FOMAS GROUP

SPECIAL STEELS AND ALLOYS

Since 1956 the reliable partner of equipment manufacturers

OPEN DIE FORGINGS
AND SEAMLESS ROLLED RINGS

FOMAS Group manufactures open die forgings and seamless rolled rings, in any type of steel and non-ferrous alloys.

Our decades of experience in the manufacturing of components for heavy duties have made us an essential partner to our clients.
We share know-how within the FOMAS Group, optimizing processes and materials, minimizing cost, and maximizing product quality.

Our added value is to provide **turnkey solutions**, from forging and ring rolling to the finished machined part.
Starting from a thorough analysis of the customer's design, then engineering the production of contour forgings close to net shape up to the finished part.
All the required machining processes such as milling, lathe-machining, drilling, sawing and others can be carried within our manufacturing units.

- **Duplex and Super Duplex**
- **Austenitic and Super Austenitic**
- **Ferritic, Martensitic and Precipitation-Hardening**
- **Nickel Alloys**
- **High Temperature**
- **Aluminium**
- **Titanium**

- Cutting-edge technology
- Quality
- On time delivery

Duplex and Super Duplex

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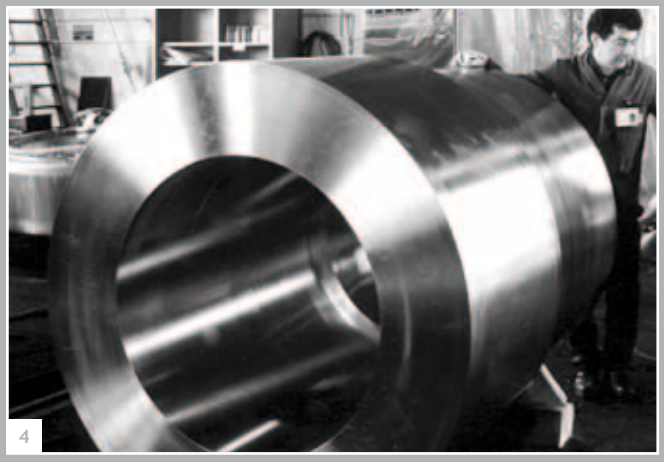

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Stainless steels based on a microstructure of austenite and ferrite, with high amounts of chromium and moderate nickel content.

Duplex steels combine high resistance to corrosion and very high mechanical strength, and are often used in heat exchangers, desalination plants and marine applications.

Today duplex and superdupex grades come in ESR quality only for improved quality performance, giving our customers the option to design even larger and heavier high integrity forging in these complex grades.

1. 2. 3. | TURRET SWIVEL CORE 27 Ton forged Weight - duplex F51 FOMAS ESR remelted quality

4. | 15 ton F53-F55 Super duplex HP Pump barrel

Austenitic and Super Austenitic

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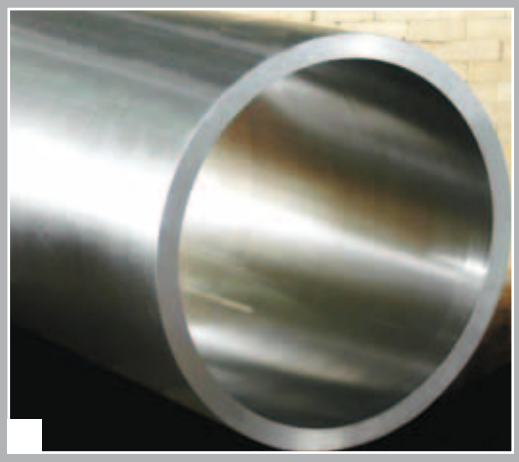
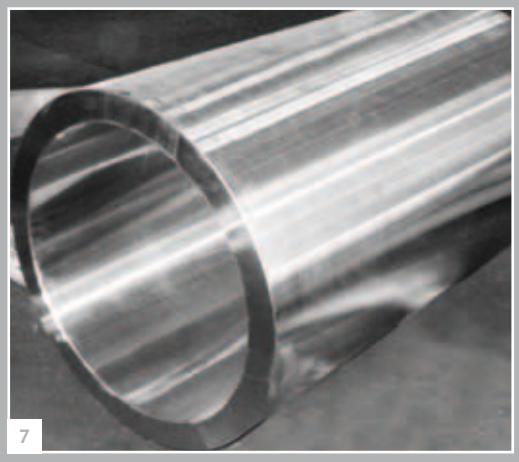


Non-magnetic alloys containing nickel and 18% chromium, to increase corrosion resistance.



