

A&D PRODUCT MANUAL Part I

Standard Products

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The main purpose of this A&D Product Manual is to give the Sales Task Force the AUBERT & DUVAL STANDARD product and offer from Les Ancizes and Firminy plants ; actually this Product Manual answers the following question : if a customer has no specific requirement what will he receive (volume, surface aspect, document ...) ?

.All you don't find in this document you have to ask Customer Services or Market Management.

This first version is restricted to Long Products and Tool Steels manufactured in Les Ancizes & Firminy plants

In case of large volume requirements, other grades or dimensions can always be considered. Please consult the corresponding Customer Service or Market Managers

Abbreviation meanings :

MOQ : Minimum Ordering Quantity

L : Length

W : Width

T : Thickness

PLANTS

LES ANCIZES

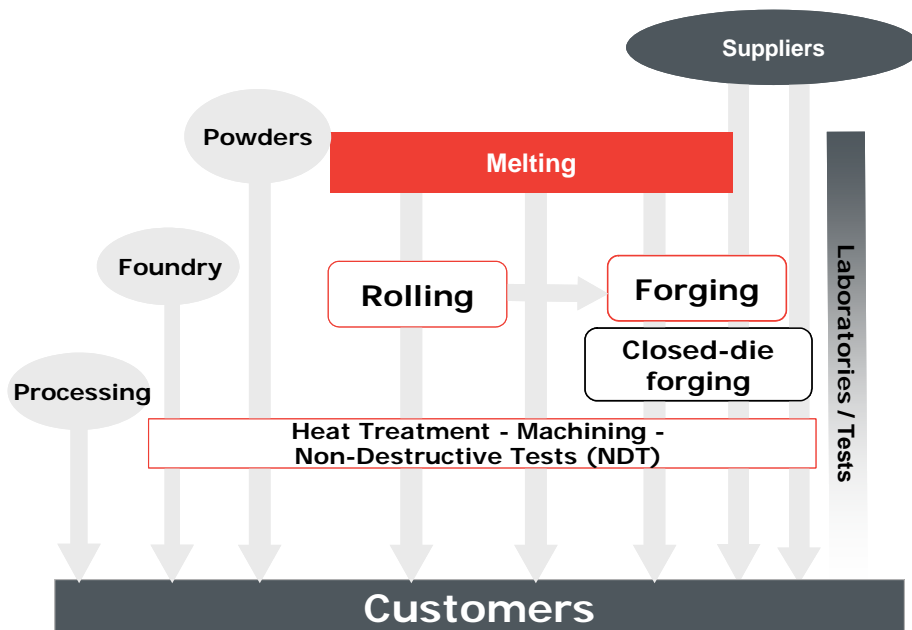
- Product lines: Aircraft engines, Power generation, 65 KT, Tool Steels, Semi-finished forged products, Metallurgical Engineering parts, Flat sheets, Foundry
- 1,450 employees
- Activities:
 - Processing and melting of steels and super alloys
 - Hot conversion by rolling and forging
 - Heat treatments
 - Machining
 - Non destructive testing
 - Inspection, test and research laboratories

FIRMINY

- Product lines: Unit Forged Parts, Defence, Mandrels, Tool Steels
- 300 employees
- Activities:
 - Melting
 - Forging
 - Heat Treatment
 - Machining
 - Inspections / tests

PROCESSES

Melting - Rolling - Forging – Closed-die forging



MELTING

Air melting

The solidification may take place by continuous pouring (large quantities) or by casting in ingots (production of special quality, of higher properties)

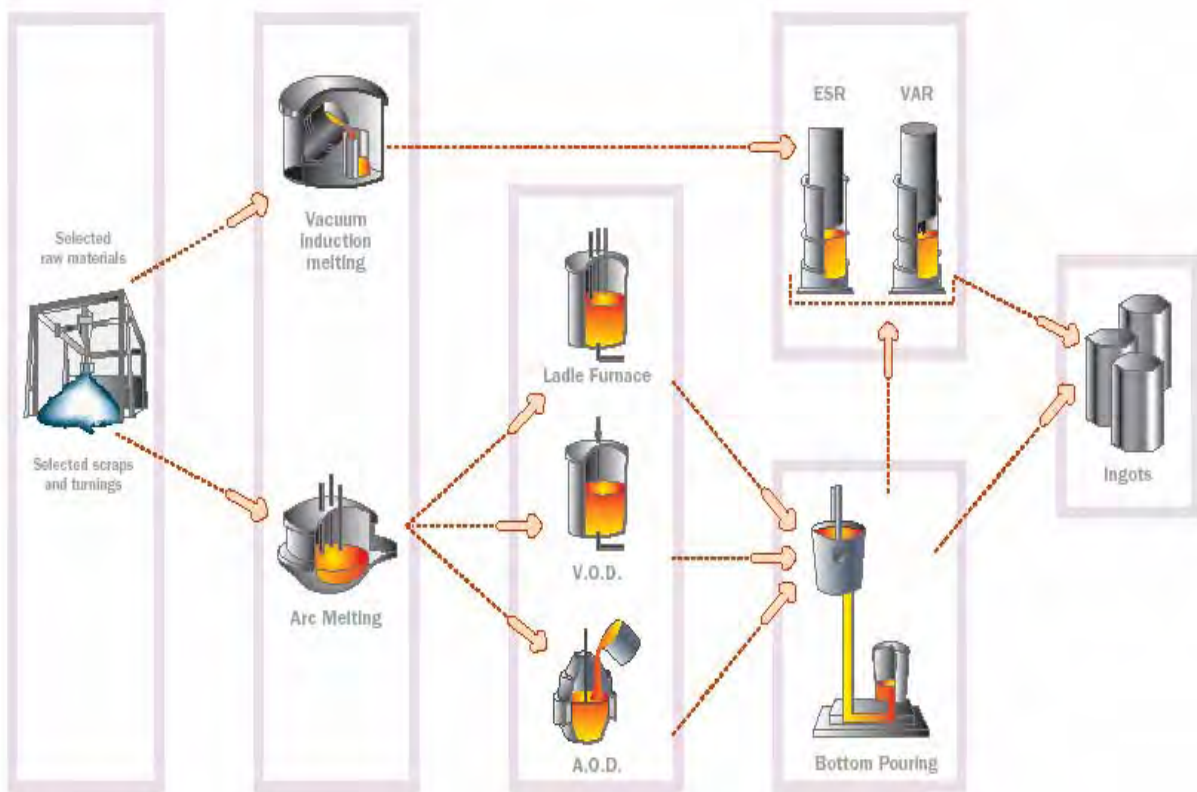
Vacuum melting

Used for alloys with higher stress applications

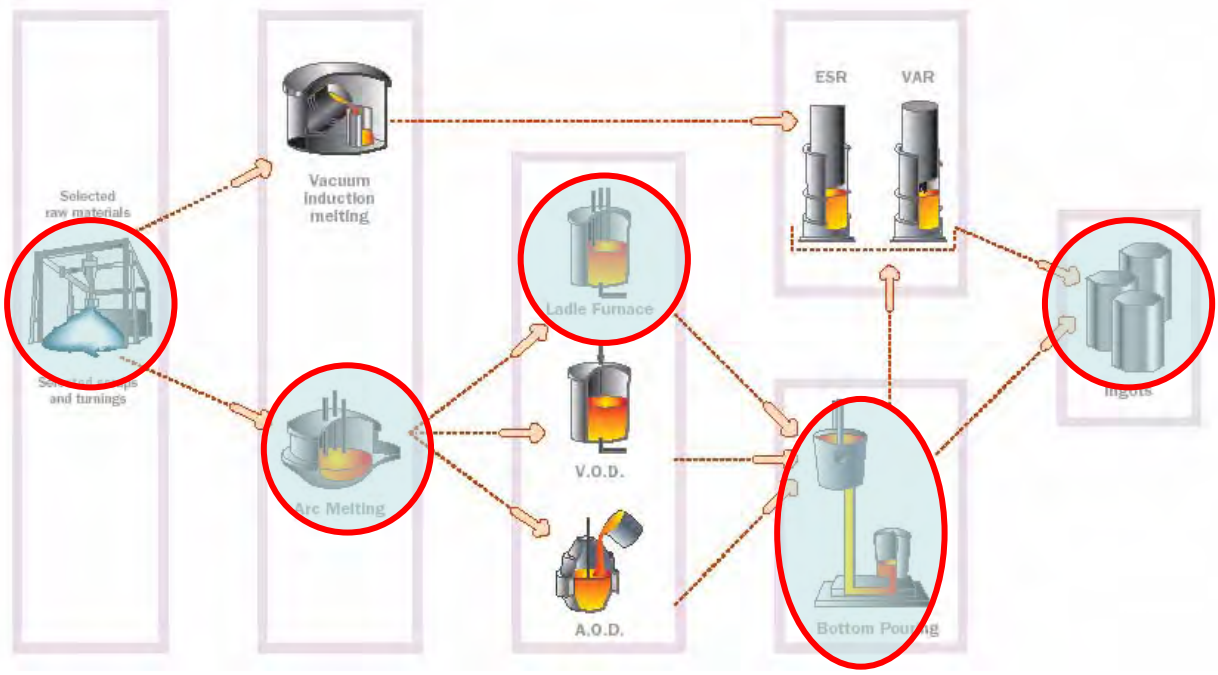
Remelting

May be under vacuum or slag. Allows improved properties and reliability of parts. Remelting is used for certain critical parts.

