



aperam

Nickel Alloys For Every Application





# About Aperam

**Aperam** is a global player in stainless steel, with the capacity to produce 2.5 mt of flat stainless steel in Europe and Brazil. Aperam is also a leading producer of high value-added specialty products, including electrical steel and nickel alloys. Aperam has a highly integrated distribution, processing and services network and a unique capability to produce stainless and specialty steels from low cost biomass (charcoal).



## Our people

Their safety is our top priority, but this duty goes well beyond health and safety.

Aperam has implemented a Learning & Development management system to enable continuous personal development.

Aperam is also keen to attract the very best talents, regardless of age, origin or disabilities and, to do so, has launched a specific program to enhance Gender Diversity at all levels of the Company.



## Our environment

Aperam continues to produce one of the world's greenest stainless steels and alloys, with carbon emissions at 0.49 tons of CO<sub>2</sub> per ton of crude steel (half the ISSF average).

Aperam remains determined to be a sector leader in environmental excellence, and is raising the bar even higher with our ambitious 2030 objectives in air, water, CO<sub>2</sub> and energy.



## Our governance

Our governance framework goes beyond regulations to take into consideration all our stakeholders.

Our Code of Conduct is guided by the strongest ethics and our internal processes are based on best practices.

Being the partner of choice for all our stakeholders means active and transparent communication about what is important to us and to them.



# Introducing Aperam Alloys Imphy

Innovation is one of our strengths. From co-inventing INVAR to launching “Precision metallurgy”, over the past 100 years Aperam Alloys Imphy has built its reputation on quality and performance.

## Your satisfaction is our focus

We offer a wide range of alloy solutions that meet the diverse needs of innovative companies working in the field of transportation and e-mobility, energy and energy transition, medical, petrochemical and consumer sectors. With a portfolio that includes an array of properties and over 200 individual grades, **we can offer you the perfect grade to match your most appropriate needs.**

## Imphy Service Center



- > **Distribution:** small quantities from our stock, no MOQ. Shipment possible from 1 kg within 48 hours.
- > **Logistics:** adapted solutions with possibility of open orders on call-off.
- > **Slitting:** possibility to slit from in-stock master coils in the requested widths. Shipment possible from 1 kg within 3 weeks.
- > **Customized products:** possibility to produce customized products from our existing products-grades in accordance to specific requirements, including non-standard dimensions and shapes.





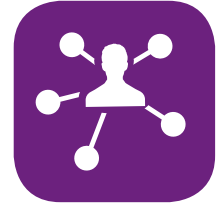
# Aperam Alloys Imphy **People**



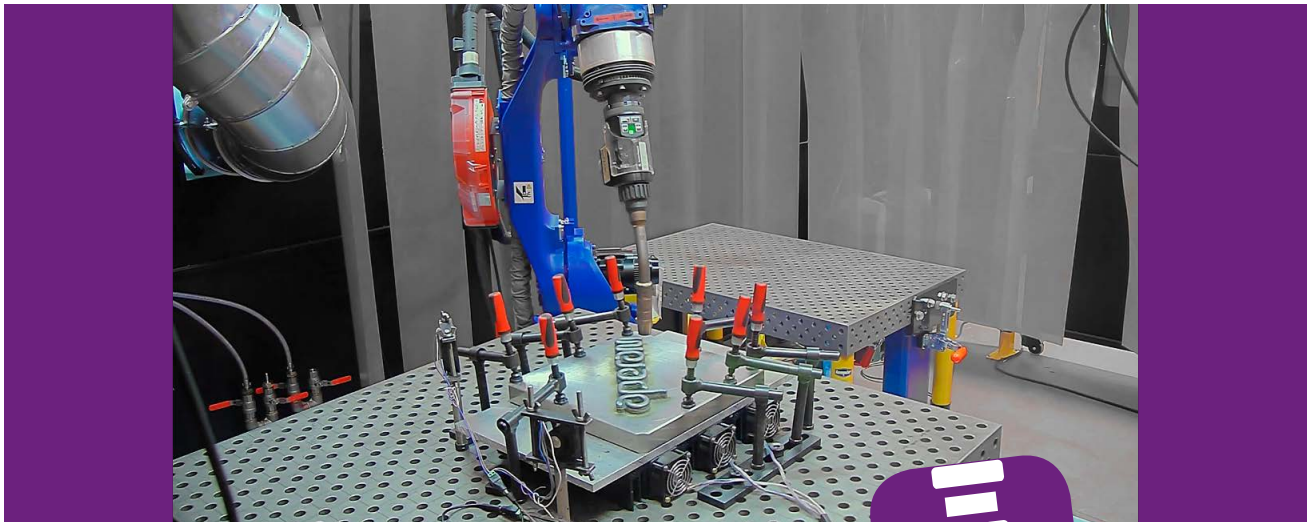
Our expert team of researchers at the Pierre Chevenard Research Center (PCRC) in Imphy, France, are dedicated to improving both the performance of alloys (Nickel base, cobalt, superalloys, etc.) and the process for using them.