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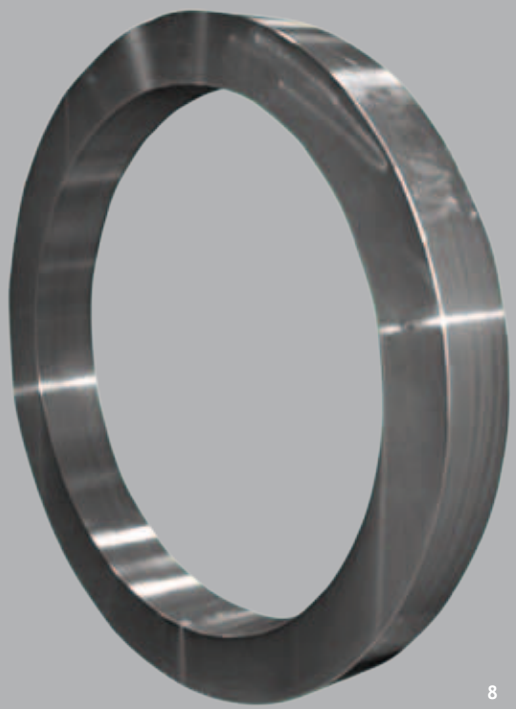

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5. | DISH END SA 336 F321

6. 7. | SHELL SA F321

8. | RING IN 718

Ferritic, Martensitic and Precipitation-Hardening

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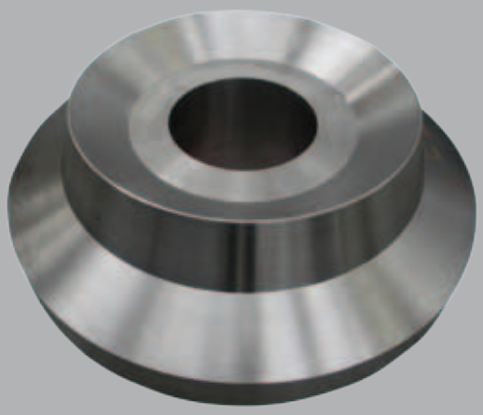

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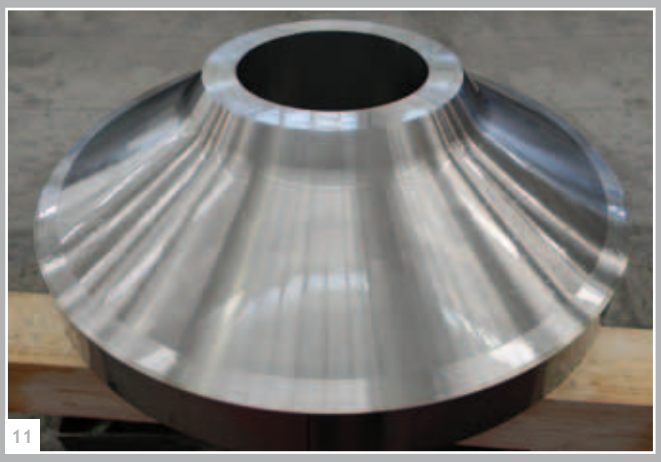

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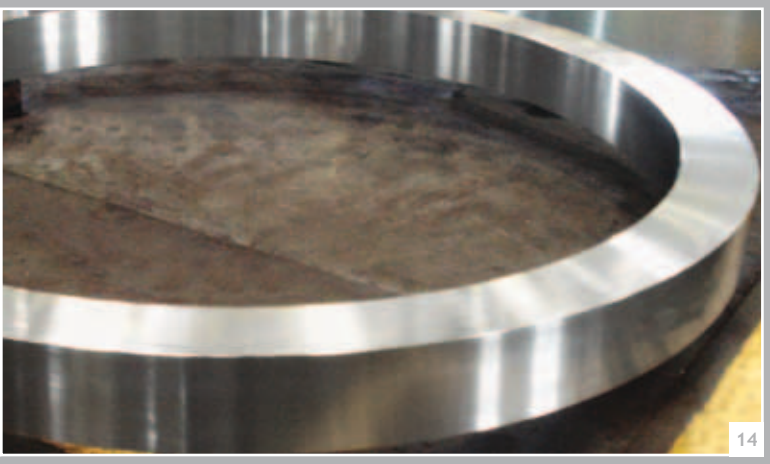
9. | Nozzle safe end
10. | 12 TON 133 PH centrifugal impeller
11. | Centrifugal impeller Virgo 38
12. | 1st stage centrifugal compressor impeller in F6NM
13. | 4 Ton High Cr Martensitic stainless creep turbine wheel

