

AUBERT&DUVAL

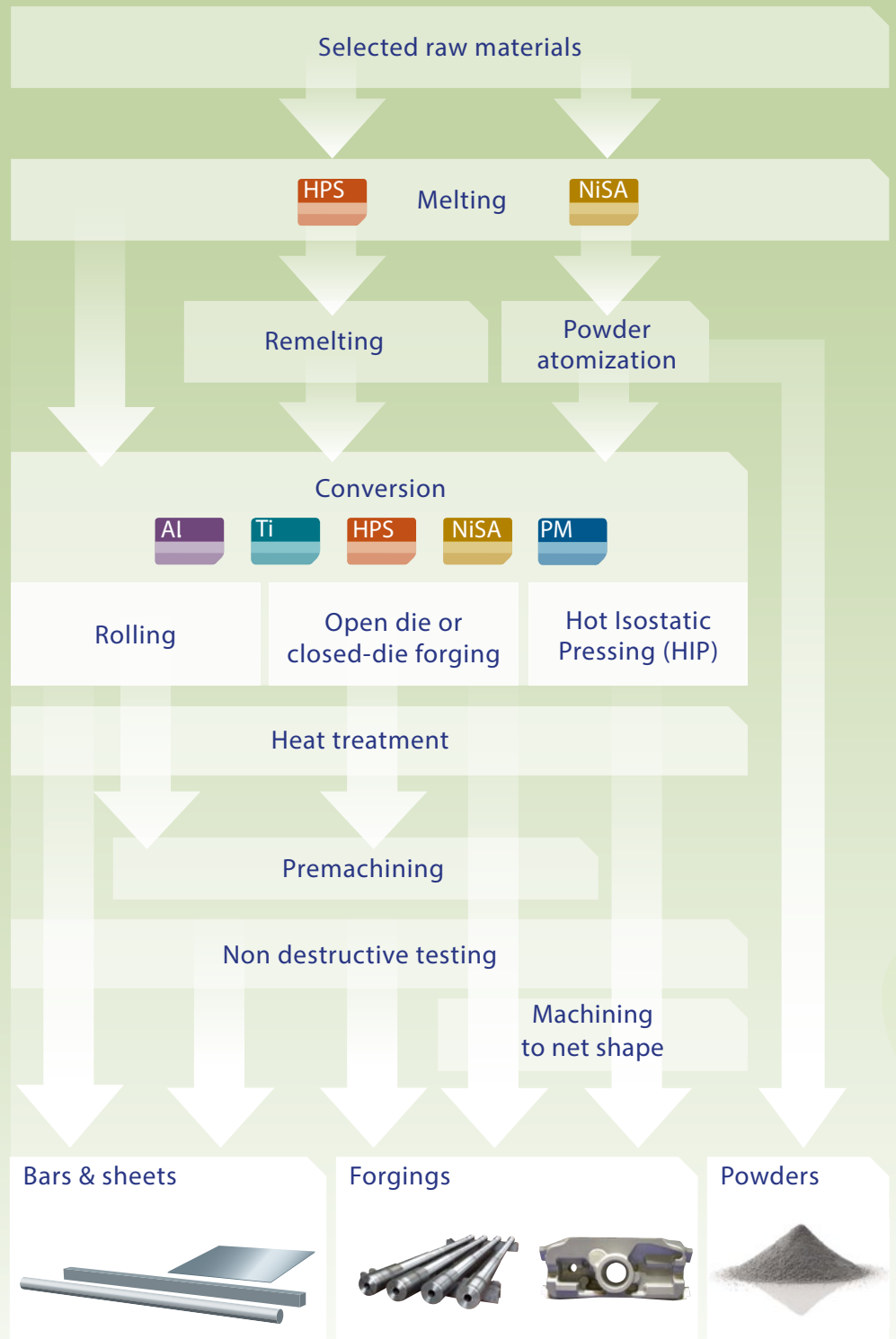


High-Strength Steels and Alloys for the Defense Industry

Enhancing your performance

Your fully integrated partner from melting to the finished part

Process flow



HPS

High-Performance Steels:

A range of alloyed steels with tightly controlled characteristics offering optimum value for customers.