The physical and mechanical properties of these alloys are closely associated with their suitability for processes such as stamping, cutting, machining, deep drawing, welding, drawing and forging.



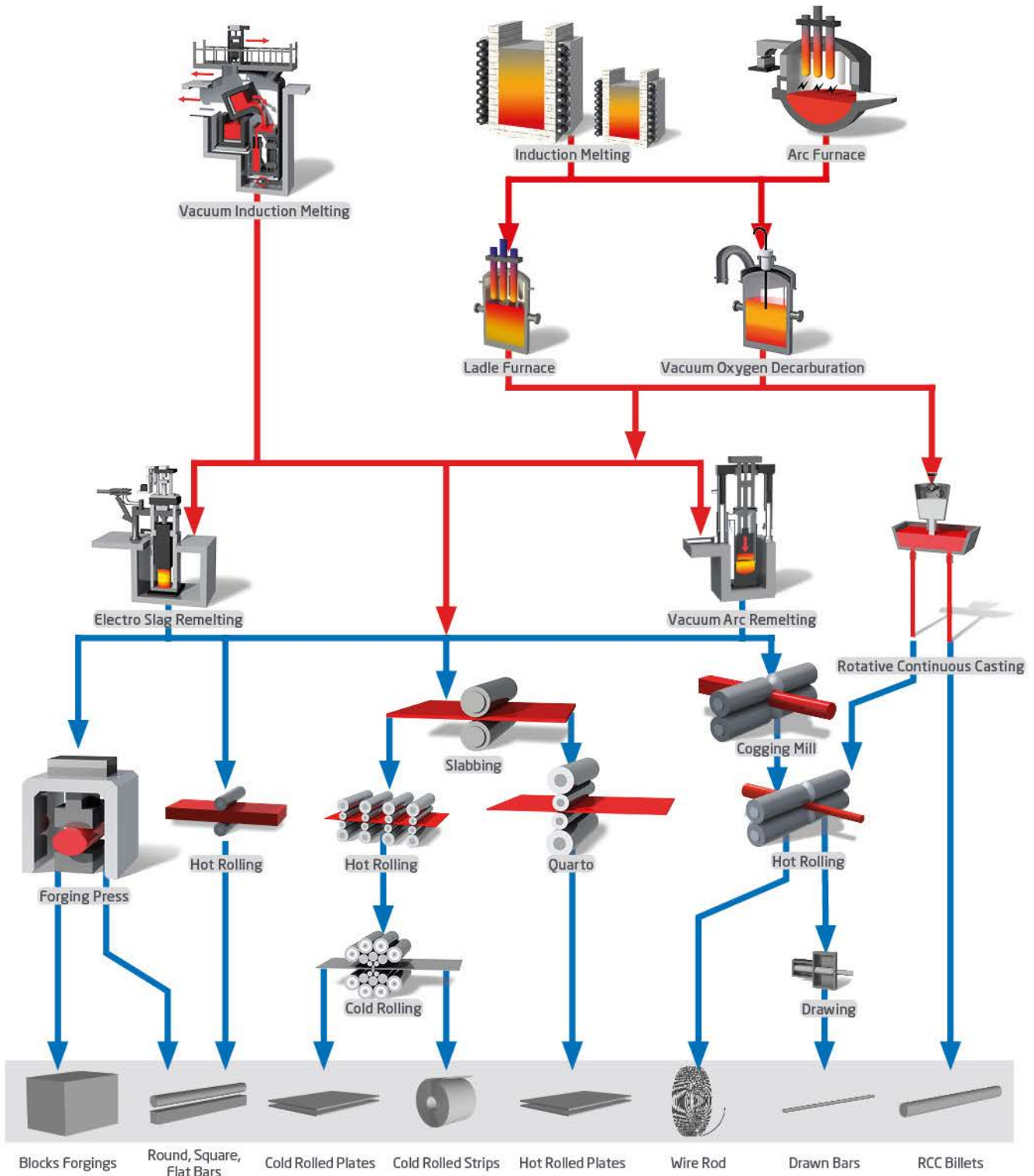
A local presence around the world, backed by an efficient and competent staff. No matter where you are located, Aperam is close to you.