Nickel Alloys



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High Temperature

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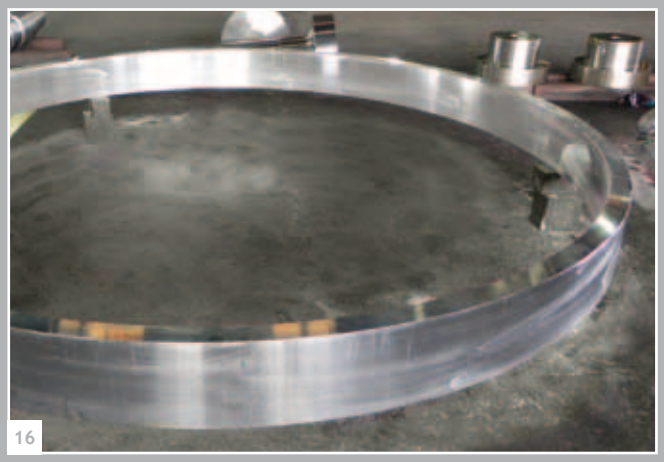
Alloy metal produced for high-performance,
high-temperature applications,
such as nickel-iron-chrome alloys
and nickel-chrome-iron alloys, and employed
for example in the manufacturing of aero-engine turbines.

14. | Ring HR 120
15. | Impeller Inconel 718
16. | Rotor Shaft 28CrMoNiV49

Aluminium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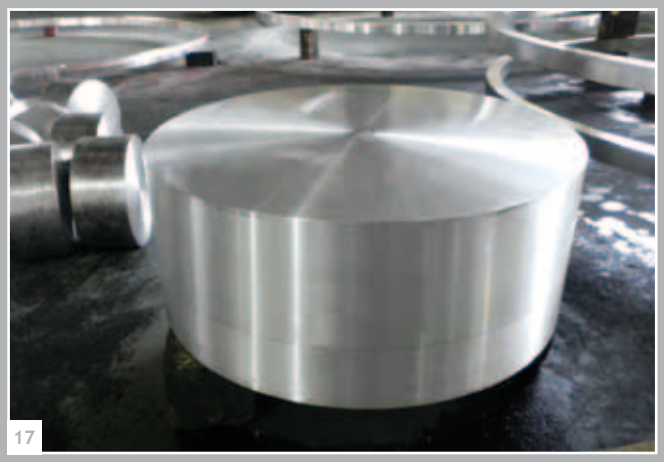
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Titanium

Very ductile and malleable white metal characterised by high strength and light weigh and especially employed in aerospace and industrial process.


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16 . 18. 19. | Rings for general purposes
17. | Turbo expander AL 7050 AND 6061