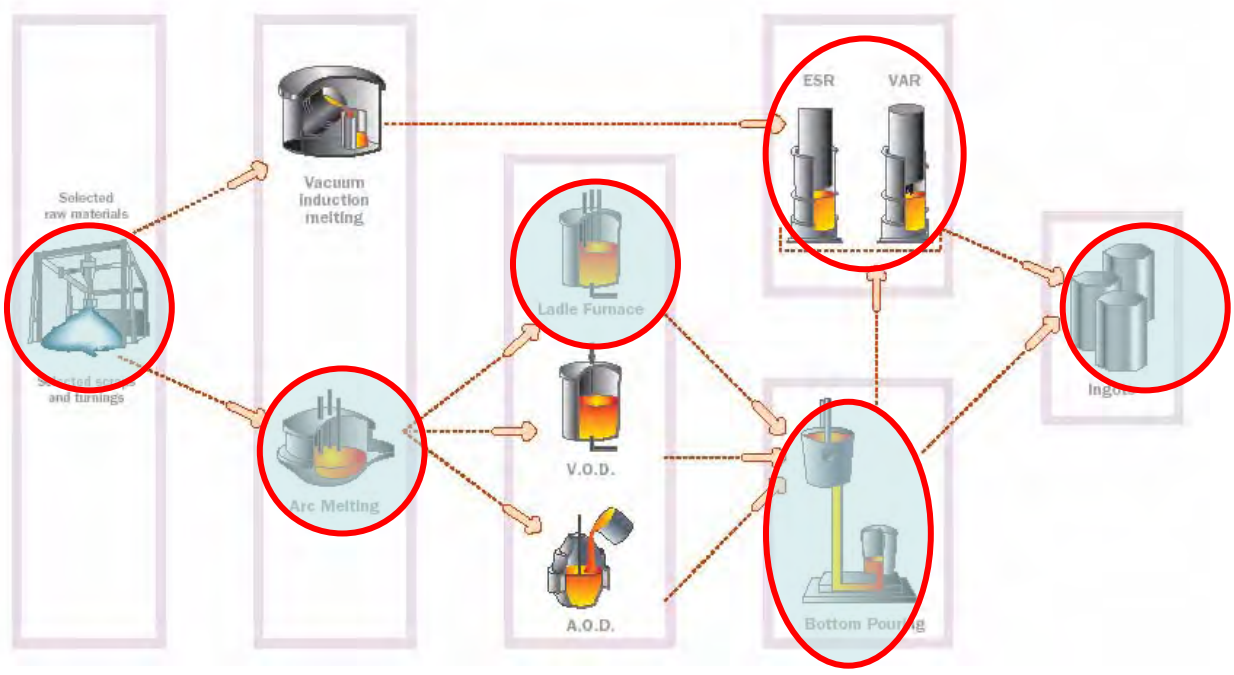
MELTING ROUTES



LOW ALLOY STEEL MELTING ROUTE

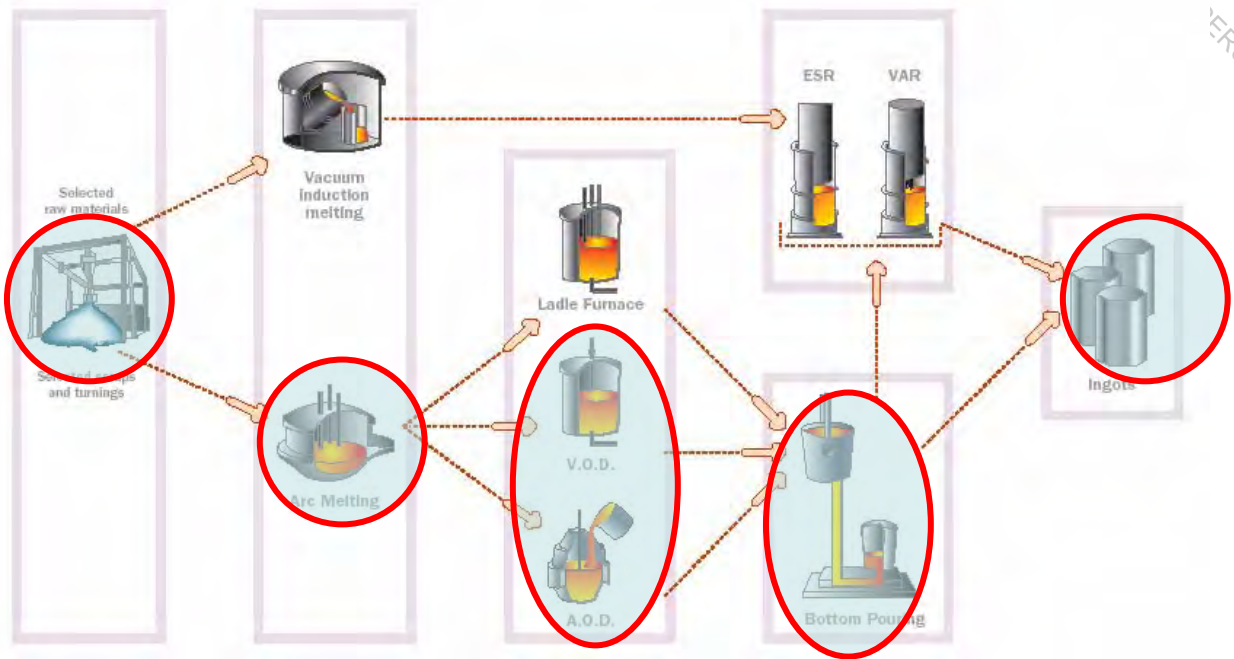


REMELTED LOW ALLOY STEEL

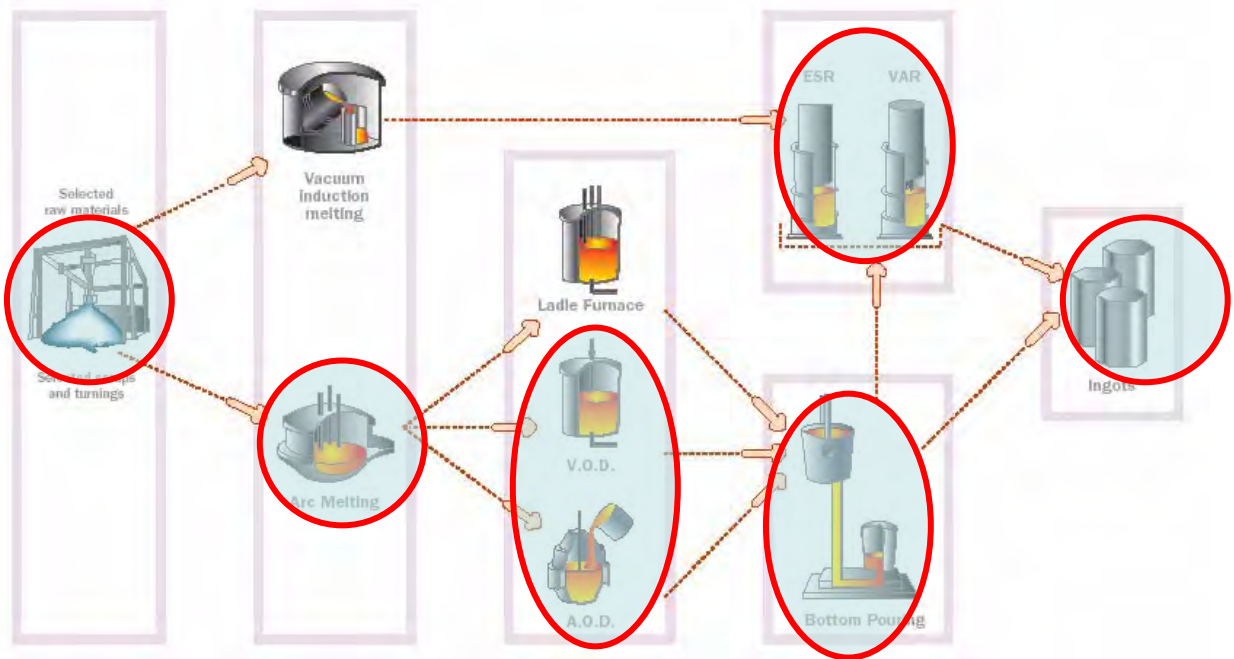


STAINLESS STEEL

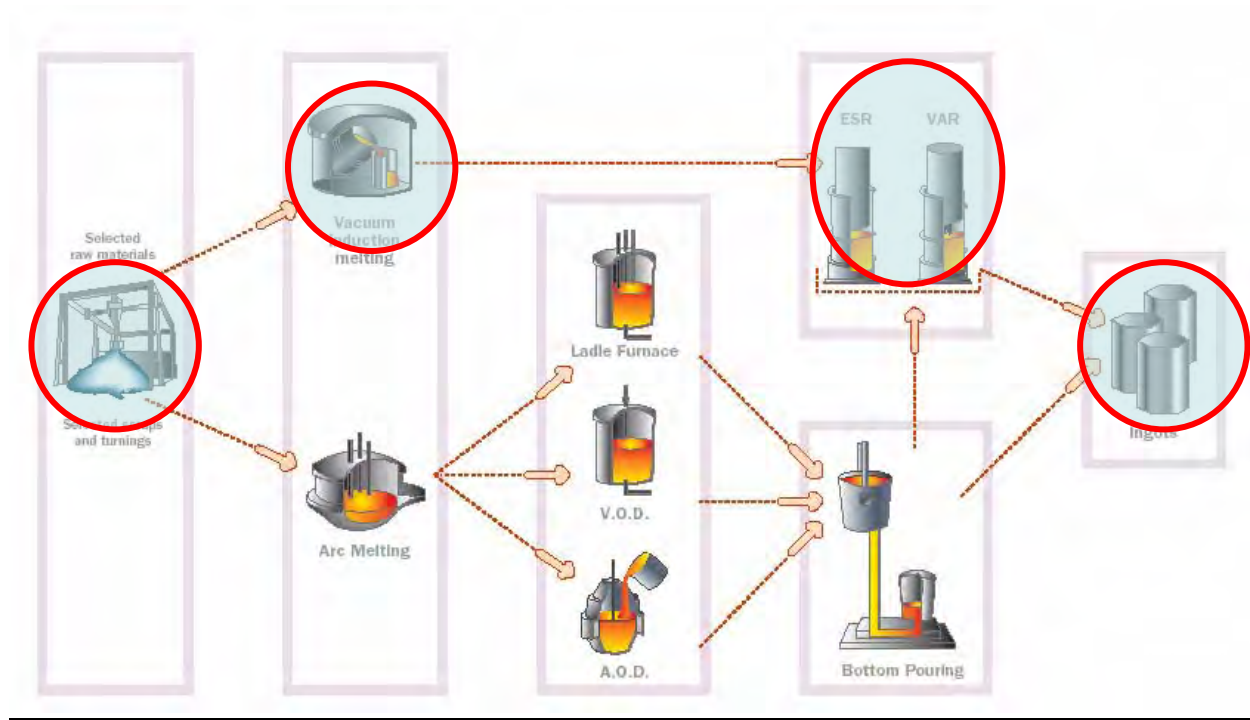
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REMELTED STAINLESS STEEL



VACUUM INDUCTION MELTING STEEL & ALLOYS



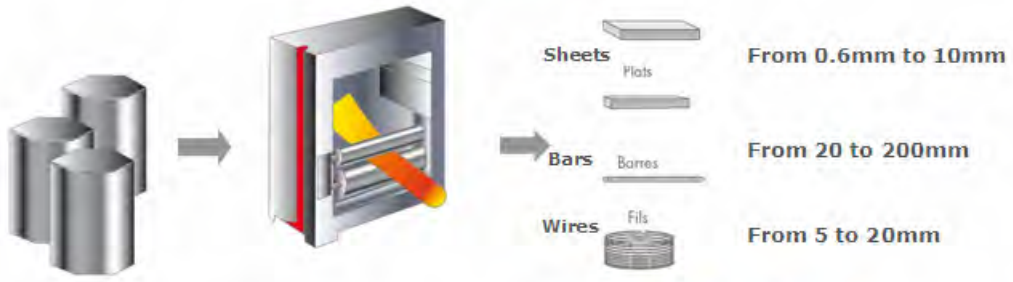
REMELTING PROCESS INFLUENCE on ALLOY ELEMENT CONTENT

ALLOY ELEMENT	VAR	ESR
Cr		
Cu		
Mn		
N ²		

For example effect of VAR process is decreasing N² content in steel but no effect of ESR process., so an electrode intended for remelting under vacuum (VAR) cannot be moved for remelting under slag (ESR)

Rolling: Reshaping of metal between two cylinders

PERSONAL USE ONLY



Bars

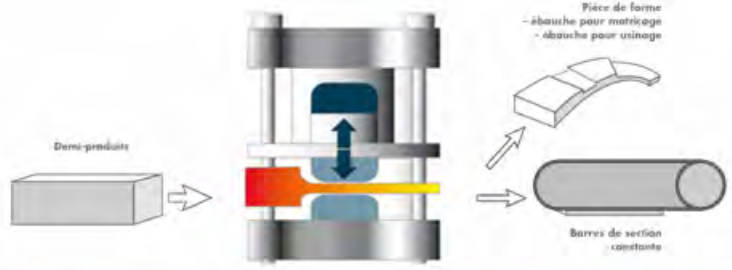


Machine wires



Forging: Reshaping of metal between two flat tools

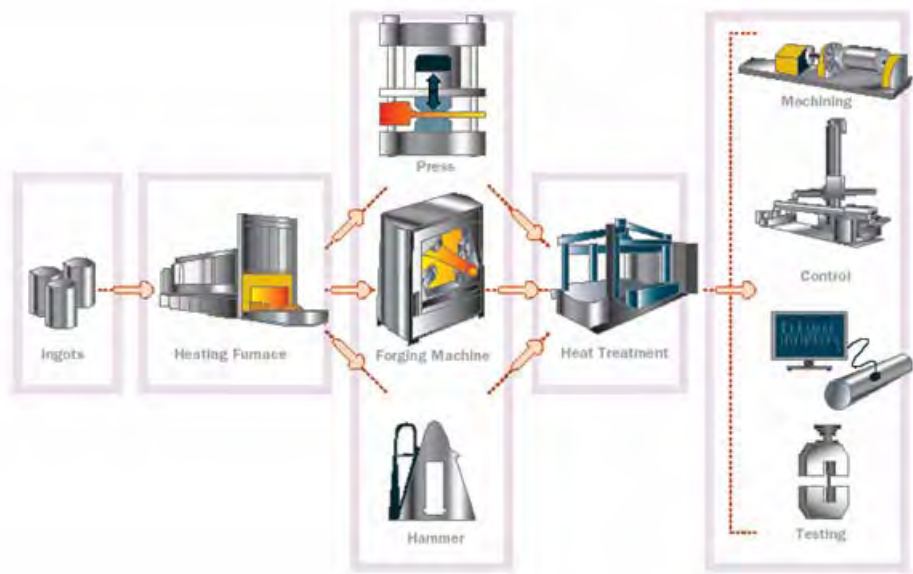
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Forging machine (SMX) - Les Ancizes



Forging of tooling at Firminy - 4,500t Press



BARS STANDARD OFFER FOR LONG PRODUCTS AND TOOL STEELS

GRADE LIST AND ROLLED DIMENSIONS RANGE

Status grade meanings :

C : Catalog grade for standard offer, no restrictions to be manufactured

D1 : Grade under development

D2 : Grade sold by Full Heat only

S : Deleted grade ; we had to carry out a new study to manufacture again this grade with new Request For Quotation considering a big quantity (two heats and more)