## The New Frontier



Additive Manufacturing technologies, also known as 3D printing, enable many industries to speed up - or even revolutionise - their production processes. Globally recognised for the quality of their welding alloys range, Aperam Alloys Imphy is your natural partner to develop additive manufacturing processes. This includes wire rod for WAAM (Wire Arc Additive Manufacturing), a result of our expertise in low residuals.



Product Form	Unit	Min	Max	Finish
Blocks Forgings	Weight (kg)	1	8,000	-
Round bars	Diameter (mm / In.)	20 / .787	400 / 15.478	Ground, peeled or turned
Square Bars	Section <sup>2</sup> (mm / In.)	15 <sup>2</sup> / .591 <sup>2</sup>	85 <sup>2</sup> / 3.346 <sup>2</sup>	Sandblasted
Flat Bars	Section <sup>2</sup> (mm / In.)	85 <sup>2</sup> / 3.346 <sup>2</sup>	400 <sup>2</sup> / 15.748 <sup>2</sup>	Ground or milled
	Thickness (mm / In.)	10 / .394	85 / 3.346	Sandblasted
	Width (mm / In.)	15 / .591	200 / 7.874	Sandblasted
Cold Rolled Plates	Thickness (mm / In.)	0.4 / .0157	8 / .315	-
	Width (mm / In.)	-	1,100 / 43.307	-
Cold Rolled Strips	Thickness (mm / In.)	0.025 / .001	5 / .197	Note:
	Width (mm / In.)	1 / .39	680 / 26.77	Width & thickness are correlated
Hot Rolled Plates	Thickness (mm / In.)	7 / .276	130 / 5.118	-
	Width (mm / In.)	-	2,300 / 90.55	-
Wire Rod	Diameter (mm / In.)	5.5 / .217	21 / .827	-
Cold Drawn Bars	Diameter (mm / In.)	4 / .157	20 / .787	-
RCC Billets	Diameter (mm / In.)	130 / 5.118	220 / 8.661	-
	Length (m / In.)	4 / 157.48	7.3 / 287.40	Black or peeled

# Alloys are essential to a number of applications



Below we highlight some alloy applications used in Transportation, Energy, Medical, Chemical Industry, and Consumer Goods markets.

## Mobility

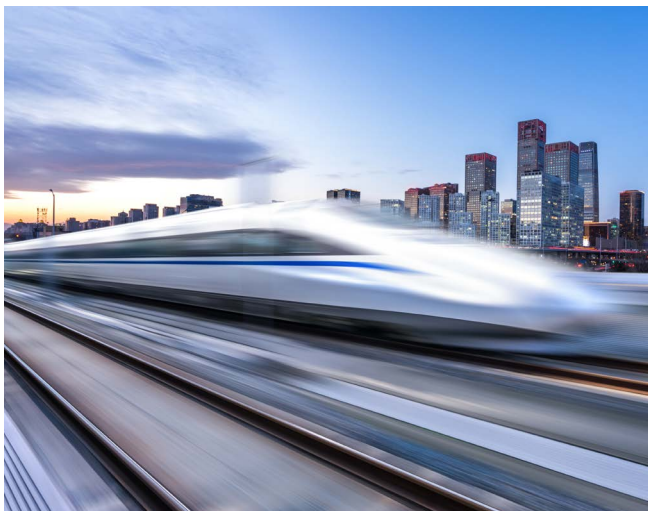
The transportation sector is facing a number of challenges, including increasing safety standards, a need for lightweight parts and materials capable of withstanding both corrosion high temperatures. Our alloys respond perfectly to all of these requirements.

### Aerospace



- > **Engines & turbines:** *IMPHY AFK* cobalt alloys grades are ideal to reduce space and weight on board.
- > **Fasteners:** *IMPHY 286*, *IMPHY 718* and *IMPHY 685* wire optimize fastening by supporting mechanical properties at high temperatures.
- > **Moulds:** *INVAR*'s special controlled expansion properties afford ultra precise dimensions for composite parts.