NiSA

Nickel-based Superalloys:

A range of alloyed materials with specific resistance to very high temperatures and corrosion, the majority component being nickel.

Ti

Titanium:

Pure or alloyed titanium, combining mechanical properties and corrosion-resistance with light weight.

Al

Aluminum:

Slightly alloyed aluminum, widely used in aircraft structural parts.

PM

Powder metallurgy:

HIP Net Shape parts & Metal Powders (steels, superalloys or titanium) for additive manufacturing.

A long history in Defense markets. Aubert & Duval has the capability to design, melt, manufacture and market metallurgical products with high mechanical properties in steels, superalloys, aluminum and titanium alloys. As a leading provider of forgings for gun barrels, Aubert & Duval has over 70 years of experience within this business segment and is proudly serving the military community both for new equipment and upgrades.



Qualified Products and Processes



4500 T forging press

Aubert & Duval is fulfilling the most stringent requirements for artillery applications.

With a long history in supplying materials to missile systems such as anti-ship, air to air, cruise, ground to air, air to ground, tactical and antitank missiles, our products meet the most stringent requirements for critical missile components. As a leading supplier of firearm steels, Aubert & Duval serves the weapon manufacturing sector through both button rifling and hammer forging processes.



Long dimensional machining



Large Vacuum Induction melting capacity

Form	Fabrication process
Thin tubes	Extruded
Heavy tubes	Forged / Hot rolled / Hollow forged
Sheet thickness < 6 mm	Cold rolled
Plate thickness > 6 mm	Hot rolled
Bars < Ø 130 mm	Rolled / Forged
Bars Ø 130 to 200 mm	Forging machine
Bars > Ø 200 mm	Forged
Forged parts	Open-die or closed-die forging

Armoured vehicles	4 - 5
Heavy and medium gun barrels	6 - 7
Firearms	8 - 9
Missiles	10
Structures and engines	11

Equipment

- MELTING**
 Melting furnaces (EAF, AOD, Ladle refining process) up to 60 tons
 Vacuum Induction Melting (VIM) up to 20 tons
 Remelting furnaces (ESR, VAR) up to 30 tons
- POWDER METALLURGY**
 Atomization (Air, VIM)
- FORGING**
 Open-die forging presses from 1,500 to 10,000 tons
 Closed-die forging presses from 4,500 to 65,000 tons
 Forging machine
- ROLLING MILL**
 7-200 mm diameter bars
- HEAT TREATMENT**
 Solution and ageing furnaces
 Horizontal and vertical quenching equipment
- TESTING**
 Immersion UT up to 13 tons (28,000 lbs)
 Automated contact UT up to 20 tons
 Material testing laboratories ISO 17025