MATERIALS - Special steels, nickel and titanium alloys

Steel	Material Number	Uns-Designation	Din-identification	Alloy	Application
Austenitic Steels	~1,4302	S30400	X5CrNi18-10	F304	Nuclear, Oil&Gas
	~1,4306	S30403	X2CrNi19-11	F304 L	
	-	S30454	X5CrNi18-10	F304 LN	
	~1,4841	S31000	X15CrNi25-21	F310	
	~1,4401	S31600	X5CrNiMo17-12-2	F316	
	~1,4404	S31603	X2CrNiMo17-12-2	F316 L	
	~1,4406	S31653	X2CrNiMoN17-11-2	F316 LN	
	~1,4541	S32100	X6CrNiTi18-10	F321	
	~1,4550	S34700	X6CrNiNb18-10	F347	
	~1,4961	S34709	X8CrNiNb18-10	F347 H	
Super austenitic Steels	~1,4454	S21904	X2CrMnNiN20-9-7	F XM-11 / Nitronic 40	Aerospace, Nuclear,Oil&Gas
	no	S20910	X3CrMnNiN22-5-12	F XM-19 / Nitronic 50	
	~1,4547	S31254	X1CrNiMoCuN20-18-7	F44	Oil&Gas
	~1,4565	S34565	X2CrNiMnMoNbN25-18-5-4	F49	
Martensitic Steels	~1,4413	S41500	X3CrNi13-4	F6NM	Oil&Gas,Process Equipment
	~1,4006	S41000	X12Cr13	F6 a	
	~1,4923	-	X22CrMoV12-1	-	Oil&Gas,Process Equipment,Power Generation
	-	-	X4CrNi16-4	Virgo 38	Oil&Gas,Process Equipment
	1,4939	-	X12CrNiMo12	Jethete M 152	Oil&Gas,Process Equipment,Power Generation
Martensitic Creep-resistant Steels	-	-	X14CrMoVNbN	Cost F	Power Generation, Gas Steam Turbine components
	-	-	X12CrMoWVNbN	Cost E	
	-	-	X13CrMoCoVNbNB	FB2	
	X10CrMoVNb9-1	K90901	X10CrMoVNb9-1	F91	Power Generation, Steam Valves, Pressure Vessel
	-	K92460	-	F92	
Stainless Precipit. Hardening Steels	~1,4545	-	-	15-5 PH	Aerospace, high-strength corrosion resistant components
	~1,4542	S17400	X5CrNiCuNb16-4-4	17-4 PH	
Duplex & Superduplex Stainless Steels	~1,4462	S31803	X2CrNiMoN22-5-3	F51	Oil&Gas,FSPO platforms
	~1,4410	S32750	X2CrNiMoN25-7-4	F53	Oil&Gas, Pumps, Valves
	~1,4501	S32760	X2CrNiMoCuWN25-7-4	F55	
	~1,4507	S32550	X2CrNiMo25-7-4	F61	
Superalloys		N08120	NiFeCr	HR120	Power generation, shrouds, diaphrams, heat shields, turbine stage
	2,4683	R30188	CoCr22NiW	Haynes 188 / Udimet 188	
	2,4733	N06230	NiCr22W14Mo	Haynes 230	
	2,4831 / 2,4856	N06625	NiCr22Mo9Nb	Inconel 625	Pressure Containers, Oil&Gas
	2,4642	N06690	NiCr29Fe	Inconel 690	
	2,4668	N06718	NiCr19Fe19Nb5Mo3	Inconel 718	Power Generation, Turbine components, Aviation, Oil&Gas, Nuclear
	2,4665		NiCr22Fe18Mo	Hastelloy X / Inconel HX	
	2,465	N07236	NiCo20Cr20MoTi	Nimonic 263	Power generation, shrouds, diaphrams, heat shields, turbine stage
				GTD333	
	1,4876	N08810	X10NiCrAlTi32-21	Incoloy 800H	Nuclear, Oil&Gas
	1,4944	no	no	A-286	Power Generation, Oil&Gas
Carbon & Low Alloys Steels				SA 105	Oil&Gas, General Industry
				SA 266	
				A 266 CL2	
				SA 350 LF2	
				SA 508 Grade 3 CL1 /CL2	
				A48 CP-APR	
				20 Mn 5	
				16 MnD 5	
				18 MnD 5	
				20 MnMoNi 55	
				A 694 F52	
				A 694 F60	
				A 694 F65	
				A 694 F70	
				A 707 Grade 3W	
				15NiCuMoNb5	
				SA 350 LF3	
				A 350 LF6	
	1,5421	K12822	20MnMo3-5	SA 336 F1	
	~1,7362	K41545	X11CrMo5	SA 336 F5	
		K11572	no	SA 336 F11	
	~1,7337	K11564	16CrMo4-4	SA 336 F12	
	no	K31545	no	SA 336 F21	
	1,738	K21590	10CrMo9-10	A 182 F22	
	no	K31835	12CrMoV9-10	A 182 F22V	
	~1,7214	no	30CrMo4	AISI 4130	
	1,7225	no	42CrMo4	AISI 4140	
				39NiCrMo3	
				A 470 CL8	
				A 522 Type1	
				20 NCD 12	
				15 Mo 3	

Other materials and alloys are available on request

FORGINGS

Actual as forged weight and dimension limits

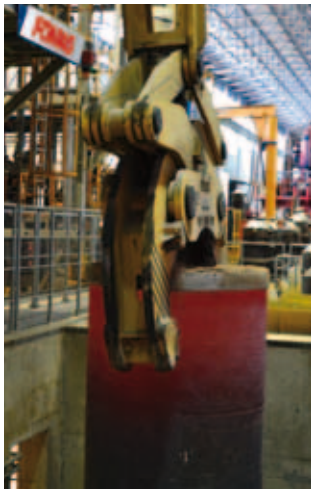
- max. diameter: 5,500 mm
- max. length: 18,000 mm
- max. ingot: 125 ton ESR (equivalent to 170 tons conventional ingot)
- max. shipped weight: 100 ton

Six state of the art automatic UT stand both vertical and horizontal, produced on FOMAS design and qualified by the major turbine manufacturers.
Titanium and Aluminium heat treatment production line equipped with electric drop furnace.

The electro slag remelting technology has been developed and used for more than 50 years in aerospace business for high value alloys due to the high cleanliness, homogeneity and reliability/reproducibility resulting of the ingots.
Our ESR plant delivers all these advantages on a larger size ingot and in a wider range of steels and applications. In addition to the traditional and standard set up, features like pressurized inhert gas protection and a high level of plant automation have been purposely designed to make the process 100%safe, reproducible and variance free in order to deliver consistently high integrity ingots.

Electro Slag Remelting plant

- Three ESR stands
- New 125 ton ESR ingot equivalent to a conventional ingot of 170 ton.



PLANT CONFIGURATION

The FOMAS ESR plant operates with static crucibles, 100% remelting under protective gas atmosphere with the possibility of electrode changing. The equipment consists of 3 melt stations with 4 furnace heads. Two melt stations have the capacity to remelt ingots with a diameter of 2000 mm and 125 tons, one melt station has the capacity to remelt ingots with a diameter of 1300 mm and 40 tons.