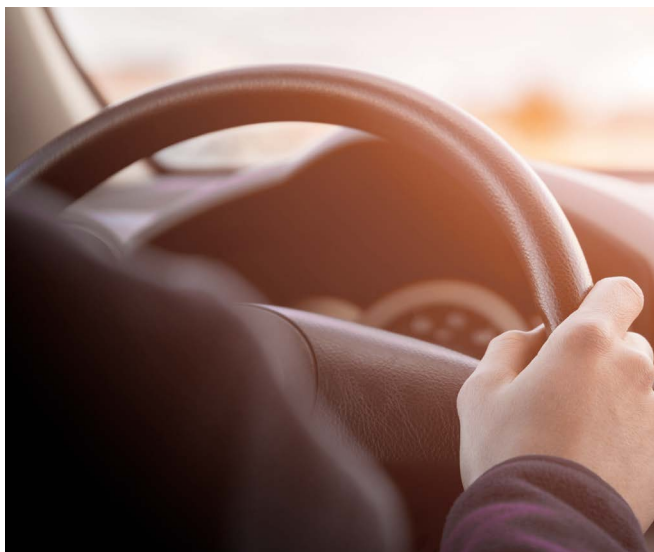
### Rail



- > **Emergency train brakes:** *INVAR* plates offer the controlled expansion needed to avoid dimensional change and secure its safety function.
- > **Locomotive rheostats:** *IMPHY GILPHY 45* and *IMPHY 601* are regularly used as they offer excellent resistance to high temperature and creep, both of which happen during the braking process.
- > **Rail switches:** *IMPHY SUPRA 50* is commonly used.



## Automotive



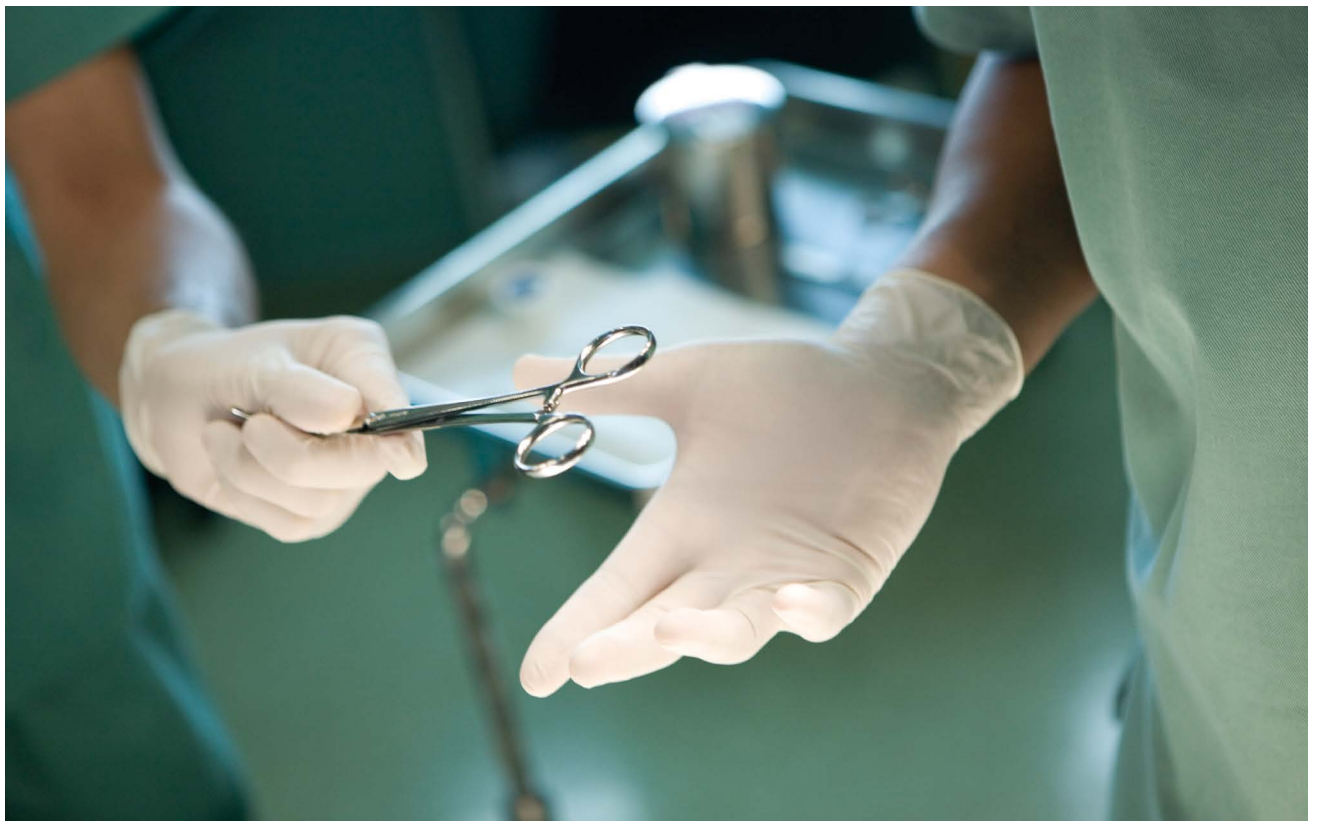
- > **Continuous Variable Transmission Belts:** *PHYTIME* is an Aperam patented maraging steel with very high tensile strength, exceptional fatigue resistance and high durability.
- > **Torque Sensors for Steering Columns:** *IMPHY SUPRA 50, PERMIMPHY, INVAR M.* Thanks to the optimized magnetic outputs of such nickel alloys, steering is more efficient (low losses), more precise (low coercive field and high permeability) and easier to implement.
- > **Injection:** *IMPHY AFK.* The injection needles used in fuel injectors benefit from the Iron Cobalt grades' ability to work with high fuel pressure in a limited space with efficient dynamics and high electrical resistance.
- > **Bimetals:** *Thermostatic bimetals are used for miniature temperature controls, protectors, drum brakes, cigar lighters, etc.*

