	0.95	0.45	0.35	0.020	0.015	2.10	0.30	0.20
80MoCr30	0.75 -	0.30 -	0.20 -	max.	max.	2.75 -	0.25 -	-
	0.85	0.60	0.35	0.020	0.015	3.25	0.35	-

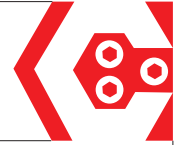
Steel purity is controlled and must correspond to ASTM E45 method A, to the following levels:

STEEL CLEANLINESS (according ASTM E45 method A)				
INCLUSION TYPE	A	B	C	D
THIN	1.5	1.5	1.5	1.5
THICK	1	1	1	1

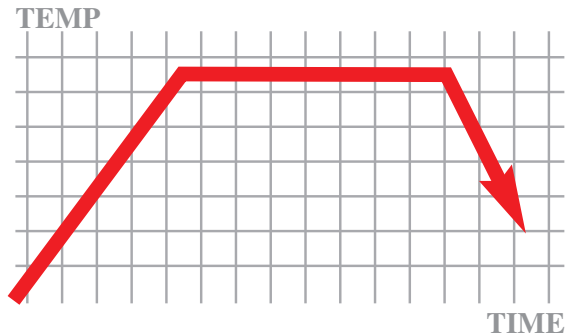
Mechanical properties (after quality heat treatment - quenching and tempering) must correspond to the following levels:

M E C H A N I C A L P R O P E R T I E S					
Y.S. (0.2)	UTS	EL.	RA	KV	HARDNESS
N/mm ²	N/mm ²	%	%	J	HB
min. 800	950 - 1200	min. 12	min. 35	min. 20	270 - 330

Test pieces are located on the end of the barrel, in cross direction, at 40 mm depth. For KV 3 tests are made



Heat treatment diagrams
(real diagrams and sketch).



Ultrasonic inspection.

The tests are performed both with:

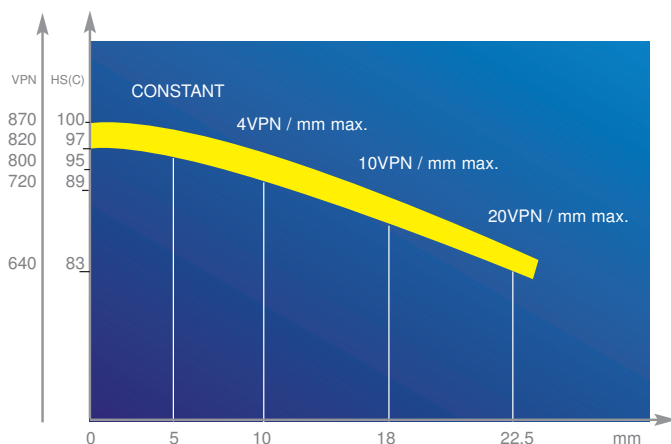
straight beam

frequency of transducers = 4 MHz
criteria acceptance / rejection are
established depending on the size of
the roll and customer's requirements

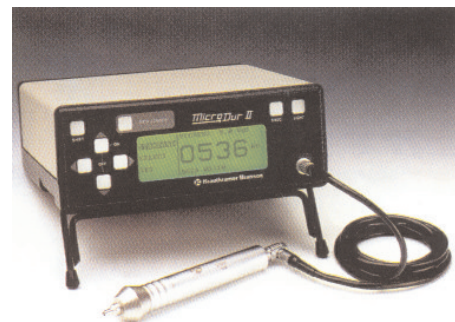
angular beam

for 45° - 60°
4 MHz - miniturized transducers
calibration on 1 mm. flat hole for 90°
1 MHz - transducer (surface waves)
for the integrity of the body roll surface

Hardness tests are performed with increasing distance from barrel surface,
for example: MICRODUR 2 KRAUTKRAMER