* Cells colored in green = standard grade

Grade	Rolled Rond Bar	Rolled Flat & Square Bar	Status
820	7.5 à 190	see following graph	C
830	7.5 à 190	see following graph	S
1087	7.5 à 190	see following graph	S
30NC11	7.5 à 190	see following graph	S
30NCDV14	7.5 à 190	see following graph	S
50NILYW	7.5 à 190	see following graph	C
56A	7.5 à 190	see following graph	D2
56AJ	7.5 à 190	see following graph	S
56BI	7.5 à 163	see following graph	D2
56BN	7.5 à 163	see following graph	S
56C	7.5 à 150	see following graph	C
56GE	7.5 à 150	see following graph	D2
56HS	7.5 à 163	see following graph	S
56T4	7.5 à 163	see following graph	S
56T5	7.5 à 163	see following graph	C
56TG	7.5 à 190	see following graph	S
56TN	7.5 à 190	see following graph	S

Grade	Rolled Rond Bar	Rolled Flat & Square Bar	Status
67T2D	7.5 à 150	see following graph	S
819A	7.5 à 190	see following graph	C
819B	7.5 à 190	see following graph	C
819C	7.5 à 190	see following graph	D2
836J	7.5 à 190	see following graph	D2
897D	7.5 à 190	see following graph	D2
897DMO	7.5 à 190	see following graph	S
AD10S	7.5 à 190	see following graph	S
AD21	7.5 à 190	see following graph	S
AD3	7.5 à 190	see following graph	D2
AD8S	7.5 à 190	see following graph	S
ADC3	7.5 à 170	see following graph	C
ADC4	7.5 à 170	see following graph	S
ADNIC261D	7.5 à 140	on request	S
ADNIC262E	7.5 à 140	on request	S
ADNIC265D	7.5 à 140	on request	S
ADNIC272D	7.5 à 140	on request	S
ADNIC275E	7.5 à 140	on request	S
ADNIC278	7.5 à 140	on request	S
ADNIC280	7.5 à 140	on request	S
ADNIC280R	7.5 à 140	on request	S
ADNIC56D	7.5 à 102	on request	S
ALACRITE163D	7.5 à 65	on request	S
ALACRITE164S	7.5 à 65	on request	S
APX	7.5 à 163	see following graph	C
APX2	7.5 à 87	see following graph	Status
APX4	7.5 à 170	see following graph	C
APXV	7.5 à 170	see following graph	C
APZ2	7.5 à 87	on request	S

Grade	Rolled Rond Bar	Rolled Flat & Square Bar	Status
APZ5	7.5 à 87	on request	S
APZ9	7.5 à 87	on request	S
BED	7.5 à 190	see following graph	C
BEV	7.5 à 190	see following graph	S
BM2	7.5 à 190	see following graph	S
BM9	7.5 à 150	see following graph	S
BMS	7.5 à 190	see following graph	D2
BMV4	7.5 à 163	see following graph	C
BX0	7.5 à 190	see following graph	D2
BX1	7.5 à 190	see following graph	S
BX3	7.5 à 190	see following graph	S
BXM	7.5 à 190	see following graph	S
CNS	7.5 à 190	see following graph	C
CNSMO	7.5 à 190	see following graph	S
D25TW	7.5 à 152	see following graph	C
DH11	7.5 à 190	see following graph	C
DH13	7.5 à 177	see following graph	C
DH33	7.5 à 177	see following graph	S
DH53	7.5 à 177	see following graph	S
DU3	7.5 à 163	see following graph	C
EA1W	7.5 à 140	on request	D2
F27	7.5 à 190	see following graph	S
F30	7.5 à 190	see following graph	S
F33	7.5 à 190	see following graph	S
F65	7.5 à 190	see following graph	C
F65S	7.5 à 190	see following graph	S
F66J	7.5 à 190	see following graph	D2
F66SS	7.5 à 190	see following graph	D2
FAD	7.5 à 190	see following graph	D2

Grade	Rolled Rond Bar	Rolled Flat & Square Bar	Status
FADC	7.5 à 190	see following graph	S
FADH	7.5 à 190	see following graph	C
FADS	7.5 à 190	see following graph	D2
FDG	7.5 à 190	see following graph	C
FDMA	7.5 à 190	see following graph	C
FND	7.5 à 190	see following graph	D1
GD223	7.5 à 163	see following graph	C
GH4	7.5 à 190	see following graph	C
GH9	7.5 à 190	see following graph	S
GK3	7.5 à 190	see following graph	C
GK5	7.5 à 190	see following graph	D2
GK5S	7.5 à 190	see following graph	D2
GKH	7.5 à 190	see following graph	C
GKJ	7.5 à 190	see following graph	S
GKP	7.5 à 190	see following graph	D2
H20D	7.5 à 87	on request	S
JD19	7.5 à 190	see following graph	D2
JE9	7.5 à 190	see following graph	S
LHD	7.5 à 190	see following graph	S
LK3	7.5 à 190	see following graph	C
LK5	7.5 à 190	see following graph	S
LK5CA	7.5 à 190	see following graph	S
LXM4	7.5 à 190	see following graph	S
M25W6	7.5 à 120	on request	C
M27	7.5 à 190	see following graph	S
M29	7.5 à 190	see following graph	S
M30NW6	7.5 à 120	on request	C
M64BCW6	7.5 à 70	on request	C
MARVAL13X	7.5 à 155	see following graph	C

Grade	Rolled Rond Bar	Rolled Flat & Square Bar	Status
MARVAL14	7.5 à 190	see following graph	S
MARVAL18	7.5 à 190	see following graph	C
MARVAL18H	7.5 à 190	see following graph	D1
MARVAL18S	7.5 à 170	see following graph	S
MARVALX12	7.5 à 190	see following graph	C
MARVALX12H	7.5 à 190	see following graph	C
MEK3	7.5 à 190	see following graph	C
MEK4	7.5 à 190	see following graph	C
MEP	7.5 à 170	see following graph	S
MES	7.5 à 163	see following graph	S
MLX138	7.5 à 145	see following graph	C
MLX17	7.5 à 190	see following graph	C
MMR0	7.5 à 190	see following graph	S
MMR1	7.5 à 190	see following graph	C
MMR3	7.5 à 190	see following graph	D2
MO6AC	7.5 à 190	see following graph	C
MOC2	7.5 à 190	see following graph	C
MOC2J	7.5 à 190	see following graph	S
MOC3	7.5 à 190	see following graph	S
MOC3J	7.5 à 190	see following graph	S
MOC7	7.5 à 190	see following graph	S
MOCV2	7.5 à 190	see following graph	D2
MOCV3	7.5 à 190	see following graph	S
MRL1	7.5 à 190	see following graph	S
MUV	7.5 à 190	see following graph	S
MVS	7.5 à 163	see following graph	S
MX455	7.5 à 163	see following graph	C
MY14	7.5 à 190	see following graph	D2
MY16	7.5 à 190	see following graph	D2

Grade	Rolled Rond Bar	Rolled Flat & Square Bar	Status
MY19	7.5 à 190	see following graph	D1
MY23	7.5 à 190	see following graph	C
MY24	7.5 à 190	see following graph	D2
N4	7.5 à 190	see following graph	S
N7	7.5 à 190	see following graph	S
N8	7.5 à 190	see following graph	S
NC25M	7.5 à 190	see following graph	S
NC26S	7.5 à 190	see following graph	D2
NC30M	7.5 à 190	see following graph	S
NC310	7.5 à 190	see following graph	C
NC35M	7.5 à 190	see following graph	D2
NC35M1	7.5 à 190	see following graph	S
NC40M	7.5 à 190	see following graph	C
NC40M1	7.5 à 190	see following graph	D2
NC40M4	7.5 à 190	see following graph	S
NC40S	7.5 à 190	see following graph	C
NCAV	7.5 à 190	see following graph	C
NCAV2	7.5 à 190	see following graph	S
NCAV2U	7.5 à 190	see following graph	S
NCAV4	7.5 à 190	see following graph	D2
NCAV5	7.5 à 190	see following graph	S
NOXIS	7.5 à 87	on request	S
NOXIS1	7.5 à 87	on request	S
NY276	7.5 à 102	on request	S
NY600	7.5 à 140	on request	D2
NY625	7.5 à 102	on request	C
NY690	7.5 à 140	on request	C
NY800	7.5 à 142	on request	D2
NY810	7.5 à 142	on request	S

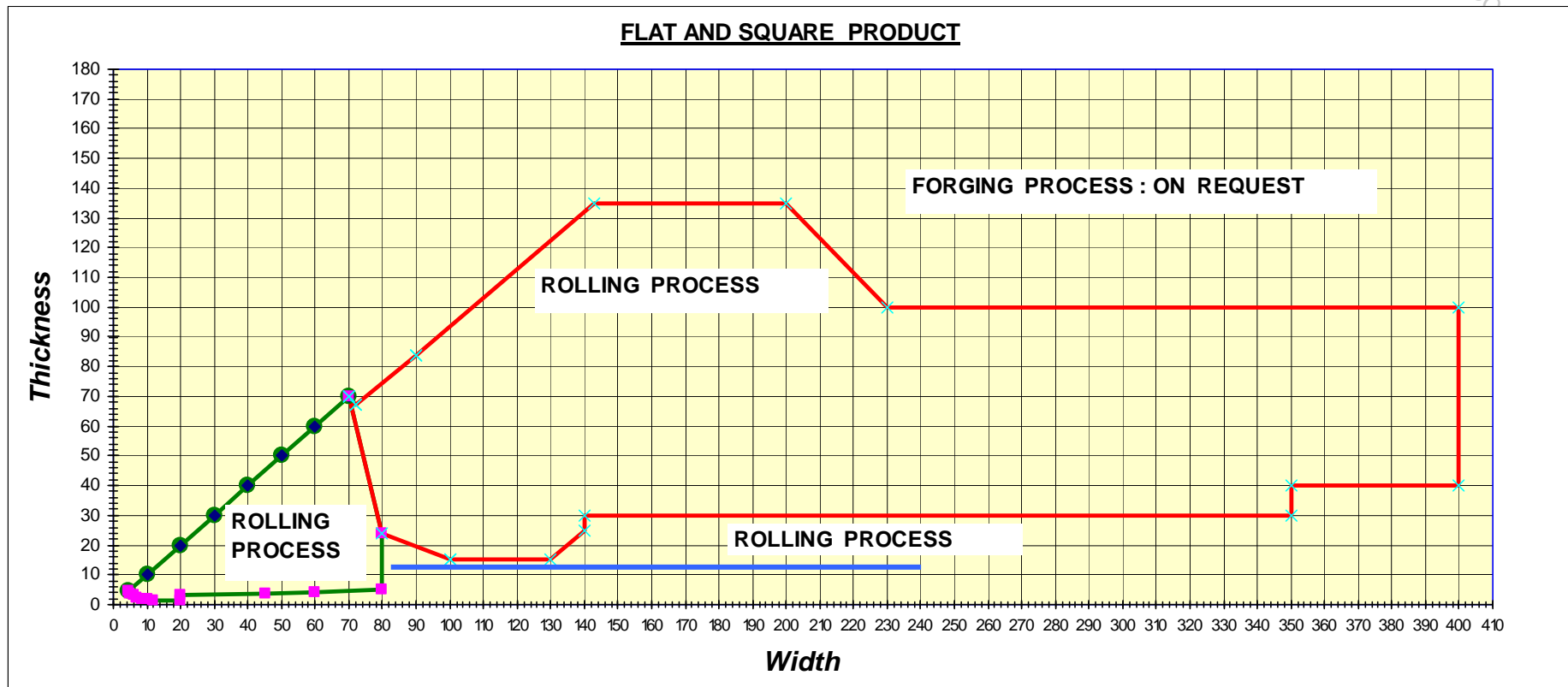
Grade	Rolled Rond Bar	Rolled Flat & Square Bar	Status
NY811	7.5 à 142	on request	S
NY825	7.5 à 142	on request	D2
NY925	7.5 à 140	on request	D1
NYF44	7.5 à 145	on request	S
NYF49	7.5 à 145	on request	S
P3C	7.5 à 70	on request	S
P43V	7.5 à 140	on request	C
P53NC	7.5 à 110	on request	C
P65C	7.5 à 102	on request	C
PER20NW	7.5 à 140	on request	D2
PER263W	7.5 à 140	on request	D1
PER2UW	7.5 à 140	on request	D2
PER2XW	7.5 à 140	on request	D2
PER3HW	on request	on request	S
PER3W	7.5 à 70	on request	D2
PER41W	on request	on request	S
PER5W	on request	on request	C
PER625W6	7.5 à 102	on request	C
PER72W	on request	on request	D2
PER75W6	7.5 à 140	on request	C
PER7HW	on request	on request	D2
PYRAD33	7.5 à 142	on request	S
PYRAD38	7.5 à 142	on request	S
PYRAD44DW	7.5 à 140	on request	S
PYRAD49DW6	7.5 à 140	on request	D2
PYRAD53NW	7.5 à 110	on request	C
R2C	7.5 à 190	see following graph	S
R6110	7.5 à 177	see following graph	C
R7050	7.5 à 177	see following graph	S