## E-Mobility



The electric vehicle revolution is well under way. From components to motors, every part of the vehicle is becoming increasingly electric. Aperam alloys are at the cutting edge of many of these components, helping to improve their efficiency, decreasing size, and expanding lifespan. Our *IMPHY AFK FeCo* range - which is already widely used in electrical motors, actuators and electrical systems - offers the highest magnetic properties and helps optimize performance.





## Medical

*Whether for x-ray shielding, implants, surgical equipment or prosthesis, medical engineering relies on nickel- or cobalt -based alloys. Depending on the application, alloys offer excellent corrosion resistance, high yield strength and superb magnetic behaviour.*

### Shielding

- › *PERMIMPHY* is required for the production of instruments such as microscopes and rooms used for magnetic resonance imaging that demands shielding against electromagnetic interferences.

### Implants & medical devices

- › *PHYNOX*, a cobalt-based grade, is designed to address following applications: pacemakers, syringes, clamps, and cardiac and peripheral stents demanding biocompatibility, corrosion resistance and other outstanding features.
- › *IMPHY SUPRA 50* is suitable for hearing aids.
- › *IMPHY AFK*, for high power in a reduced space, is used in artificial heart micromotors.
- › *IMPHY 420 DVM* has been developed for scalpels.
- › Remelted stainless steel can be used for the production of needles.





# Industry

*More than any other metallic material, nickel and cobalt alloys are fundamental to the construction of chemical and petrochemical processing equipment. Luckily, the chemical industry has an array of grades to choose from, each of which offers various levels of corrosion resistance, mechanical properties and cost-effectiveness – meaning there is an alloy for every type of CPI application.*

## Overlaying against corrosion

- › The high corrosion resistance of *IMPHY 625* makes it the flagship grade for the weld overlay process. *IMPHY 625 W* and *IMPHY 825* are also base materials used by the oil and petrochemical industries.

## Waste burners and the environment

- › Incineration, high-temperature waste treatment and environmental release all involve a combustion of organic substances. They will also require the use of alloys with robust corrosion and oxidation resistance and good mechanical properties over a wide-range of temperatures and corrosive elements. *IMPHY 625 W*, *IMPHY 693* and *IMPHY 686* are ideal for these types of applications.



*Without energy there is no heat, no light, no transportation and no production - and from fossil fuels to renewable energy, there is always an alloy.*

## Renewable energy



- > **Concentrated Solar Power:** *IMPHY DILVER* is ideal for parabolic trough collectors (heating collector element) where special thermal expansion control is needed to seal glass to metal parts.  
*IMPHY 625* for molten salt receptors needing high resistance to corrosion, high temperature and abrasion.