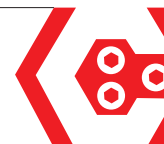


SURFACE DEPTH

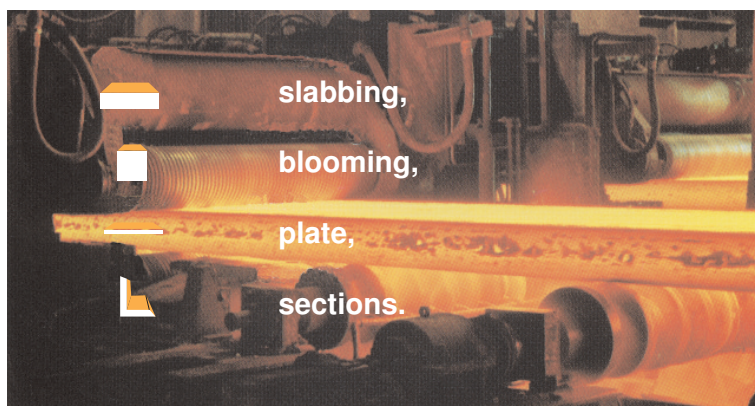


Hardness vs. depth from surface (superficial hardened barrel by medium frequency induction heating)

Actual hardness range and thickness of the hardened
layer are according to customer requirements.

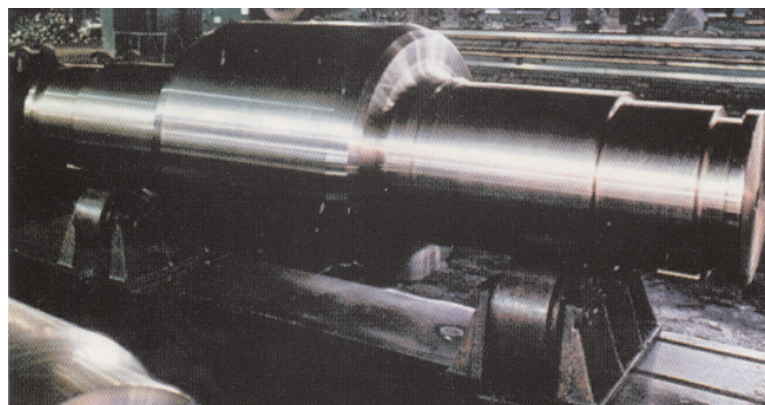


We have an extensive experience in manufacturing of steel forging hot rolls in the entire range of dimension, forms and hardness for the purpose of the hot rolling:

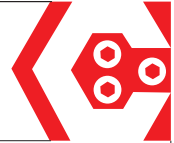


HOT WORKING ROLLS DIMENSIONAL FEATURES

BARREL DIAMETER	350 - 1300 mm
BARREL LENGTH	250 - 3000 mm
TOTAL LENGTH	1000 - 6000 mm
UNIT WEIGHT	5000 - 30000 kg



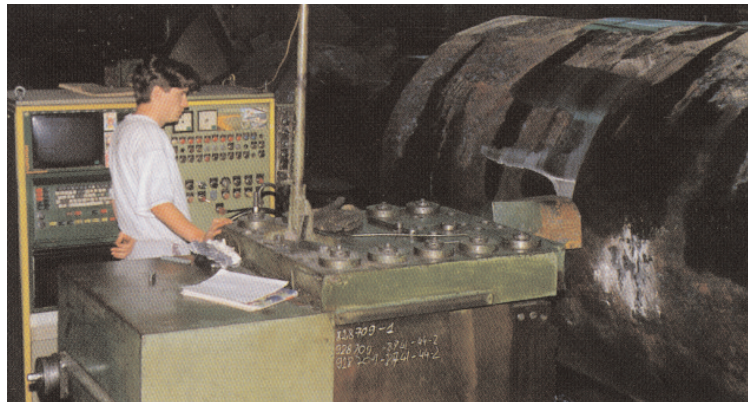
The hot working rolls are finished according to the customer's drawings.



We are also a producer of back-up rolls having the following features:

BACK-UP ROLLS DIMENSIONAL FEATURES

MAXIMUM DIAMETER	1300 mm
MAXIMUM LENGTH	3000 mm
MAXIMUM WEIGHT	35000 kg

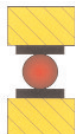


MANUFACTURING PROCESS

The steel is made by the basic electric furnace process including:



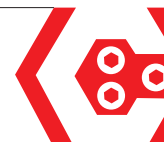
- ➡ ladle vacuum degassing of liquid steel (for ingots up to 60 tons), or
- ➡ vacuum pouring of liquid steel (for ingots larger than 60 tons).



All forging work is made on a press with sufficient power to work the metal throughout the forging cross section. The bottom and top of each ingot are cut for disposing the useless parts and remove the impurities. Actual forging ratio is minimum 4 for roll barrel.