Grade	Rolled Rond Bar	Rolled Flat & Square Bar	Status
RA4	7.5 à 130	on request	C
RA5	7.5 à 130	on request	C
RA50YW	7.5 à 130	on request	C
RA6	7.5 à 90	on request	D2
RAD	7.5 à 160	see following graph	C
RADM	7.5 à 140	see following graph	S
RAPIDEB	7.5 à 87	on request	S
RAPIDEM	7.5 à 90	on request	D2
SANCY2	7.5 à 130	see following graph up to 250mm width	C
SCV	7.5 à 190	see following graph	C
SIMO	7.5 à 163	see following graph	D2
SM2	7.5 à 190	see following graph	S
SM2CB	7.5 à 190	see following graph	S
SM33LC	7.5 à 190	see following graph	C
SMH	7.5 à 120	see following graph up to 250mm width	D2
SMI	7.5 à 190	see following graph	C
SMP3	7.5 à 177	see following graph	C
SMR	7.5 à 177	see following graph	C
SMR4	7.5 à 177	see following graph	S
SMR7	7.5 à 177	see following graph	C
SMS3	7.5 à 177	see following graph	C
SMV	7.5 à 177	see following graph	S
SMV3	7.5 à 177	see following graph	C
SMV4	7.5 à 177	see following graph	S
SMV5	7.5 à 177	see following graph	C
SOS3	7.5 à 145	see following graph	S
SRV2	7.5 à 145	see following graph up to 250mm width	C
SY26	7.5 à 120	on request	D2
SY4	7.5 à 110	see following graph up to 250mm width	S

Grade	Rolled Rond Bar	Rolled Flat & Square Bar	Status
TITAL318	15 à 110	on request	D1
TITAL318ELI	15 à 110	on request	D1
V300	7.5 à 190	see following graph	C
V325	7.5 à 190	see following graph	D2
VCE	7.5 à 190	see following graph	S
VCE4	7.5 à 190	see following graph	S
VOLVIC	7.5 à 87	on request	S
VOLVIC10	7.5 à 120	on request	C
VOLVIC2	7.5 à 87	on request	C
VOLVIC4	7.5 à 87	on request	S
WIS	7.5 à 190	see following graph	S
X12NB	7.5 à 163	see following graph	D2
X13	7.5 à 163	see following graph	C
X13BC	7.5 à 163	see following graph	D2
X13D	7.5 à 163	see following graph	S
X13DN	7.5 à 163	see following graph	S
X13E	7.5 à 163	see following graph	C
X13M	7.5 à 163	see following graph	S
X13MA	7.5 à 163	see following graph	D2
X13MB	7.5 à 163	see following graph	D2
X13MU	7.5 à 163	on request	S
X13N4	7.5 à 163	see following graph	S
X13T1	7.5 à 163	see following graph	S
X13T5	7.5 à 163	see following graph	S
X13T6	7.5 à 163	see following graph	C
X13U	7.5 à 163	on request	S
X45U	7.5 à 170	see following graph	D2
X47D	7.5 à 120	on request	S
X4S	7.5 à 170	see following graph	S

Grade	Rolled Rond Bar	Rolled Flat & Square Bar	Status
X520	7.5 à 170	see following graph	C
X52DU	7.5 à 120	on request	S
XD15N	7.5 à 170	see following graph	C
XDBD	7.5 à 120	see following graph up to 250mm width	C
XDBDW	7.5 à 120	see following graph up to 250mm width	C
XM112	7.5 à 50	on request	S
XM114	7.5 à 50	on request	D2
XM114U	7.5 à 50	on request	S
XM19	7.5 à 90	on request	S
XM211	7.5 à 50	on request	S
XMF24	7.5 à 145	on request	S
XN26AW	7.5 à 152	see following graph	C
XN26TW	7.5 à 152	see following graph	C
XN26TWS	7.5 à 152	see following graph	D1
XN904	7.5 à 140	see following graph	D2
XSH	7.5 à 100	on request	C
XSL	7.5 à 100	on request	D2
X13VD	7.5 à 163	see following graph	C
X13VK	7.5 à 163	see following graph	S
X13W3	7.5 à 163	see following graph	S
X15D2	7.5 à 95	see following graph	S
X15U5	7.5 à 170	see following graph	C
X15U5D	7.5 à 170	see following graph	S
X15V	7.5 à 170	see following graph	D1
X16D3	7.5 à 100	see following graph	S
X17T	7.5 à 150	see following graph	D2
X17U4	7.5 à 170	see following graph	C
X17U4R	7.5 à 170	see following graph	D2
X18	7.5 à 163	see following graph	S

Grade	Rolled Rond Bar	Rolled Flat & Square Bar	Status
X18BC	7.5 à 160	see following graph	D2
X18J	7.5 à 160	see following graph	S
X18LB	7.5 à 160	see following graph	S
X18M	7.5 à 160	see following graph	S
X18MBC	7.5 à 160	see following graph	D2
X18MC	7.5 à 160	see following graph	D2
X18MNB	7.5 à 160	see following graph	D2
X18MP	7.5 à 160	see following graph	S
X18NB	7.5 à 160	see following graph	S
X18NBJ	7.5 à 160	see following graph	D2
X18PA	7.5 à 160	see following graph	C
X18U	7.5 à 87	on request	S
X19T4	7.5 à 50	see following graph	S
X203	7.5 à 120	on request	D2
X20DU	7.5 à 87	on request	S
X20T	7.5 à 140	see following graph	S
X20T2	7.5 à 160	see following graph	D1
X20T3	7.5 à 140	see following graph	S
X20T3R	7.5 à 140	see following graph	S
X21M2	7.5 à 50	on request	S
X21RB	7.5 à 50	on request	S
X21RC	7.5 à 50	on request	C
X23N	7.5 à 50	on request	D2
X25	7.5 à 142	on request	S
X25A	7.5 à 142	on request	S
X25V	7.5 à 152	on request	C
X35	7.5 à 50	on request	S
X39	7.5 à 50	on request	S
X39V	7.5 à 152	on request	S



ROUND BARS : BLACK – PEELED - GROUND

DIMENSIONS (mm)	TOLERANCES (mm)	SURFACE DELIVERY	DIMENSIONS (mm)	LENGTH (mm) (other dimensions on request)	STRAIGHTNESS	ROUGHNESS (micrometer)	SURFACE INSPECTION	DIMENSIONS (mm)
$7.5 \leq \emptyset \leq 10$	+/- 0,25	Black only	$7.5 \leq \emptyset \leq 10$	3500 to 6000	2 mm/m with < 0.12% on total length	black :Ra ≤ 12.5 μm peeled : Ra ≤ 6.3 μm ground : Ra ≤ 3.2 μm	Eddy current (up to dia 50mm on peeled and ground bars)	$7.5 \leq \emptyset \leq 10$
$10 < \emptyset \leq 14$	+/- 0.25	Black or peeled	$10 < \emptyset \leq 14$					$10 < \emptyset \leq 14$
$14 < \emptyset \leq 20$	+/- 0.25	Black. peeled or ground	$14 < \emptyset \leq 20$					$14 < \emptyset \leq 20$
$20 < \emptyset \leq 40$	+/- 1.25% Ø		$20 < \emptyset \leq 40$					$20 < \emptyset \leq 40$
$40 < \emptyset \leq 50$	+/- (0.1 + 1% Ø)	peeled or ground	$40 < \emptyset \leq 50$				US (above dia 50mm)	$40 < \emptyset \leq 50$
$50 < \emptyset \leq 125$	+/- (0.1 + 1% Ø)		$50 < \emptyset \leq 125$					$50 < \emptyset \leq 125$
$125 < \emptyset \leq 140$	- 0 /+ (0.2 + 2% Ø)		$125 < \emptyset \leq 140$					$125 < \emptyset \leq 140$
$140 < \emptyset \leq 190$	- 0 /+ 3 - * for ground		$140 < \emptyset \leq 190$	$140 < \emptyset \leq 190$				
$190 < \emptyset \leq 350$	- 0 /+ 3	peeled	$190 < \emptyset \leq 350$	3500 to 8000	3 mm/m	VISUAL	$190 < \emptyset \leq 350$	
$350 < \emptyset \leq 900$			$350 < \emptyset \leq 900$	2000 to 6000	3 mm/m with < 0.12% on total length		peeled Ra ≤ 12.5 μm	$350 < \emptyset \leq 900$

In case of milled forged bars tolerance on diameter is -0/+5 mm

Marking : batch number+ heat number+ brand name on : $\emptyset < 12$: label - $12 \leq \emptyset < 50$ on generatrice (ink or stamp) - $\emptyset > 50$: stamp on end bar section : batch number

Packaging : Wooden box for sea - air shipping ; others : fastened with 3 straps (middle and each end) - ground bars are packed in wrapped bundles or on wooden pallets

NDT US Inspection: FBH 2 mm (long+ group) à 3 mm (alone) : control performed on product or semi –product

Release Note : Chemical analysis

Ovality : 75% on black - 50% on peeled & ground on tolerance diameter

Chamfer : black : N/A ; peeled : 45° chamfer from 3 up to 6 mm on range dia 50 to 120 mm ; ground : on request

MINIMUM ORDERING QUANTITY : FOR ROUND BARS

CONFIDENTIAL DOCUMENT - PERSONAL USE ONLY

ROUND ROLLED BARS

Kg	MOQ	Engineering steel		Stainless steel		XDBD / X18PA	RA50YW	Superalloys
		Arc melted	Remelted	Arc melted	Remelted	Arc melted	Remelted	
<u>Wire and black bar dia < 50mm</u>	MOQ	(3 x 190) + n x 190						(3 x 190) + n x 190 Wire only
<u>Ø < 50 peeled</u>	MOQ	(3 x 170) + n x 170						(2 x 100) + n x 100
<u>52 < Ø < 164</u>	MOQ	1850 + n x 1850	1450 + n x 1450	1650 + n x 1650	1350 + n x 1350	1230 + n x 1230	1400 + n x 1400	900 + n x 900
<u>165 < Ø < 200</u>	MOQ	1400 + n x 1400	1400 + n x 1400		1350 + n x 1350			

n = 0 or 1 or 2 or 3 ...

Tolerance of MOQ is ± 10%

ROUND FORGED BARS FOR TOOL STEELS

Ancizes :

Electric Arc Furnace (EAF)

Minimum Ordering Quantities (kg) \pm 10%	
DIAMETER (mm)	ELECTRIC ARC FURNACE (EAF)
dia rolled to 300	1 900
300 $\Phi \leq 340$	2 400
340 $\Phi \leq 370$	3 100
370 $\Phi \leq 435$	4 200
435 $\Phi \leq 550$	6 400
550 $\Phi \leq 900$	8 000

Vacuum Arc Remelting (VAR) & Electro-Slag Remelting ' ESR)

Minimum Ordering Quantities (kg) \pm 10%	
REMELTED (VAR or ESR)	DIAMETER (mm)
1 800	dia rolled to 290
2 300	290 $\Phi \leq 320$
2 900	320 $\Phi \leq 365$
4 300	365 $\Phi \leq 440$
6 100	440 $\Phi \leq 520$
8 500	520 $\Phi \leq 620$
12 200	620 $\Phi \leq 900$

Firminy specific to 5%Chromium Steels

Minimum Ordering Quantities (kg) \pm 10%	
DIAMETER (mm)	ELECTRIC ARC FURNACE (EAF)
350-380	3 325
381-450	4 750
451-535	6 475
536-610	9 700
611-900	12 500

ROUND FORGED BARS FOR SEMI-PRODUCT

The following table is available only with standard condition: bars are manufactured by direct drawing and conversion ratio is equal to 5.