- > **Deep geothermal applications:** *IMPHY 625* is the right choice to resist sulfuric, salty and high temperature environments (plug pipes and tubes in hydraulic pumps).



- > **Hydrogen: Fuel cells/Electrolysis**
  - >> **Hot applications:** *IMPHY 800, 825, 625, 286* are some of the suitable solutions for heat exchangers or casings and solid oxide components.
  - >> **Cold applications** (i.e. automotive):  
*IMPHY 286* for bipolar plates for PEMFC (patented solution).  
*IMPHY N99* (Alloy Ni 201) for Alkaline Water Electrolysis (AWE).



## Traditional energy uses



- > **Exploration, production and transportation of Oil & Gas:** alloys offer reliable resistance to the highly corrosive environments of oil and gas fields.
  - » **UPSTREAM:** *IMPHY 625 W* and *IMPHY 825* for overlay of flow lines; *IMPHY 625* strips for banding of umbilicals, cladded pipes, etc. (e.g., vacuum circuit breakers).
  - » **MIDSTREAM:** *INVAR M93* for the membrane tanks of methane carriers and LNG transfer lines.
  - » **DOWNSTREAM:** *IMPHY 625 W* for overlay of pressure vessels and refining equipment.



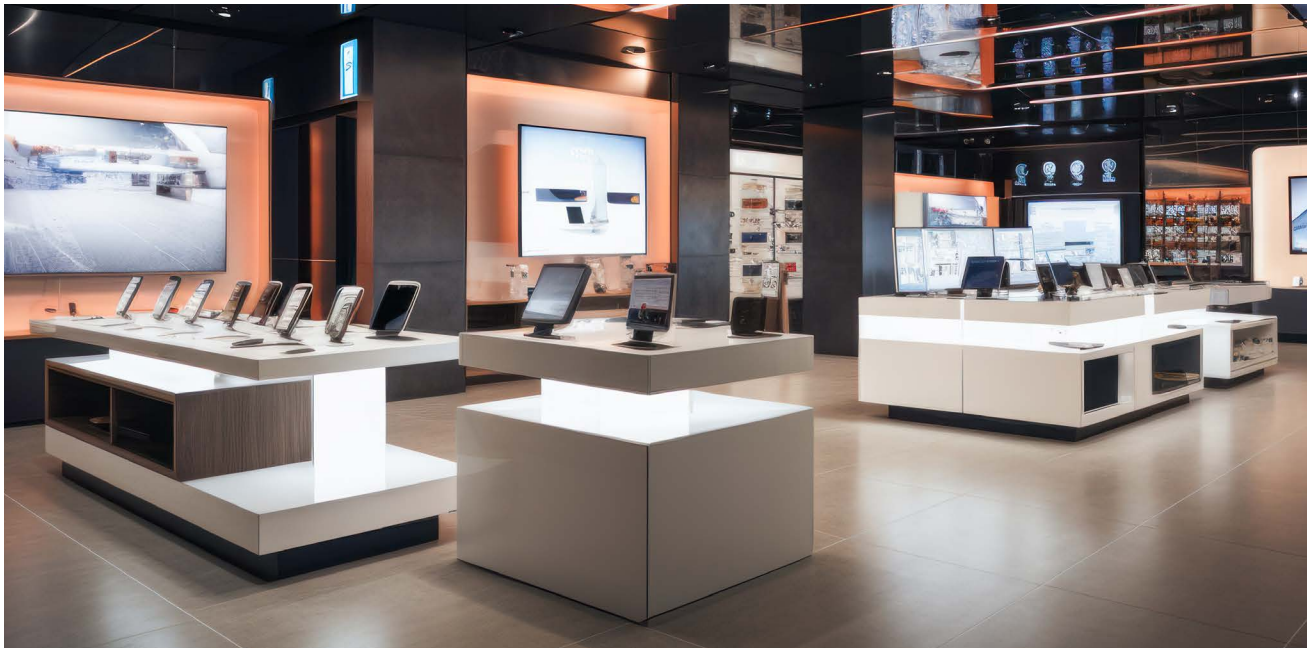
- > **Bimetals:** *Thermostatic bimetals* play a key role in the residential and industrial circuit breakers used to protect against over-intensity when the current draw exceeds the circuit's amperage.