Dedicated brochure for Navy on www.aubertduval.com

Armoured vehicles

Half wheel

AI FORGINGS



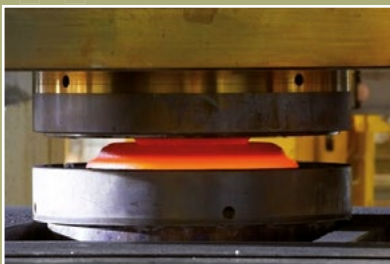
Main Battle tank (MBT) Half Road wheel

Hatch

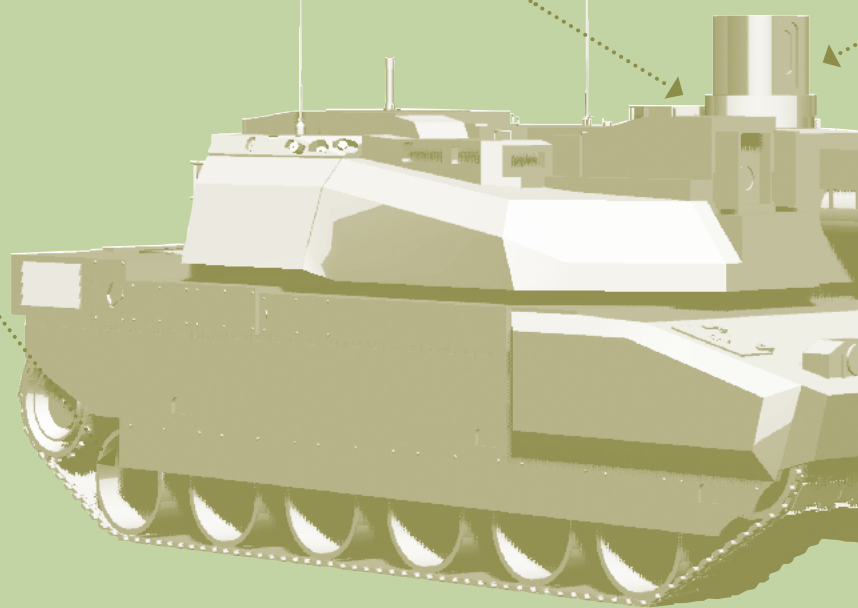
AI FORGINGS

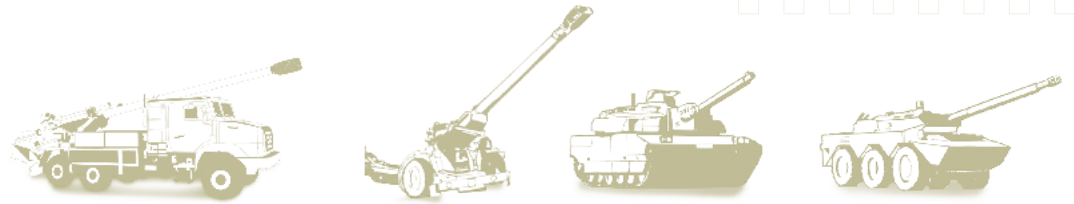


Hatch : forging part for protective equipment for armoured vehicle



As a specialist in upscale metallurgy Aubert & Duval operates several closed die facilities, such as its 22,000 MT, 40,000 MT and 65,000 MT hydraulic presses. Closed-die forging is the process of forming complex-shaped parts from a metal semi-product between two engraved tools (dies) by pressing with a closed-die forging press.





Hatch Cover

Al
FORGINGS



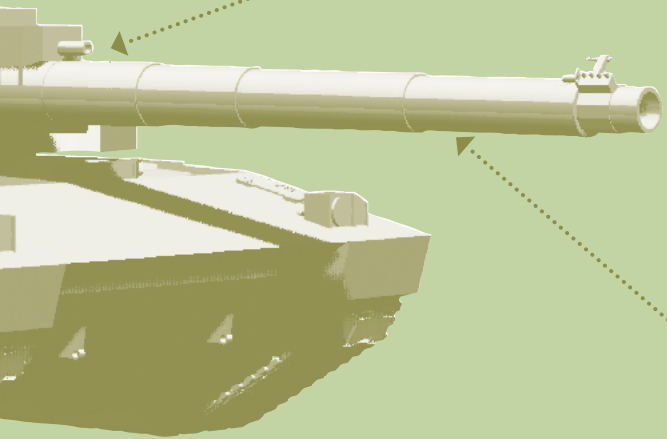
Hatch Cover : forging part for protective equipment for armoured vehicle

Turret shield

HPS
FORGINGS



Forging Turret Mantlet for protective equipment Main Battle tank (MBT)



Artillery parts

HPS
FORGINGS



Gun barrels
(More pages 6-7)



Breech ring

Main materials

High Performance Steels

HPS

A&D grade:

819B	36NiCrMo16
GKH®	33CrMoV12.9
NC35MW	35NiCrMoV 14-4
NC35M1	39NiCrMoV15-6
CLARM®HBR	30NiCrMoV14
CLARM®HB3	33NiCrMoV15
CLARM®	
HB7	40NiCrMoV15
J-Steel	32NiCrMoV14-4
GK4W	40CrMoV13-9

Aluminum Alloys

Al

Aluminum:

2000
5000
7000

Titanium Alloys

Ti

Titanium:

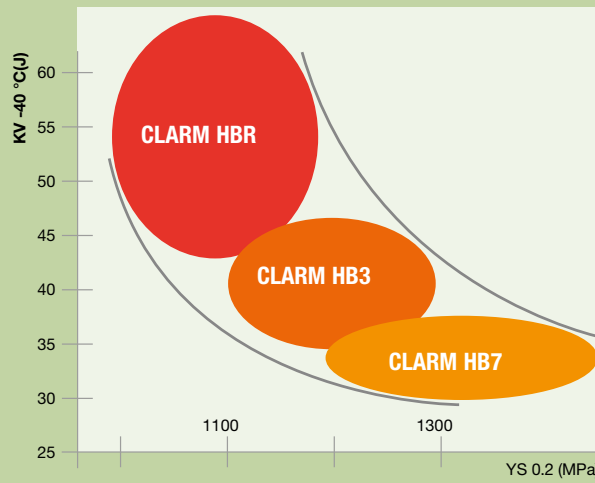
T40
Tl64



Heavy and medium gun barrels

Choose the best designed grade for your application

Heavy gun barrels



Corresponding data sheets are available on request.



Aubert & Duval meets the defense industry's material requirements for artillery forgings, drawing on extensive, worldwide experience in artillery systems.

The CLARM® steel grades are the most advanced steels for large caliber gun barrels: CLARM®HBR, CLARM®HB3, and CLARM®HB7 steel grades meet all the critical metallurgical requests of the most advanced arm systems. CLARM family steel grades provide to artillery components manufacturers a wide range of mechanical properties with yield strengths from 1000 to 1400 MPa, combined with exceptional level of toughness (Charpy Energy values or K1c).

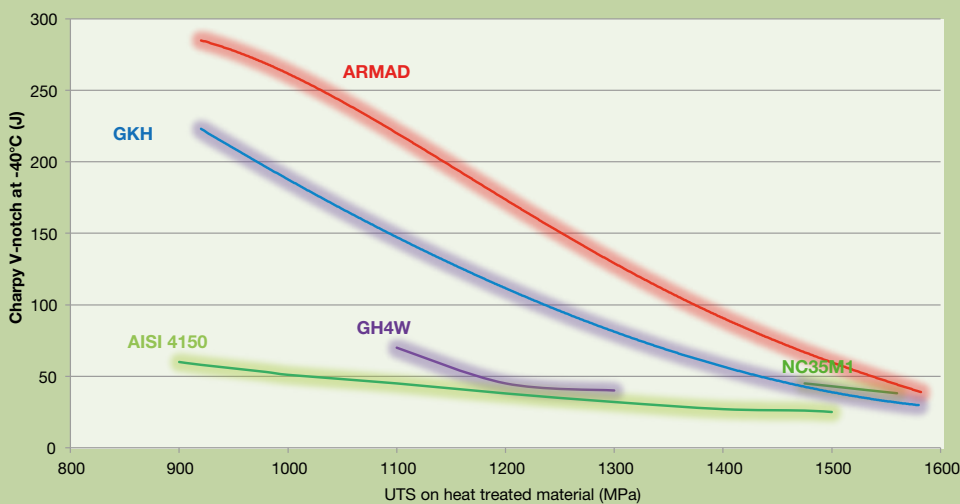


- Field towed guns: 105 - 122 - 155 mm
- Tank guns: 60 - 90 - 100 - 105 - 120 - 125 - 140 mm
- Self-propelled howitzers: 105 - 120 - 155 mm
- Naval guns: 40 - 57 - 76 - 127 - 155 mm
- Mortars: 60 - 81 - 120 - 160 mm
- Breech rings, breech blocks and muzzle brakes



Medium calibers

Evolution of Charpy V-notch at -40°C vs Ultimate Tensile Strength



Main materials

High Performance Steels

HPS

A&D grade:

819B	36NiCrMo16
GKH®	33CrMoV12.9
NC35MW	35NiCrMoV 14-4
NC35M1	39NiCrMoV15-6
CLARM®HBR	30NiCrMoV14
CLARM®HB3	33NiCrMoV15
CLARM®HB7	40NiCrMoV15
J-Steel	32NiCrMoV14-4
GK4W	40CrMoV13-9



Open-die and rotary forgings

Final product format can be: blooms, round bars, square bars, plates, disks, mandrels, blocks, shafts, flanges, tubes or hollow forgings, etc.