For Aeronautic Orders move down the diameter range by 50mm

Minimum Ordering Quantities (kg) \pm 10%				
DIAMETER (mm)	ELECTRIC ARC FURNACE (EAF)	VACUUM ARC REMELTED (VAR)	ELECTRO- SLAG REMELTED (ESR)	DIAMETER (mm)
dia rolled to 200	1600	2800	2800	dia rolled to 200
205 - 220	2200	6000		205 - 220
225 - 240			245 - 290	6300
245 - 290	3800	5000	5500	245 - 290
295 - 300				295 - 300
305 - 400				305 - 400
405 - 450	-	-		405 - 450

Concerning Superalloys forged bars: the minimum Ordering Quantity vary between 900 kg up to 6000 kg depending on the melting route or ingot supplier

FLAT OR SQUARE BARS

PRODUCTS	DIMENSIONS (mm) (other dimensions on request)	TOLERANCES (mm)		STRAIGHTNESS	DELIVERY SURFACE	SQUARENESS
Flat bars	thickness : ≤ 170 width : ≤ 400 see graph for rolled possibility ; other on request	see table in appendix		3 mm/m	black or shot - peening / blasted	≤ 0.03
	$170 \leq \text{Thickness} \leq 700$ $400 \leq \text{Width} \leq 1050$	0 +5				
Square bars	square max rolled C = 70 mm	Side ≤ 20	+/- 0.20	4 mm/m	black or shot - peening / blasted	≤ 0.06
		$20 < C \leq 40$	+/- 1.25% C			
		$40 < C \leq 70$	+/- (0.1 + 1% C)			
Square billets	side (C) as rolled dimensions	+/- 3% C		4 mm/m	black or milled	≤ 0.06
	$50 \leq C \leq 105$					
	$115 \leq C \leq 220$	+/- 2				
	$220 \leq C \leq 310$					
Blooms	Thickness : 120 à 220	+/- 3% C		4 mm/m	black or milled	≤ 0.06
	Width : 140 à 250					

Length : 2000 to 6000 mm , others on request

Roughness : $Ra \leq 12.5 \mu\text{m}$

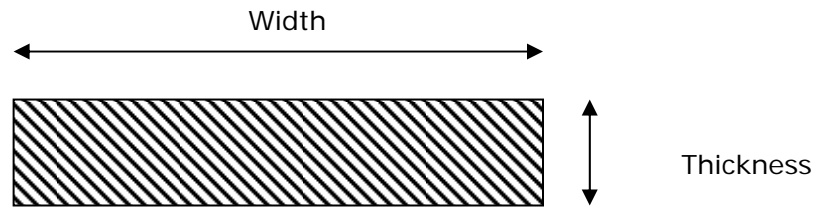
Marking : label or stamp

NDT US Inspection : FBH 2 mm (long + group) to 3 mm (alone)

Tolerances on cutting length : - 0 / + 50 mm

Surface inspection : visual

Packaging : Wooden box for sea - air shipping ; others : fastened with 3 straps (middle and each end) -or on wood pallets.

TOLERANCES FOR ROLLED FLAT PRODUCT

Flat standard tolerances ⇒ green and red zone on graph

width (w in mm)	width tolerances (mm)	Thickness tolerances (t in mm)						
		t < 13	13 < t ≤ 20	20 < t ≤ 40	40 < t ≤ 50	50 < t ≤ 75	75 < t ≤ 100	100 < t ≤ 170
w ≤ 20	± 0,4	± 0,3	± 0,3	-	-	-	-	-
20 < w ≤ 40	± 0,6	± 0,3	± 0,4	± 0,5	-	-	-	-
40 < w ≤ 50	± 0,8	± 0,4	± 0,5	± 0,6	± 0,75	-	-	-
50 < w ≤ 100	± 1,2	± 0,4	± 0,5	± 0,75	± 0,75	± 1,0	-	-
100 < w ≤ 125	± 1,5	± 0,4	± 0,5	± 0,75	± 0,75	± 1,0	± 1,5	-
125 < w ≤ 150	± 1,5	-	± 0,5	± 0,75	± 0,75	± 1,0	± 1,5	± 2,5
150 < w ≤ 400	± 0,01 b	-	± 0,6	± 1,2	± 1,5	± 2,0	± 2,5	± 3,0

⇒ Green zone : possibilities see in the following table

⇒ Red zone : more strict tolerances on request

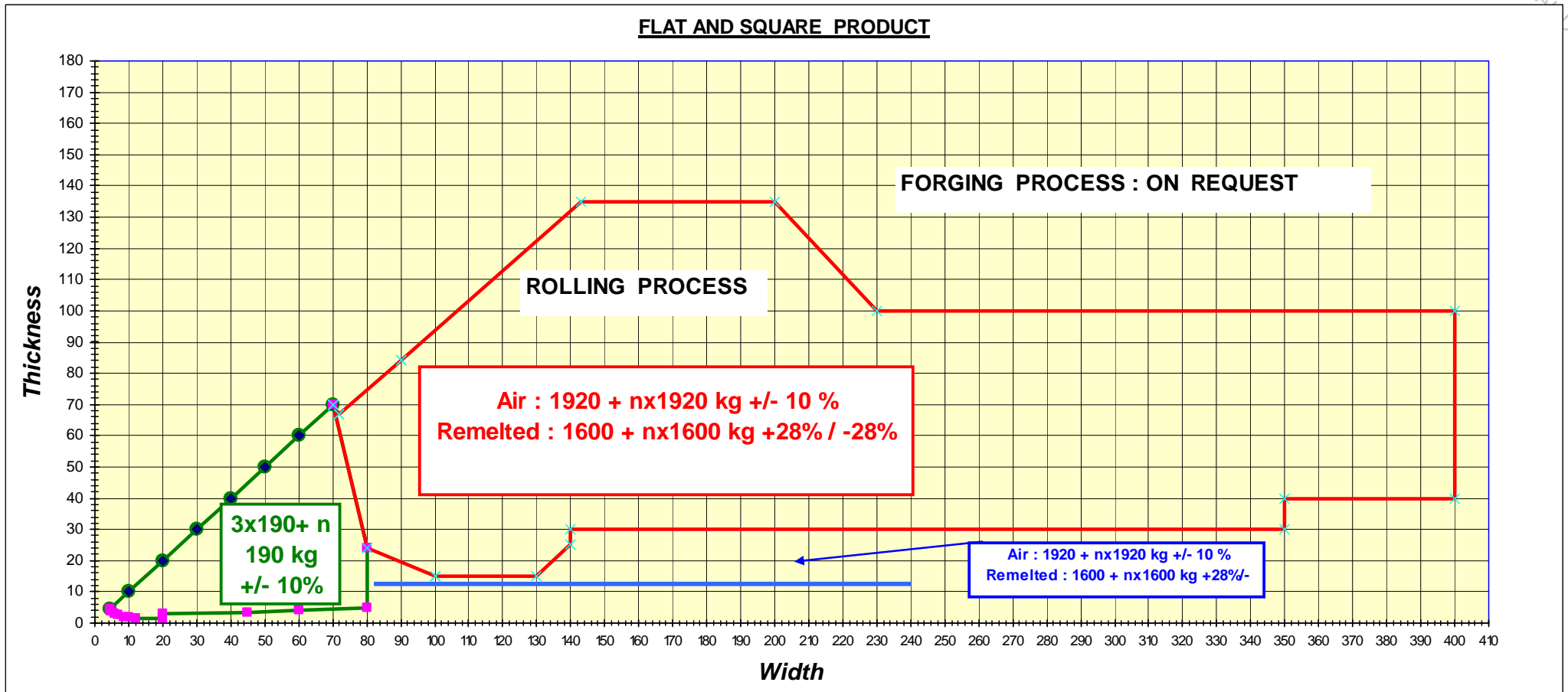
Possible tolerances

(Green zone in Minimum Ordering Quantity Flat & Square product graph)

		Width (mm)			
		W ≤ 40	40 < W ≤ 60	W ≥ 60	
Thickness (mm)	t ≤ 20	Tol e	± 0,20		
		Tol L	± 0,50	± 0,60	± 0,70
	20 < t ≤ 30	Tol e	± 0,20		
		Tol L	± 0,50	± 0,60	± 0,70
	30 < t ≤ 40	Tol e	± 0,30		
		Tol L	± 0,60	± 0,70	± 0,80
	40 < t ≤ 50	Tol e	± 0,35		
		Tol L		± 0,80	± 0,90
	t ≥ 50	Tol e	± 0,40		
		Tol L		± 0,90	± 1,00

MINIMUM ORDERING QUANTITY (MOQ) : FOR FLAT BARS

ROLLED FLAT BARS



FLAT FORGED BARS FOR TOOL STEEL

Ancizes :

Electric Arc Furnace (EAF)

Vacuum Arc Remelting (VAR)
& Electro-Slag Remelting (ESR)

Minimum Ordering Quantities (kg) $\pm 10\%$	
Section (dm ²)	ELECTRIC ARC FURNACE (EAF)
S ≤ 10.0	2 400
10.0 < S ≤ 12.9	3 100
12.9 < S ≤ 17.4	4 100
17.4 < S ≤ 27.0	6 500
27.0 < S	8 000

Minimum Ordering Quantities (kg) $\pm 10\%$	
Section (dm ²)	REMELTED (VAR or ESR)
S ≤ 8.7	2000
8.7 < S ≤ 11.0	29000
11.0 < S ≤ 17.6	4100
17.6 < S ≤ 24.8	5900
24.8 < S ≤ 35.5	8400
35.5 < S	11900

Firminy

TOOL STEELS IN FIRMINY PLANT			DH11/DH13 DH53 55 NCDV 7	ADC3 - SMV3 BLACK	ADC3/SMV3 2 SIDES GROUND
Tol = +10/- 0	Tol = +10/-0		Tol = +/- 5 %	Tol = +/- 5 %	Tol = +/- 5 %
Width (mm)	thickness (mm)	Number of bar	MOQ (kg)	MOQ (kg)	MOQ (kg)
410	180	2	3640	3430	3180
450	260	1	3640	3430	3180
500	150 - 185	2	3640	3430	3180
500	190-200	1	3640	3430	3180
510	150	2	3640	3430	3180
510	160-225	1	3640	3430	3180
515	285	1	5200	4900	4600
570	180	1	3640	3430	3180
600	150-155	2	3640	3430	3180
600	160-225	1	3640	3430	3180
600	230-250	1	5200	4900	4600
610	215-260	1	3640	3430	3180
610	265-316	1	5200	4900	4600
700	150-195	1	3640	3430	3180
800	150-170	1	3640	3430	3180
800	175-230	1	5200	4900	4600
800	235-300	1	7050	6650	6300

TOOL STEELS IN FIRMINY PLANT			DH11/DH13 DH53 55 NCDV 7	ADC3 - SMV3 BLACK	ADC3/SMV3 2 SIDES GROUND
Tol =+10/- 0	Tol =+10/0		Tol = +/- 5 %	Tol = +/- 5 %	Tol = +/- 5 %
Width (mm)	thickness (mm)	Number of bar	MOQ (kg)	MOQ (kg)	MOQ (kg)
810	150-170	1	3640	3430	3180
810	175-215	1	5200	4900	4600
810	265-315	1	7050	6650	6300
900	200-210	1	5200	4900	4600
900	215-310	1	7050	6650	6300
900	315-400	1	10550	9950	9450
960	150-195	1	5200	4900	4600
960	200-290	1	7050	6650	6300
960	295-300	1	10550	9950	9450
960	510	1	13380	12600	12000
1000	200-275	1	7050	6650	6300
1000	280-350	1	10550	9950	9450
1100	300-365	1	10550	9950	9450
1100	370-700	1	13380	12600	12000
1200	300-600	1	13380	12600	12000
1300	300-500	1	13380	12600	12000

SHEETS

PRODUCTS	THICKNESS (mm) (other dimensions on request)	TOLERANCES (mm)	LENGTH (mm) (other dimensions on request)	STRAIGHTNESS - FLATNESS	ROUGHNESS (micrometer)	DELIVERY SURFACE	NDT US	MINIMUM ORDERING QUANTITY	TOLERANCES ON CUTTING LENGTH (mm)
Sheet	0.5 à 9.99 10 à 15	NF EN 10259 (cold rolled) - NF EN 10051 (hot rolled)	2000 x1000	NF EN 10259 (cold rolled) - NF EN 10051 (hot rolled)	cold rolled Ra ≤ 3.2 µm - hot rolled Ra ≤ 6.3 µm	pickled or shot- peening or skin pass	FBH 1.2 mm (long+group) à 2 mm (alone) on semi product	800 kg up to 6000 kg	0/+5 **
	15 à 30	±0.5	up to 4000 on request	NF EN 10051	Ra ≤ 12.5 µm	black or shot - peening	FBH 1.2 mm (long+group) à 2 mm (alone) on semi product and NF EN 10160 classe S3 / E4 on final product	1000 kg up to 7500kg	0/+30 **
	30 à 150	2/0							0/+30 **

** : if water cutting, tolerances become - 0/+100 mm on width and length

Marking on sheets : ink : European norm+ heat treatment symbol+ heat number
+thickness (1/10e mm) +brand name + AD logo + Order
manufacturing number

Packaging : Sheets are wrapped on wood pallets

Release Note : Chemical analysis

Surface inspection : Visual

3D FORGED BLOCKS

3 D Forged Blocks are standard only for Tool Steels. For other grades, please ask the Market Manager in charge

Length (mm)	L ≤ 1800
Dimensions	$L \leq 3/2 (W + H)$ et $L/H \leq 5$ OR $L \leq (W + H)$ et $W/H \leq 7$ OR $L = W$ & $W/H \leq 9$
Tolerances on black blocks (mm)	0,+4% on length and 0,+2% on width & higher
Delivered Surface	as forged
Squareness	$(D - d)/D \leq 0,03$
Max Weight	12 Tons
Flatness	See following table
Marking	Stamp on side the heat number and brand name
Packaging	Wooden box for sea - air shipping; others fastened with 3 straps (middle and each end)
NDT US inspection	FBH 1.2 mm (long+ group) to 2 mm (alone)
Surface inspection	Visual
Release Note	Chemical analysis