ELECTRODE CHANGE

The ESR plant is equipped with automatic electrode change which ensures a high degree of production flexibility and efficiency by remelting fit to custumized design ESR ingots up to 125Ton. The number of possible electrode changes is unlimited, the automatic change mode with hihgly standarized times, grants process output and perfect reproducibility.

PROTECTIVE GAS SYSTEM

The ESR plant runs as a closed seal off system, as it is equipped with a protective pressurized gas structure, where 100% Nitrogen or 100% Argon or any mixture can be used to protect the liquid slag and the steel pool from influences of the atmosphere and completely avoid secondary reoxidation. In fact the protective gas system avoids any reaction of the chemical elements with the oxygen from the atmosphere, so in general there is no change in the analysis from the electrode (steel ingot) to the ESR ingot. (apart further desulphurization - 0.0005% S values are typical - given the highly metallurgical active and refining liquid slag the single molten steel droplets have to cross).
Also with this system the Hydrogen pick up in the ESR ingot is completely avoided.

ESR'S INGOT QUALIFICATION

Each type of steel, first ESR ingot, undergoes under a fully metallurgical characterization with product analysis and PMI.

After complete satisfactory results, process is frozen on repetitive production.As far as today we produced more than 100 ESR ingots and successfully qualified different steel grades from carbon steel to high alloy steel and stainless steels including CRA alloys for Oil and Gas applications.

HIGH QUALITY 2000 MMDIA ESR INGOTS:

- Very clean steel due to slag refining
- Unchallenged chemical homogeneity: absence of macro segregation (no metallurgical axis)
- Segregation behavior equivalent to a 1.5 Ton very small conventional Ingot
- Very fine crystal cast structure
- No shrinkage
- Good surface quality

These unique features lead to excellent raw material soundness which mitigates risk and ensures even more the delivery of a high integrity forging to our customer.

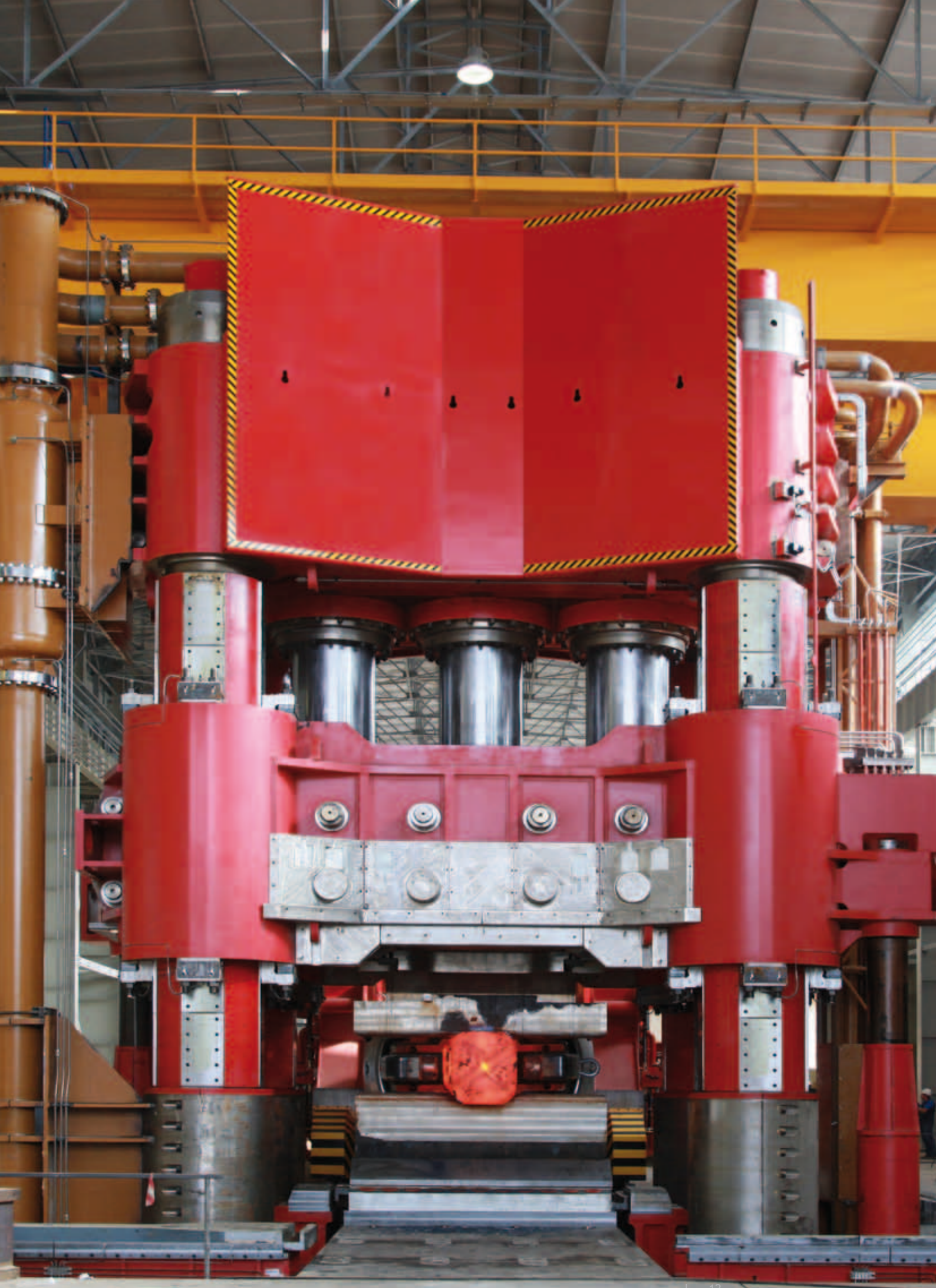
PROCESS OPTIMIZATION AND CONTROL:

- High material recovery & yield
- Fit to design ingot weight (100% material optimization)
- High process automation and reproducibility (no human factor)
- Full digital real time records of all process driving parameters

Aluminium electric-drop furnace which guarantess full immersion of batch charge within 5 seconds.

Horizontal spray-quench

- Differential heat treatment
- Fully control on drasticity
- Cooling zone control
- Time evolution of drasticity control
- Full rotor stability due to rotation
- Very uniform properties
- Plc controlled ›› fully reproducible process (no variance)
- Full control on position/distance of nozzles
- Green process



Presses

The forgings are processed in smaller or larger presses depending on the contours and size.
Our presses for open die forgings
(all with integrated manipulators):

- 11,300 ton
- 6,000 ton
- n° 2 - 3,500 ton
- 2,000 ton

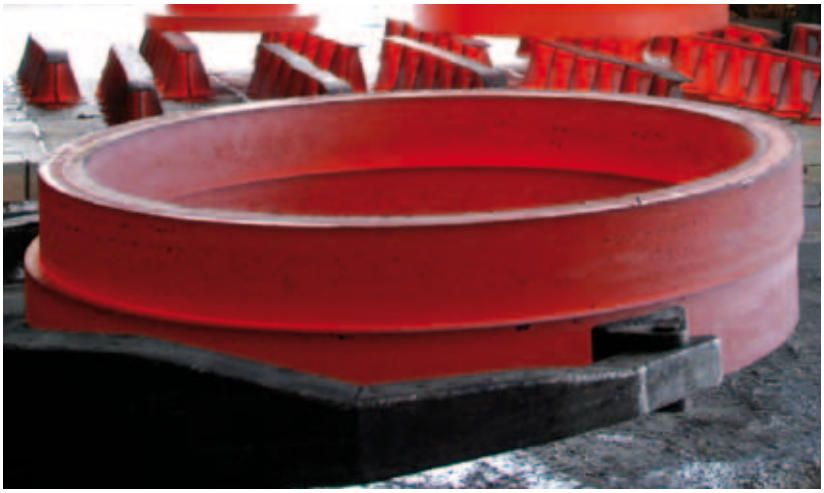
RINGS

- **max. ring diameter: 7,000 mm**
- **max ring height: 1,200 mm**
- **max ring weight: 15 ton**
- **max ingot weight: 40 ton**

Rolling Mills

17 lines (axial/radial)

State of the art in-house heat treatment plants, with an automated mobile conveyor for loading/unloading operations. This means quick, consistent and optimized transfer time from furnace to tank. The Rings Division currently produces approximately 60,000 tons per year and has capacity to manufacture rings in the following range: 7,000 mm diameter, 1,200 mm in height and up to an approximate weight of 15 tons.

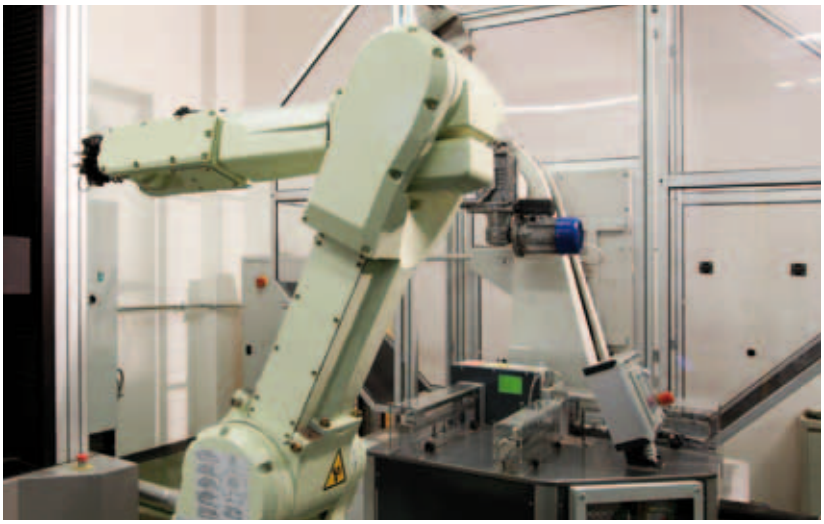


CERTIFICATIONS

All the Group's Companies are certified with:

- ISO 9001
  Det Norske Veritas (DNV)
- ISO 14001
  Environmental Management (DNV)
- BS OHSAS 18001
  Occupational Health and Safety (DNV)

Moreover each company is certified by the most prestigious institutes in specific sectors.



FOMAS Group's central research and development department aims to respond to customer needs. We often provide, on request co-design solutions. Our approach is to focus on safety, cost reduction, minimize end waste. Moreover we strive to sustain profitability providing the highest level of quality and safety throughout the entire manufacturing cycle and at the same time ensuring the least possible impact on the environment.

FOMAS GROUP

OUR GROWTH PATH

Our mission is to fulfil customer requirements with unmatched quality and on time delivery.
Our 50 years experience enable us to provide the highest level of material and process knowledge on critical industrial applications.

The Group has over 1,300 employees all around the world. Working with us signifies entering a team which is focused on continuous evolution, a company that measures its success in the achievement of excellence at each and every step of function and process.

The Group is organised in two main business units, Forgings Division and Rings Division and its factories are located in Italy, France, India and China.

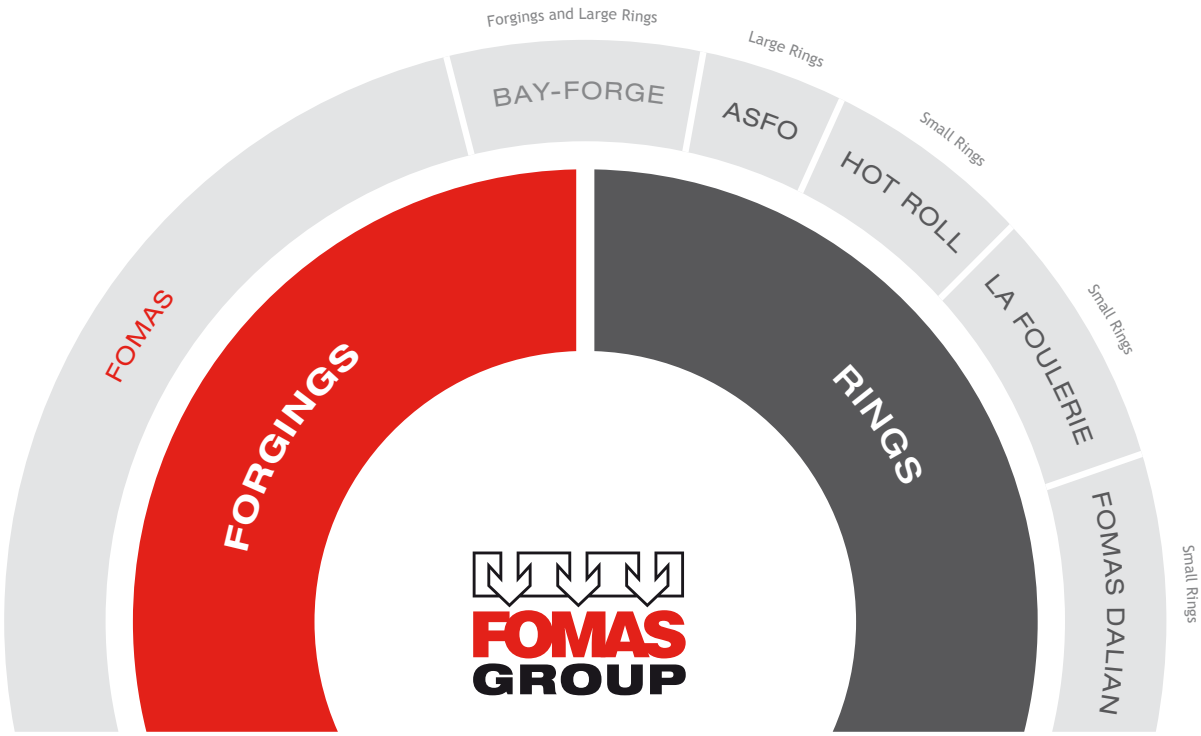
In order to comply with the most demanding customer requests, in 2007 the Group initiated an extensive **250 million euro investment** in new facilities, technology, and machinery and human capital around the world.