Quality heat treatment consist in normalizing plus tempering or quenching (by using oil, fog or water-spray) plus tempering.



CHEMISTRY

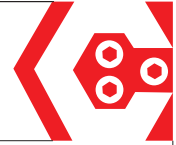
If the purchase order does not call for a specific steel our company utilizes the steel grades given in the following table

STEEL GRADE	PURPOSE	C H E M I S T R Y (l a d l e) % w t .							
		C	Si	Mn	P	S	Mo	V	Cr
55VMoCr12	working	0.50 -	0.20 -	0.35 -	max.	max.	0.30 -	0.10 -	1.00 -
	bloom rolls	0.60	0.37	0.65	0.025	0.025	0.50	0.20	1.30
65VMoCr15	working	0.60 -	0.20 -	0.65 -	max.	max.	0.30 -	0.10 -	1.40 -
	slab and heavy plate rolls	0.70	0.37	0.90	0.025	0.025	0.50	0.20	1.70
90VMoCr15	working	0.85 -	0.20 -	0.25 -	max.	max.	0.20 -	0.10 -	1.40 -
	shape rolls	0.95	0.35	0.45	0.025	0.020	0.30	0.20	1.70
80MoCr30	back-up rolls	0.78 -	0.15 -	0.60 -	max.	max.	0.30 -	-	2.80 -
	with barell	0.84	0.35	0.80	0.015	0.015	0.35	-	3.20
VMoCrNi17	hardness								
	between	0.52 -	0.15 -	0.60 -	max.	max.	0.50 -	0.10 -	1.60 -
	65 - 75 HSc	0.62	0.35	0.80	0.015	0.015	0.60	0.20	1.90

PURITY

STEEL PURITY (according ASTM E45 method A)

INCLUSION TYPE	A	B	C	D
THIN	1.5	1.5	1.5	1.5
THICK	1.5	1.5	1.5	1.5

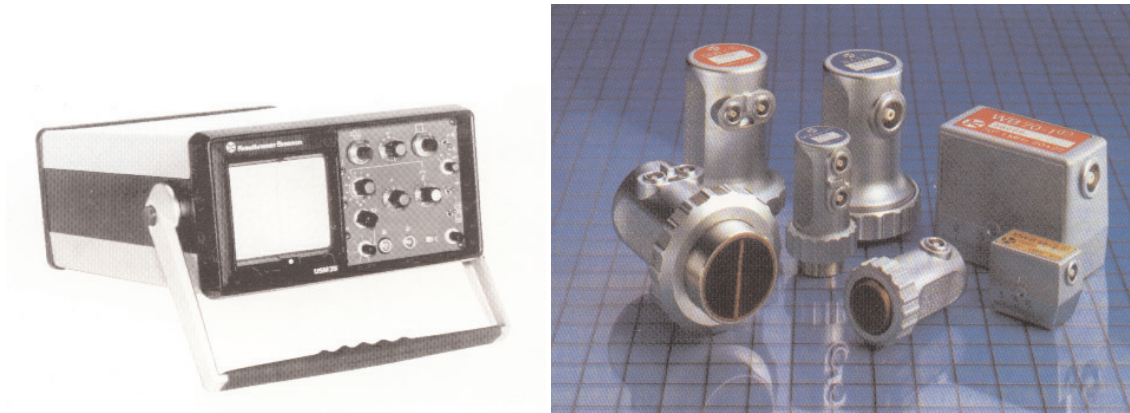


MECHANICAL PROPERTIES

MECHANICAL PROPERTIES (minimum)						
STEEL GRADE	Y.S. (0.2)	UTS	El. (x4d)	RA	Mesnager impact	HB
	N/mm ²	N/mm ²	%	%	kgfm/cm ²	range
55VMoCr12	450	800	10	30	2.5	240 - 280
65VMoCr15	500	900	10	30	2.5	275 - 320
90VMoCr15	700	800	-	-	1.5	260 - 330
80MoCr30	720	950	12	35	3.0	280 - 330
VMoCrNi17	650	950	10	30	3.0	280 - 330

Test pieces are on the end of the body, transversal direction, at 40 mm depth.

NON-DESTRUCTIVE INSPECTION



NDT Inspection (ultrasonic) with B4SN transducer:

for 100 mm from a barrel surface are acceptable only isolated flaws with a max. 1 mm diameter;

for the rest of roll are acceptable isolated flaws with a max. 3.0 mm diameters.