L : length ; W : width ; H : height

Minimum Ordering Quantity: ask the Market Manager in charge

3D FORGED DISKS

3 D Forged Disks are standard only for Tool Steels. For other grades, please ask the Market Manager in charge

Diameter (mm)	Diameter ≤ 2800
Dimensions	$1 \leq \text{ratio (dia / thickness)} \leq 10$
Tolerance on black (mm)	.-0/+3% on diameter & -0/+4% on thickness
Delivered surface **	as forged
Max Weight	12 Tons
Marking	Stamp on side the heat number and brand name
Packaging	Wooden box for sea - air shipping; others fastened with 3 straps (middle and each end)
NDT US inspection	FBH 1.2 mm (long+ group) to 2 mm (alone)
Surface inspection	Visual
Release Note	Chemical analysis

**Possibility of machining delivery surface on request

Minimum Ordering Quantity: ask the Market Manager in charge

FLATNESS ON FORGED FLAT BARS, 3D BLOCKS, DISKS

Dimension (mm)	Defect (mm)
$D \leq 200$	≤ 2
$200 < D \leq 300$	≤ 3
$300 < D \leq 500$	≤ 4
$500 < D \leq 700$	≤ 5
$700 < D \leq 1000$	≤ 6
$1\ 000 < D \leq 1400$	≤ 8
$1\ 400 < D \leq 1800$	≤ 10
$1\ 800 < D \leq 2200$	≤ 12
$2\ 200 < D \leq 2800$	≤ 15

TABLE : A&D BRAND NAME – NORMS

Aubert & Duval Brand Name	European Norm	UNS	AISI / SAE	usual trade name	Werkstoff	British Santard	AMS
820	40CrNiMo18						
866	34NiCrMo6				1.6582		
165ND	CoCr28MoNi	R30021		STELLITE 21			
50NILYW	13MoCrNi42-16-14			M50NIL			6278
56AJ	28MoCrV14						
56A	28CrMoV5-8						
56BI	X22CrMoWV12-1				1.4935		
56BN	X20CrMoV11-1				1.4922		
56BN					1.4923		
56CW	X10CrCoMo10-6			FV535	1.4911	S 152	
56GE	X20CrMoWNI12	S42200					5655
56T4	X12CrNiMoNbV11			FV448		S 150	
56T5	X19CrMoNbVN11-1				1.4913		
56TG	21CrMoV5-7				1.7709		
56TG	24CrMoV5-7				1.7733		
819AW	35NiCrMo16				~1.6773		
819B	36NiCrMo16				1.6773		
820	40NiCrMo18				~1.2767		
836J	30CrNiMo8				1.6604		
836J					1.6580		
897D	30NiCr11		SAE 3435		1.6580		
AD21	35CrNiMoV6						
AD3	10NiCr12		AISI E 3316		~1.5752		
ADC3	X36CrMoV5		~H11	H11 modifié	1.2340		

Aubert & Duval Brand Name	European Norm	UNS	AISI / SAE	usual trade name	Werkstoff	British Santard	AMS
NY690 NY690	NiCr29Fe	N06690		INCONEL 690	2.4642		
ADNIC 265 D	NiMo28	N10001		HASTELLOY B	2.4617		
ADNIC 265 D		N10665		HASTELLOY B2	~2.4810		
NY600	NiCr15Fe	N06600		INCONEL 600			5540
NY600							5665
NY276	NiMo16Cr15W	N10002		HASTELLOY C	2.4819		5530
NY276		N10276		HASTELLOY C276			
ALACRITE 602	G-CoCr29W5	R30006		STELLITE 6			5387
APX	X17CrNi16-2	S43100	431	431	1.4044	S 80	
APX					1.4057		
APX4	X4CrNiMo16-5-1				1.4418		
APXV	X17CrNi16-2	S43100	431	431	1.2787		
APZ9	X85CrMoV18-2				1.4748		
BED	43CrMo4				1.3563		
BED	43CrMo4				1.7225		
BM2	15CrMo4-05						
BMV4	40CrMoV20	T20811			1.7784		6437
BMV4							6485
BMV4W	40CrMoV20	T20811			1.7784		6487
BMV4W					1.7784		6488
BMV5	36CrMoV20				1.2340		
BXM	17CND6						
CLARM HB7	40NiCrMoV15						
CLARM HBR	30NiCrMoV14						
CNS	35NiCr6						
CNSMo	35NiCrMo6						
DH11	X37CrMoV5-1		H11		1.2343		

Aubert & Duval Brand Name	European Norm	UNS	AISI / SAE	usual trade name	Werkstoff	British Santard	AMS
DH13	X40CrMoV5-1		H13		1.2344		
DH33	32CrMoV12-28		~H10		~1.2365		
DH53	X38CrMoV5-3				1.2367		
D25T	X6NiCrTiMoVB25-15	S66286		A286	1.4980		
DU3	X5CrNiCuNb16-4	S17400	S17400	17-4PH	1.4542		
DU3				630	1.4542		
EA1	NiCr20TiAl	N07080	J775	NIMONIC 80A	2.4952		
EA1			HEV-5				
F65	34CrMo4				1.7220		
F65					1.7224		
F65					1.7225		
F66J	30CrMo4	G41300	4130	4130			6370
F66J							6371
F66J							6348
F66J							6350
F66S	25CrMo4				1.7218	S 142	
F66S					1.7214	S 158	
FAD	16NiCrMo13						
FADC	10NiCrMo13-5	G93106	E9310	9310			6260
FADCW	10NiCrMo13-5	G93106	E9310	9310			6265
FADCW							6267
FADH	14NiCrMo13-4				1.6657	S 157	
FADHW	14NiCrMo13-4				1.6658		
FADS	16NiCrMo16-5				1.6723	S 82	
FADSW	16NiCrMo16-5				1.6722	S 156	
FDG	20NiCrMo13						
FDMA	30NiCrMo16				~1.6657		
GD223	X60NiMnCr13-5-3			X50CrNiMn12		S 131	
GD223				Z50CNM12			

Aubert & Duval Brand Name	European Norm	UNS	AISI / SAE	usual trade name	Werkstoff	British Santard	AMS
GH2	33CrMoV12-9	K24340					
GH4	40CrMoV13-9				1.8523	S 132	
GH4						S 134	
GH4W	40CrMoV13-9					S 138	
GHC	20CrMo12						
GK3	31CrMo12				1.8564		
GK3					1.7361		
GK3					1.8515		
GK4	40CrMoV13-9				1.8523		
GK5	20CrMo12				1.8519		
GK5S	24CrMo13-6				1.8516	S 106	
GK5S					1.8519		
GKH	33CrMoV12-9	K24340					
GKHW	33CrMoV12-9	K24340					6481
GKJ	31CrMoV9				1.8514		
GKJ					1.8519		
GKJ					1.7707		
GKP	32CrMoV5						
JD19	20NiCrMo2-2	G86200	8620	8620	1.6523		6274
LK3	41CrAlMo7-10	K24065		NITRALLOY 135	1.8509		6470
LK3							6472
LK3W	41CrAlMo7-10	K24065			1.8509		
LK5	32CrAlMo7-10				1.8505		
LXM4	X1CrNiMoAlTi12-9-2				1.4530		
M25W	X2CrNiMo18-15-3	S31673			1.4441		
M30NW	X4CrNiMoN21-9-4			REX734			
M 64 B.C	CoCr28Mo	R31537					
M 64 C	CoCr28Mo	R31538					
MARVAL18	X2NiCoMo18-8-5	K92890		Maraging 250	1.6359	S 162	6512

Aubert & Duval Brand Name	European Norm	UNS	AISI / SAE	usual trade name	Werkstoff	British Santard	AMS
MY14	X1NiCoMo14-10-05						
MY16	X2NiCoMo18-08-05						
MY17PQ	X2NiCoMo18-08-05						
ML18PQ	X2NiCoMo18-08-05						
MY19	X2NiCoMo18-9-5	K93120			1.6358		
MY23	X2NiCoMo18-12-04						
MY24	X2NiCoMo18-13-05						
MARVALX12	X1CrNiMoAlTi12-9-2				1.4530		
MARVALX12H	X1CrNiMoAlTi12-10-2				1.4596		
MLX138	E-Z3CNDA13-8			13-8 Mo			
MARVAL13X	X3CrNiMo13-8-2	S13800	S13800	PH13-8Mo	1.4534		5629
MARVAL13X							5864
MYM1	X2NiCoMo18-8-5	K92890		Maraging 250	1.6379		
MYM1	X2NiCoMo18-8-5	K92890		Maraging 250	~1.2706		
MYM2	X2NiCoMo18-9-5	K93120		Maraging 300	1.6358		
MARVAL X12 H	X1CrNiMoAlTi12-10-2						
MEK3	33CrMoV12-9	K24340			1.7765		6481
MEK3	33CrMoV12-9	K24340			~1.8522		6481
MEK4	40CrMoV13-9				1.8523		
MEP	45WCrMo8	S1			1.2542		
MES	35CrWMo12						
MMR0	18NiCr5-4				1.5810		
MMR1	16NiCr5-4						
MMR3	10NiCr5-4				1.5805		
MOC2	42CrMo4				1.7225		
MOC3J	40CrMo4	G41400	4140	4140			6349
MOC3J							6382
MOCV2	40CrMoV4-6	K14675		17-22 A	1.7711		6304
MOCV2W	40CrMoV4-6	K14675		17-22 A			6305

Aubert & Duval Brand Name	European Norm	UNS	AISI / SAE	usual trade name	Werkstoff	British Santard	AMS
MPY	NiCr20Co13Mo4Ti3Al	N07001		WASPALLOY	2.4654		5544
MPYV	NiCr20Co13Mo4Ti3Al	N07001		WASPALLOY	2.4654		5544
MX455	X3CrNiCuTiNb12-9	S45500		CUSTOM 455	1.4543		5617
MX455							5860
NC25M	28NiCrMo11						
NC310YW	40SiNiCrMoV10			HP310			
NC40M	41NiCrMo7-3-2	G43400	4340	4340	1.6563	S 149	6415
NC40M							6359
NC40M1	40NiCrMo7-3	K24064					
NC40MW	41NiCrMo7-3-2	G43400	4340	4340	1.6563		6414
NC40MW							6454
NC40SW	40NiSiCrMo7	K44220		300M	~1.6928	S 155	6417
NC40SW							6419
NC40SW							6257
NCAV	12NiCr12						
NCAV2	14NiCr12						
NCAV4	16NiCr12						
P43V	NiFeCr17MoTiAl						
NY718	NiCr19Fe19Nb5Mo3	N07718		INCO 718			
NY625	NiCr22Mo9Nb	N06625		INCO 625			
PER75	NiCr20Ti			NIMONIC 75		HR 203	
PER75						HR 5	
NY750	NiCr15Fe7TiAl	N07750		INCONEL X750	2.4669		
NY750							5667
NY750							5668
NY750							5671
PER263	NiCo20Cr20MoTi			C 263			
PER2U	NiCr20Co18Ti			NIMONIC 90	2.4632	HR 2	
PER2U					2.4632	HR 202	

Aubert & Duval Brand Name	European Norm	UNS	AISI / SAE	usual trade name	Werkstoff	British Santard	AMS
PER2X	NiCr20TiAl	N07080		NIMONIC 80A	2.4631	HR 1	
PER2X					2.4952	HR 201	
PER2X						HR 601	
PER3	NiCr20Co13Mo4Ti3Al	N07001		WASPALLOY	2.4654		5544
PER3							5704
PER3							5706
PER3							5707
PER3							5708
PER3							5709
PER5	NiCr19Co18Mo4Ti3Al3	N07500		UDIMET 500			
PER5							5763
PER625	NiCr22Mo9Nb	N06625		INCO 625			5599
PER625							5666
PER706	NiFe38Cr16Nb	N09706		INCO 706			5605
PER706							5606
PER706							5701
PER706							5702
PER706							5703
PER72	NiCr18Co15TiMoAl			UDIMET 720			
PER72	55CrNiMoV5						
PYRAD 44 DW	X4NiCrMoTi43-13						
PER901	X4NiCrMoTi43-13	N09901		INCO 901	2.4662	HR 53	5660
PER901							5661
PYRAD 49 D	NiCr22Fe18Mo	N06002		HASTELLOY X	2.4665	HR 6	5536
PYRAD49D					2.4665	HR 204	5754
PYRAD53NW	NiCr19Fe19Nb5Mo3	N07718		INCO 718	2.4668		5596
PYRAD53NW					2.4668		5597
PYRAD53NW							5662
PYRAD53NW							5663
PYRAD53NW							5664