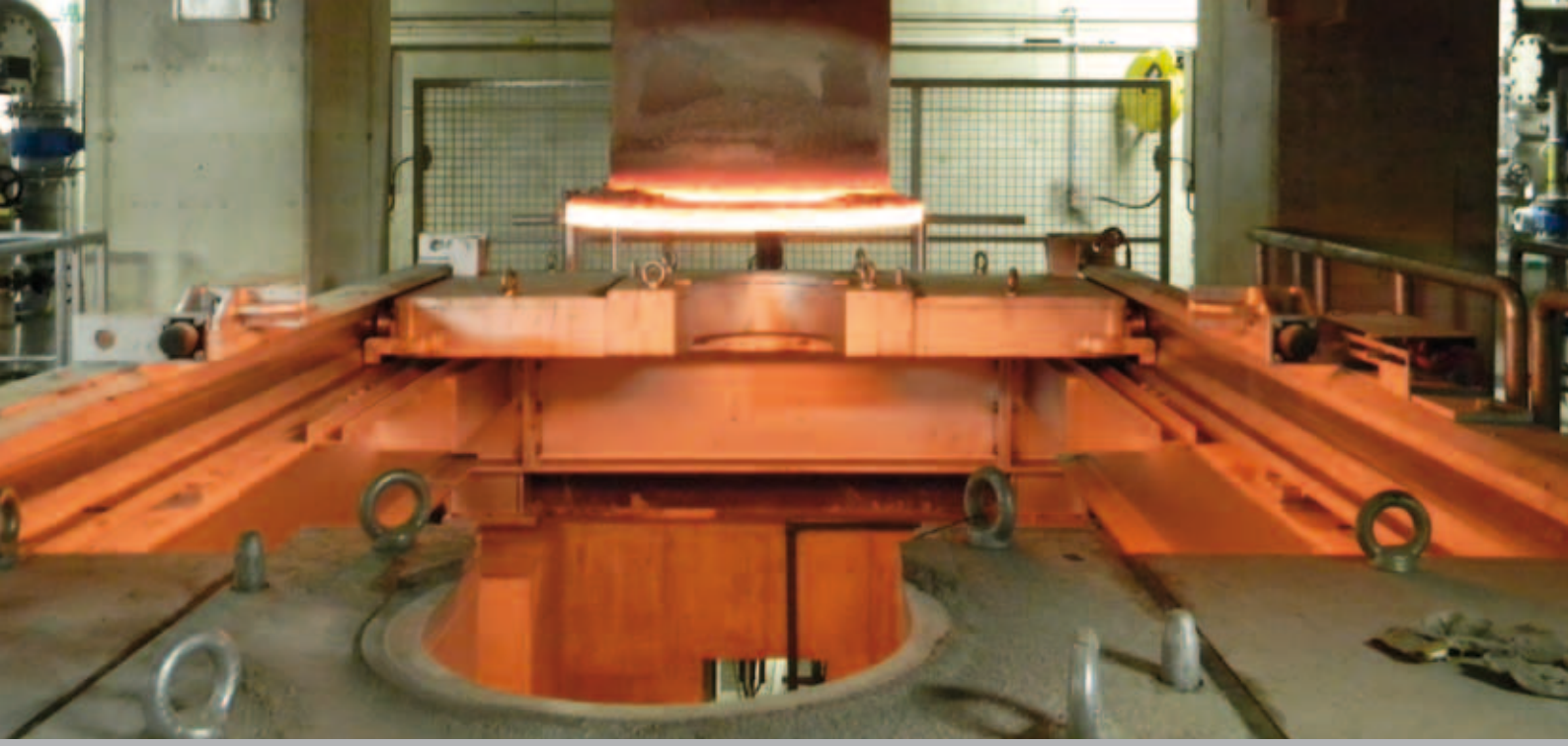
The "FOMAS 2012" project was launched to significantly increase the Group's manufacturing capabilities and capacity.

While the world's financial crisis hit, FOMAS continued to move forward with investments as planned: this major investment project was completed more than a year ahead of schedule.
And we are still forging ahead with more upcoming investments.

1,320
employees

FOMAS GROUP STRUCTURE





POWER GENERATION

Steam

Gas

Hydro

Geothermal

Nuclear

Wind

OIL and GAS

Upstream

Downstream

Process Equipment

MOBILITY/TRANSPORTATION

Automotive

Industrial Vehicles

Aerospace

Railway

Ship Industry

CONSTRUCTION EQUIPMENT

Construction

Mining

Tunnelling

GENERAL INDUSTRY

Dies & Rolls

Agriculture

Chemical Process Equipment

Fluid Handling

GEARS TRANSMISSIONS & BEARINGS

Gear Boxes

Speed Reducers

Gear

Ultra Large Bearings

SPECIAL STEELS and ALLOYS

average

180,000 tons

raw material purchased per year

studiochiesa

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