Small calibers: Reliability and performance to meet your safety requirements



Gun barrels

Aubert & Duval offers for this application three martensitic grades achieving the best high strength / toughness compromise on the market: ARMAD[®], GKH[®] (CrMoV martensitic grades), and APX4 (martensitic stainless grade). For barrels submitted to a transverse load during firing, a specific care has been placed on transverse properties of bars. Aubert & Duval grades (ARMAD[®], GKH[®] and APX4) present a highly isotropic structure given to the material stable properties when longitudinal and transverse directions are compared. (see photos below)

Main materials for mechanisms

High Performance Steels

HPS

FADH	14NICRMO13-4
FDG	20NICRMO13-4
FND	15NIMOSICR10
FDMA	30NICRMO16
819B	36NICRMO16
819AW	E35NICRMO16
MARVAL18	X2NICOMO18-8-5

Mechanism parts

For firing pins, extractors, ejectors, breeches...
All main parts in gun mechanisms are submitted to shock, intensive wear and are expected to exhibit the highest fatigue performances possible.



Gun Barrel Shape Evolution during the Forming Process



Fine and isotropic microstructure (x100)



Standard CrMoV (x100)

Aubert & Duval keeps innovating best steel solutions dedicated to Army and Law Enforcement safeguarding.

Our R&D guide lines remain:

- Best safety even in worst usage condition
- Highest accuracy during intensive shooting
- Best operational performance

	APX4	GKH®	ARMAD®	
Type	Martensitic stainless	Martensitic CrMoV	Martensitic CrMoV	
EN designation	X4CrNiMo16-5-1	33CrMoV12-2	32CrMoV12-10	
HRC as delivered	28/34	28/34	28/34	
HRC after final hardening	38/42	38/42	38/46	
UTS (MPa)	900/1050	930/1080	1200/1250	1500/1550
YS 0,3 (MPa)	≥ 700	≥ 750	> 950	> 1250
A5d (%)	≥ 16	≥ 15	> 16	> 14
KV (RT)	≥ 120	≥ 140	> 160	> 50
KV (hgfh)	≥ 90	≥ 130	> 130	> 40



Services & Capabilities

- In house fully integrated production process
- NADCAP Heat Treatment
- Approved by major NATO gun manufacturers
- Logistics service provider
- Dedicated products for all manufacturing processes: drilling, machining, cold forming (hammer forging, swaging)
- ISO 9001, EN 9100, ISO 14001
- Full Authorized Economic Operator (AEO)

Customer benefits directly coming from our metallurgical expertise

Benefits for firearm Producer/designer

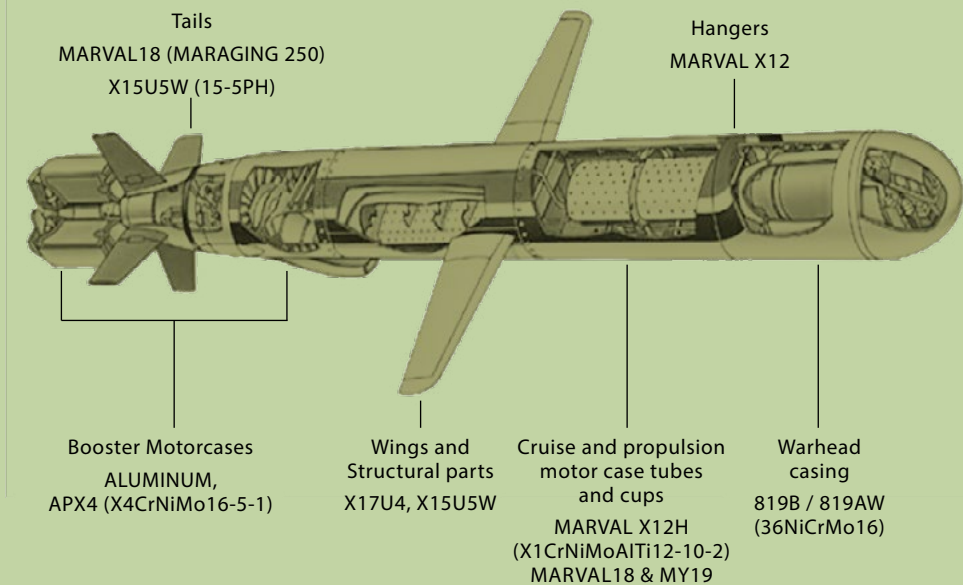
- Uses higher deformation yields of cold hammering and preserve more material compared with other grades
- Saves production costs by cold hammering both chamber and gun barrel limiting misalignment between chamber and gun barrel.
- Uses fatigue/strength upgrading opportunities of GKH® and ARMAD® to design lighter barrels.
- Ensures stable process and limit troubles during manufacturing
- Ensures perfect straightness during the cold hammering / swaging operation
- Core properties not impacted by nitriding/ nitrocarburizing
- Exceptional safety margin regarding torture tests