Aubert & Duval Brand Name	European Norm	UNS	AISI / SAE	usual trade name	Werkstoff	British Santard	AMS
R25T2	X6NiCrTiMoVB25-15	S66286		A286	1.4944		
R6110	X38CrMoV5-3				1.2367		
RA4W	80MoCrV42-16	T11350		~M50	1.3551		
RA50YW	80MoCrV42-16	T11350		M50	1.3552		6490
RA50YW							6491
RA6	X82WMoCrV6-5-4			M2	1.3343		
RA6W	X82WMoCrV6-5-4			M2	1.3343		
RAD	100Cr6	G52986	E52100		1.3504	S 135	
RAD					1.3505		
RADW	100Cr6	G52986	E52100		1.3514	S 136	6444
RADW					1.3505		6447
RADYW	100Cr6	G52986	E52100		1.3504		
RADYW					1.3505		
RAPIDEM	X85WMoCrV6-5-4-2	T11302	M2	M2	1.3343 / 1.3339		
SANCY	X180CrMoW13		~D2				
SANCY2	X160CrMoV12		~D2		1.1379		
SC2104	X2CrNiMoN17-13-3	S31654		316LN	1.4429		
SC2104							
SC2109	X2CrNi18-10			Z2 CN 19-10			
SC 2118	X2CrNiMo17-12			Z 2 CND 18-12 + N2			
SC2118							
SCV	15CrMoV6				1.7734		
SCV					1.7736		
SCVW	15CrMoV6				1.7736		
SCVW					1.7734		
SIMO	X40CrSiMo10-2				1.4731		
SM2	55CrNiMoV4						
SM2M	55CrNiMoV5						

Aubert & Duval Brand Name	European Norm	UNS	AISI / SAE	usual trade name	Werkstoff	British Santard	AMS
SMH	X100CrMoV5				1.2363		
SMI	60NiCrMo11						
SMK	X35CrWMoV5						
SMK3	X37CrMoV5-1	T20811					
SMP3	X37CrMoV5-1	T20811			1.234		
SMR	32CrMoV12-2-8		~H10		1.2365		
SMR4	35CrWMoV12-8-8						
SMR7	X38CrMoCoV5-3-3						
SMS3	X37CrMoV5-1						
SMV	X35CrWMoV5		~H12		1.2605		
SMV3	X37CrMoV5-1	T20811	H11	H11	1.2343		
SMV4S	X40CrMoV5-1		H13	H13 Superior	1.2344		
SMV5	X50CrMoWV5						
SOS3	X45CrSi9-3		J775	SILCHROME 1	1.4718		
SOS3			HNV3				
SY4	X150CrMoVCo12						
TA2	35NiCrMo16				~1.2766		
TA3	40NiCrMo18				~1.2767		
V300	46SiCrMo6			45SiCrMo6	1.8062		
V325	50SiCrMo6				1.8063		
V3S	45SiCrMo6						
VCE	51CrV4	G61500	6150	6150	1.8159		6448
VCE4	52CrMoV4				1.7701		
VOLVIC10	X20CoCrWMo10-10-6-2				1.2888		
X12NBW	X14CrNb12	S41041		403 CB			
X13	X30Cr13	S42000			1.4028		
X13D	X20Cr13	S42000	420	420	1.4014	S 62	
X13D					1.4021		

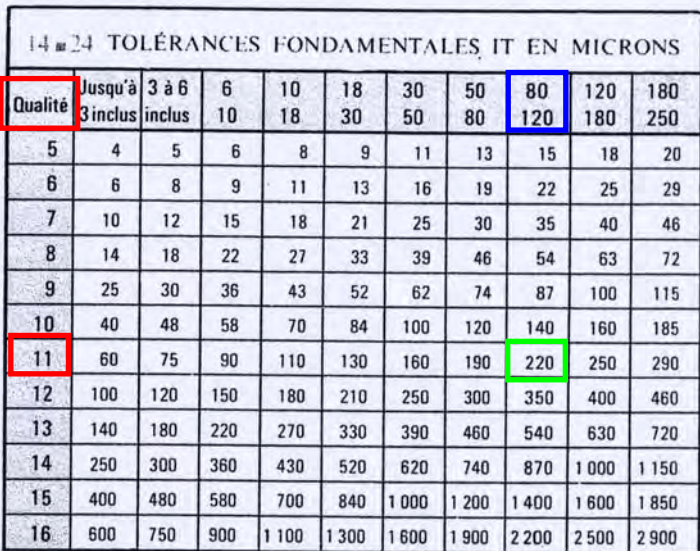
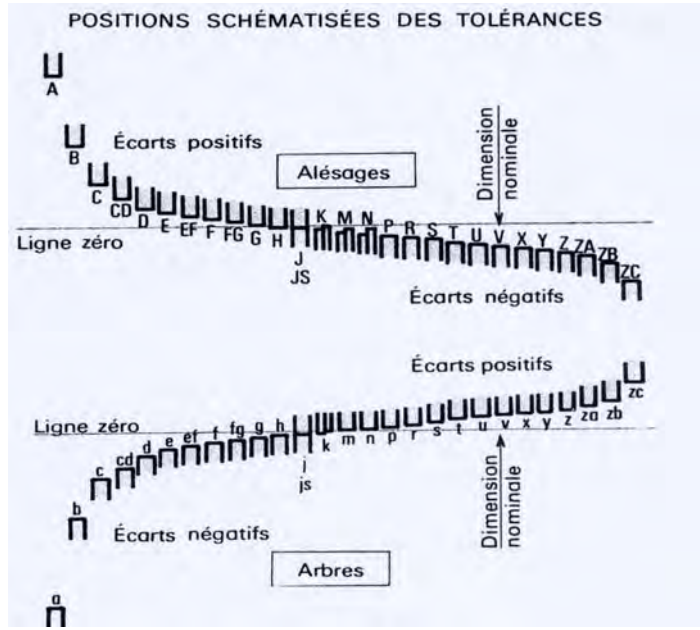
Aubert & Duval Brand Name	European Norm	UNS	AISI / SAE	usual trade name	Werkstoff	British Santard	AMS
X13E	X12CrNi13	S41001			1.4024		5612
X13E		S41000					5613
X13EW	X12CrNi13	S41001					5611
X13M	X12Cr13	S41000	410		1.4006	S 61	
X13T6	X40CrMo15				1.2083		
X13T6	X40CrMo15				1.4118		
X13VD	X12CrNiMoV12-3	S64152		JETHETE M152	1.4933	S 151	
X13VD					1.4938	S 159	
X13VD						S 538	
X13VDW	X12CrNiMoV12-3	S64152			1.4939		5719
X13VDW							
X13W3	X17CrWNi13	S41800					5616
X15D2	X6CrNiMo15-07		PH 15-7 Mo	Z6CND15-07			
X15TN	X40CrMoVN16-2	S42025			1.4123		
X15U5W	X5CrNiCu15-5	S15500	S15500	15-5PH	1.4545		5659
X15U5W				XM12			5862
X15V	X30CrCoMoW15-04						
X17U4	-	S17400	S17400	17-4PH	1.4542		5604
X17U4				630			5643
X17U4W	X5CrNiCuNb16-4	S17400	S17400	17-4PH	1.4548		5622
X17U4W				630	1.4548		
X18BC	X2CrNi19-11	S30403	304L	304L	1.4306		5511
X18BC							5647
X18M25W	X2CrNiMo18-15-3						
X18MBC	X2CrNiMo17-12-2	S31603	316L	316L	1.4404		5507
X18MBC							5653
X18MNB	X6CrNiMoNb17-12-2						
X18NB	X6CrNiNb18-10	S34700	347	347	1.4550	S 130	5512
X18NB							5646

Aubert & Duval Brand Name	European Norm	UNS	AISI / SAE	usual trade name	Werkstoff	British Santard	AMS
X18PA	X6CrNiTi18-10	S32100	321	321	1.4544	S 129	5510
X18PA					1.4541		5645
X18PA					1.4878		
X203	X12CrNiMoCoW21-20	R30155			1.4974		5532
X203							5768
X203							5769
X20MD	X4CrNiMoN21-9-4			REX734			
X20T	X25CrNiWSi20-9						
X20T2	X25CrNiW22						
X21RB	X53CrMnNiNb21-9				1.4870		
X21RC	X50CrMnNiNbN21-9		J775	21-4Nb	1.4882		
X21RC			XEV-F				
X23N	X33CrNiMn23-08		J775	23-8N			
X23N			EV15	NITRONIC 20			
X25V	X15CrNiSi25-21	S31400	314		1.4841		
X25V					1.2782		
X39V	X10NiCrSi39-18						
X45U	X4CrNiCuMo15-06-01	S45000		CUSTOM 450			
X45UW	X4CrNiCuMo15-06-01	S45000		CUSTOM 450			5773
X45UW							5859
NY47N+	X2CrNiMoN25-7			URANUS 47N+			
X520	X5CrNiMoCuNb14-5			FV 520 B	1.4594	S 143	
X520						S 144	
X520						S 145	
NY52N+	X2CrNiMoCuN25-6-3			URANUS 52N+	1.4507		
XD15NW	X40CrMoVN16-2	S42025			1.4123		5925
XDBD	X105CrMo17	S44004	440C	440C	1.4125		5630
XDBD							5880
XDBDW	X105CrMo17	S44004	440C		1.3544		5618

Aubert & Duval Brand Name	European Norm	UNS	AISI / SAE	usual trade name	Werkstoff	British Santard	AMS
XM114	X53CrMnNiN21-9		J775	21-4N	1.4871		
XN26AW	X2NiCrTiMoV25-15						
XN26TW	X6NiCrTiMoVB25-15-2	S66286		A286	1.4944	HR 51	5525
XN26TW					1.498	HR 650	5731
XN26TW							5732
XN26TW							5734
XN26TW							5737
XN26TW							5726
XN26TWS	X3NiCrTiMoV25-15-2-1				1.4943	HR52	
XN26TWS						HR251	
XSH	CoCr20W15Ni	R30605		HS25	2.4964	HR 40	5537
XSH				L605	2.4964	HR240	5759

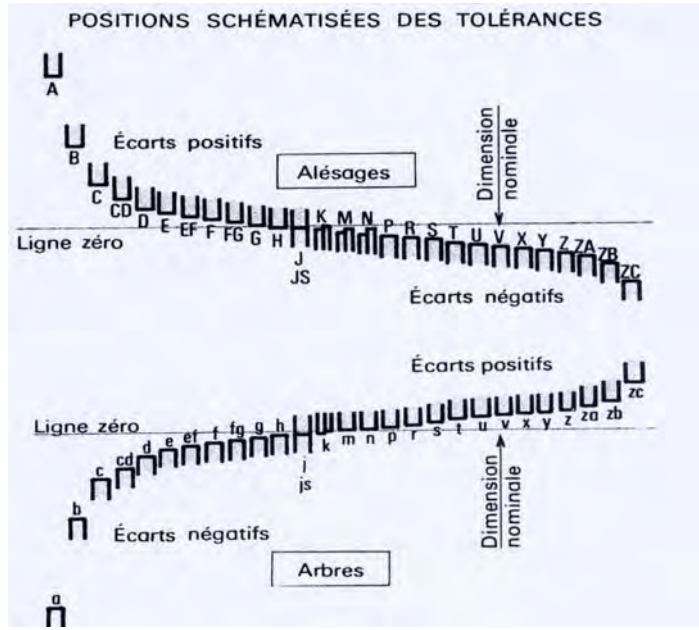
GLOSSARY

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WORD	EXAMPLE OF CRITERIA	EXPLANATION
Tolerance on diameter	$\varnothing \dots \pm 0.25$ $\varnothing \dots \pm (0.1 + 1\% \cdot \varnothing)$	$\varnothing 18 \pm 0.25 = \varnothing 17.75/18.25$ See appendix A,
	Quality 'x'	There are 18 levels : IT 01, IT 02,IT17, IT18  

14 # 24 TOLÉRANCES FONDAMENTALES IT EN MICRONS

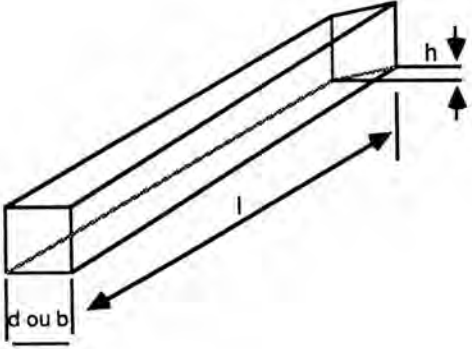
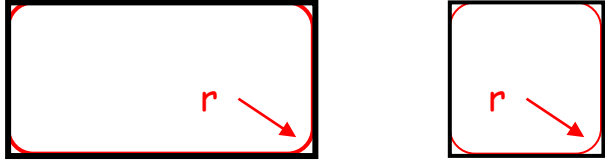
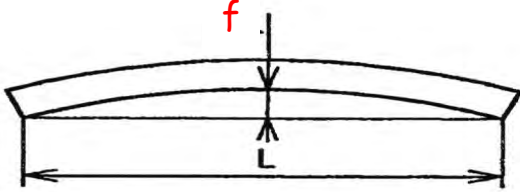
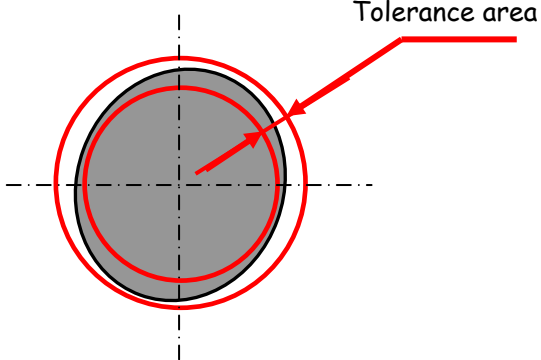
Qualité	Jusqu'à 3 inclus	3 à 6 inclus	6 à 10 inclus	10 à 18 inclus	18 à 30 inclus	30 à 50 inclus	50 à 80 inclus	80 à 120 inclus	120 à 180 inclus	180 à 250 inclus
5	4	5	6	8	9	11	13	15	18	20
6	6	8	9	11	13	16	19	22	25	29
7	10	12	15	18	21	25	30	35	40	46
8	14	18	22	27	33	39	46	54	63	72
9	25	30	36	43	52	62	74	87	100	115
10	40	48	58	70	84	100	120	140	160	185
11	60	75	90	110	130	160	190	220	250	290
12	100	120	150	180	210	250	300	350	400	460
13	140	180	220	270	330	390	460	540	630	720
14	250	300	360	430	520	620	740	870	1 000	1 150
15	400	480	580	700	840	1 000	1 200	1 400	1 600	1 850
16	600	750	900	1 100	1 300	1 600	1 900	2 200	2 500	2 900



8. Cotation tolérancée et ajustements

Extraits de tolérances ISO pour arbres (en microns : 1 µm = 0,001 mm)														
		dimensions nominales (en mm)												
au-delà de		1	3	6	10	18	30	50	80	120	180	250	315	400
à (inclus)		3	6	10	18	30	50	80	120	180	250	315	400	500
d9	es	-20	-30	-40	-50	-65	-80	-100	-120	-145	-170	-190	-210	-230
	ei	-45	-60	-76	-93	-117	-142	-174	-207	-245	-285	-320	-350	-385
d10	es	-20	-30	-40	-50	-65	-80	-100	-120	-145	-170	-190	-210	-230
	ei	-60	-78	-98	-120	-149	-180	-220	-260	-305	-355	-400	-440	-480
d11	es	-20	-30	-40	-50	-65	-80	-100	-120	-145	-170	-190	-210	-230
	ei	-80	-105	-130	-160	-195	-240	-290	-340	-395	-460	-510	-570	-630
e7	es	-14	-20	-25	-32	-40	-50	-60	-72	-85	-100	-110	-125	-135
	ei	-24	-32	-40	-50	-61	-75	-90	-107	-125	-146	-162	-182	-198
e8	es	-14	-20	-25	-32	-40	-50	-60	-72	-85	-100	-110	-125	-135
	ei	-28	-38	-47	-59	-73	-89	-106	-126	-148	-172	-191	-214	-232
e9	es	-14	-20	-25	-32	-40	-50	-60	-72	-85	-100	-110	-125	-135
	ei	-39	-50	-61	-75	-92	-112	-134	-159	-185	-215	-240	-265	-290
f6	es	-6	-10	-13	-16	-20	-25	-30	-36	-43	-50	-56	-62	-68
	ei	-12	-18	-22	-27	-33	-41	-49	-58	-68	-79	-88	-98	-108
f7	es	-6	-10	-13	-16	-20	-25	-30	-36	-43	-50	-56	-62	-68
	ei	-16	-22	-28	-34	-41	-50	-60	-71	-83	-96	-108	-119	-131
f8	es	-6	-10	-13	-16	-20	-25	-30	-36	-43	-50	-56	-62	-68
	ei	-20	-28	-35	-43	-53	-64	-76	-90	-106	-122	-137	-151	-165
g5	es	-2	-4	-5	-6	-7	-9	-10	-12	-14	-15	-17	-18	-20
	ei	-6	-9	-11	-14	-16	-20	-23	-27	-32	-35	-40	-43	-47
g6	es	-2	-4	-5	-6	-7	-9	-10	-12	-14	-15	-17	-18	-20
	ei	-8	-12	-14	-17	-20	-25	-29	-34	-39	-44	-49	-54	-60
h5	es	0	0	0	0	0	0	0	0	0	0	0	0	0
	ei	-4	-5	-6	-8	-9	-11	-13	-15	-18	-20	-23	-25	-27
h6	es	0	0	0	0	0	0	0	0	0	0	0	0	0
	ei	-6	-8	-9	-11	-13	-16	-19	-22	-25	-29	-32	-36	-40
h7	es	0	0	0	0	0	0	0	0	0	0	0	0	0
	ei	-10	-12	-15	-18	-21	-25	-30	-35	-40	-46	-52	-57	-63
h8	es	0	0	0	0	0	0	0	0	0	0	0	0	0
	ei	-14	-18	-22	-27	-33	-39	-46	-54	-63	-72	-81	-89	-97
h9	es	0	0	0	0	0	0	0	0	0	0	0	0	0
	ei	-25	-30	-36	-43	-52	-62	-74	-87	-100	-115	-130	-140	-155
h10	es	0	0	0	0	0	0	0	0	0	0	0	0	0
	ei	-40	-48	-58	-70	-84	-100	-120	-160	-185	-210	-230	-250	-250
h11	es	0	0	0	0	0	0	0	0	0	0	0	0	0
	ei	-60	-75	-90	-110	-130	-160	-190	-220	-250	-290	-320	-360	-400
h13	es	0	0	0	0	0	0	0	0	0	0	0	0	0
	ei	-140	-180	-220	-270	-330	-390	-460	-540	-630	-720	-810	-890	-970
j6	es	+4	+6	+7	+8	+9	+11	+12	+13	+14	+16	+16	+18	+20
	ei	-2	-2	-2	-3	-4	-5	-7	-9	-11	-13	-16	-18	-20
j7	es	+6	+8	+10	+12	+13	+15	+18	+20	+22	+25	+26	+29	+31
	ei	-4	-4	-5	-6	-8	-10	-12	-15	-18	-21	-26	-28	-32
js5		±2	±2,5	±3	±4	±4,5	±5,5	±6,5	±7,5	±9	±10	11,5	±12,5	±13,5
		±3	±4	±4,5	±5,5	±6,5	±8	±9,5	±11	12,5	±14,5	±16	±18	±20
js7		±5	±6	±7,5	±9	±10,5	±12,5	±15	±17,5	±20	±23	±26	±28,5	±31,5
		+12	+15	+18	+21	+26	+31	+37	+43	+50	+57	+65	+70	+77
js11		+30	+37	+45	+55	+65	+80	+95	+110	±125	±145	±160	±180	±200
		±70	±90	±110	±135	±165	±195	±230	±270	±315	±360	±405	±445	±485
k5	es	+4	+6	+7	+9	+11	+13	+15	+18	+21	+24	+27	+29	+32
	ei	0	+1	+1	+1	+2	+2	+2	+3	+3	+4	+4	+4	+5
k6	es	+6	+9	+10	+12	+15	+18	+21	+25	+28	+33	+36	+40	+45
	ei	0	+1	+1	+1	+2	+2	+2	+3	+3	+4	+4	+4	+5
m6	es	+8	+12	+15	+18	+21	+25	+30	+35	+40	+46	+52	+57	+63
	ei	+2	+4	+6	+7	+9	+9	+11	+13	+15	+17	+20	+21	+23
m7	es	—	+16	+21	+25	+29	+34	+41	+48	+55	+63	+72	+78	+86
	ei	—	+4	+6	+7	+8	+9	+11	+13	+15	+17	+20	+21	+23
n5	es	+8	+13	+16	+20	+24	+28	+33	+38	+45	+51	+57	+62	+67
	ei	+4	+8	+10	+12	+15	+17	+20	+23	+27	+31	+34	+37	+40
n6	es	10	+16	+19	+23	+28	+33	+39	+45	+52	+60	+66	+73	+80
	ei	+4	+8	+10	+12	+15	+17	+20	+23	+27	+31	+34	+37	+40
p6	es	+12	+20	+24	+29	+35	+42	+51	+59	+68	+79	+88	+98	+108
	ei	+6	+12	+15	+18	+22	+26	+32	+37	+43	+50	+56	+62	+68

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WORD	EXEMPLE OF CRITERIA	EXPLANATION
Twistness	<p>$\leq 4\%$ of width or thick (with maxi 15° of total length)</p>	
angle roundness	<p>$r \leq 1 \text{ mm}$</p>	
Straightness	<p>1 mm/m (maximum of 0.12% on total length)</p>	 <p>Straightness is measured by camber (straightning defect). f = camber measured L = total length</p>
Ovality	<p>50% of diameter tolerance (mm)</p>	 <p>Wrong circularity, shape of each section has to be included between two circles of which difference diameter is less than 50% of tolerance range nominal value diameter</p>

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Roughness

It is the total of macroscopic and microscopic surface unevenness : machining surfaces are not perfect, we can see unevenness due to machining process, cutting tools, steel...

The lower the index , the more difficult to reach the right roughness and the more expensive the product.

Criteria

This criteria is really microscopic consist in mean variation the range average of the roughness.

The statistic criteria R_a , is the difference between arithmetic mean deviation compared with the mean line.

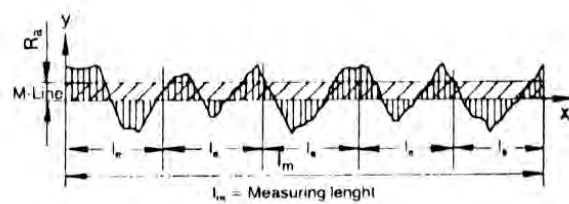
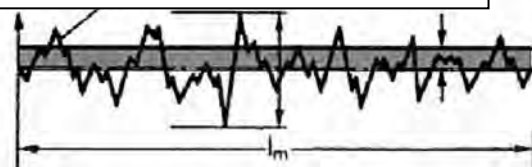
Roughness

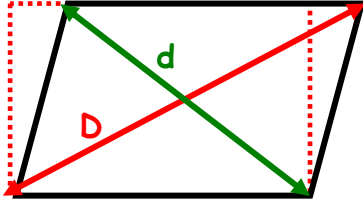
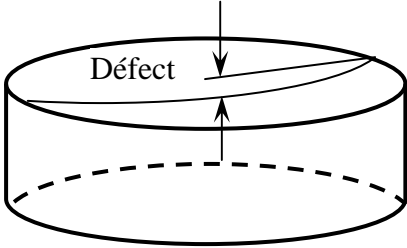
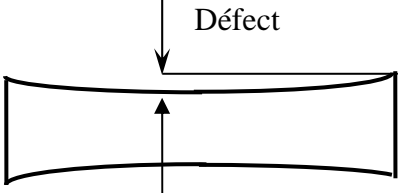
$R_a < 6.3$
 μm

$$R_a = \frac{1}{l_m} \int_{x=0}^{x=l_m} |y| dx$$

Moyenne arithmétique de toutes les distances absolues du profil de

Arithmetic mean of all values of roughness profile R on inspected surface



WORD	EXAMPLE OF CRITERIA	EXPLANATION
<p>Squareness</p>	$\frac{D - d}{D} < 0.025$	<div style="text-align: center;">  </div> <p style="text-align: center;">Squareness or transverse tolérance</p> <p>Ratio on difference between two lengths</p> $\frac{D - d}{D} < 0.025$ <p>(example : squares or flats)</p>
<p>Flatness</p>	<p>defect < 2mm</p>	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="display: flex; align-items: center; margin-bottom: 20px;"> <div style="margin-right: 10px;">Disc</div>  </div> <div style="display: flex; align-items: center;"> <div style="margin-right: 10px;">Flat</div>  </div> </div>