Benefits for firearm user

- Keeps perfect straightness during intensive firing and retains accuracy and safety
- Has longer fatigue lifetime, limiting bore ovalization, which causes a lack of accuracy
- Uses a lighter weapon

A long history in missile materials. Aubert & Duval has a long history in supplying material to missile systems such as:

- Ballistic
- Cruise missile
- Anti-ship
- Anti-tank
- Surface-to-air
- Anti-aircraft
- Anti-ballistic
- Air-to-air

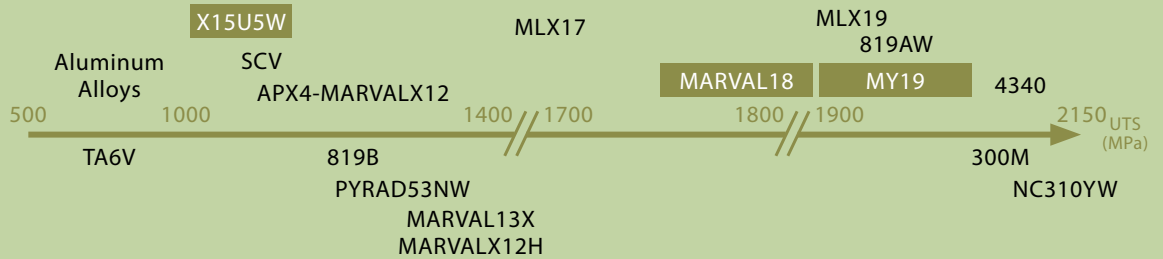


HPS
HIGH PERFORMANCE STEELS

NiSA
NICKEL-BASED SUPERALLOYS

Al
ALUMINUM

A complete answer to your UTS requirement



Rolled & forged bars



Applications	Grades	EN designation
Pinions and gears for transmissions	FAD/FADH	16NiCrMo13
	FDMA	30NiCrMo16
	V300	45SiCrMo6
	GKH/GK3	32CrMoV12 / 30CrMo12
Torsion Bars	819B	36NiCrMo16
	V300	45SiCrMo6
Energy recovery systems	LXM5	X1CrNiMoAlTi12.10.2
	F66S	25CrMo4
	F65	34CrMo4
	GK3	30CrMo12
	NC25M	28NiCrMo11

Aubert & Duval meets the most stringent requirements in terms of grade composition, micro-structural material integrity, dimensional tolerances and quality control.

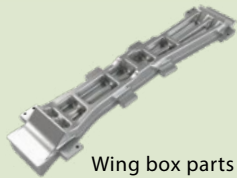
All our products comply with ASTM standards.



Structures & engines



Engine pylon parts



Wing box parts



Main fittings



Transmission box parts



LPT disks



Turbine shafts



Rotor parts

HPS
HIGH PERFORMANCE
STEELS

NiSA
NICKEL-BASED
SUPERALLOYS

Al
ALUMINUM

Ti
TITANIUM

PM
POWDER METALLURGY

Powder metallurgy



Pearl® Micro metal powder for additive manufacturing



PM HIP billets

PM

Additive Manufacturing and HIP parts

Ni-Base	Ni 625, Ni 718, HX
Co-Base	CoCr
Ti-Base	Ti6Al4V, Ti6Al4V ELI
Steels	316L, 17-4PH, ASP®, etc...

AUBERT & DUVAL



ARMAD, AD730, GKH, MARVAL, MLX, X13, X15NW, XD15NW
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