- > **Power distribution:** A special hardened *INVAR* is designed for "ZTACIR" power lines, *IMPHY 601*, *IMPHY GILPHY 45* for load banks, and *IMPHY N42* or *IMPHY DILVER* for electric vacuum circuit breakers.



- > **Nuclear:** *IMPHY 690* for nuclear steam generator.



## Consumer Goods

*Alloys supports enhance the safety, comfort, and useability of many of our everyday applications and open the door to the applications that will define our Future.*

### OLED displays



- > **INVAR** provides the controlled expansion properties needed by the fine screens of our mobile phones, tablets and virtual glasses. **INVAR** can be used to bring the mechanical properties required by the back panels of some OLED TVs to be sealed to the display.

### Clock and watches



- > **DURIMPHY**, **PHYTIME** and **PHYNOX** (high-yield strength alloys) provide after aging outstanding mechanical properties beneficial to the manufacturing of the complex miniature parts that control a watch's movement. **IMPHY SUPRA 50** is used for the design of stators thanks to its high magnetic properties.



## Printing



- > *PHYTHERM*, a controlled temperature material, allows one to enhance the efficiency and quality of fast printing. Moreover, by assuring a Curie point with narrow tolerance, printer manufacturers can stabilize the printers' processes.
- > *IMPHY N42 E* is a special solution for chemical etching applications that ensures cleanliness.

## Electric & household appliances

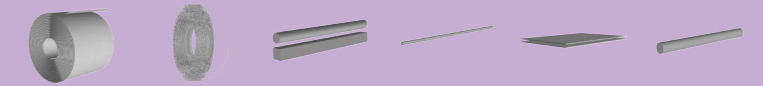


- > *IMPHY 800* and *IMPHY 825* are used for calrods in household appliances.
- > For temperature control and safety reasons, thermostatic bimetals are found in many common home appliances such as washing machines (door locking system), kettles, toasters, irons, mixer taps, room thermostats, thermometers, ovens, electric blankets, coffee makers, hair dryers...

## Cooking



- > *PHYTHERM* monitors the temperature of the cookware, helps preventing overheating and ensures that a food maintains its nutritional qualities and flavours. This also results in an increased durability of the cookware and reduces electricity consumption.



Family	Properties	Designation	Standards					Chemical Analysis	Product Form						
			ASTM	DIN	UNS	WERKSTOFF	AWS		OTHERS	STRIP	WIRE	BAR	DRAWN BAR	PLATE	SEMI
Nickel	Corrosion resistant alloy	IMPHY N99, series	B160		N02200	2.4066		Ni99.2	✓	✓					
Nickel Alloy	Corrosion resistant alloy	IMPHY 22, 22 MO LFE-1	B574		N06022	2.4602, 2.4635		Ni Cr21 Mo14 Fe4 W3		✓			✓		
Nickel Alloy	Corrosion resistant alloy	IMPHY 276	B574		N10276	2.4819, 2.4886	5.14	Ni Mo16 Cr15 Fe5 W4		✓			✓		
Nickel Alloy	Corrosion resistant alloy	IMPHY 625, series	B443 B446		N06625	2.4831, 2.4856	5.14	Ni Cr22 Mo9 Nb3.5 Fe	✓	✓			✓		
Nickel Alloy	Corrosion resistant alloy	IMPHY 686			N06686	2.4606	5.14	Ni Cr21 Mo16 W3.5		✓					
Nickel Alloy	Corrosion resistant alloy	IMPHY 82, series			N06082	2.4648, 2.4806	5.14	Ni Cr20 Mn3 Nb2.5	✓	✓					
Nickel Alloy	Corrosion resistant alloy	IMPHY 825, series	B423, B425		N08825	2.4858	5.14	Ni Fe30 Cr22 Mo3 Cu2 Ti1	✓	✓			✓		✓
Nickel Alloy	High performance alloy	IMPHY 617, 617-2			N06617	2.4627	5.14	Ni Cr22 Co11 Mo9 Al1		✓					
Nickel Alloy	High performance alloy	IMPHY 718, series	A1014, B637, B670		N07718	2.4667, 2.4668	5.14	Ni Fe20 Cr18 Nb5 Mo3 Ti1 Al0.5	✓	✓			✓		✓
Nickel Alloy	High temperature resistant	IMPHY N95Al			N03301			Ni Al4.5 Ti0.5		✓					
Nickel Alloy	High temperature resistant	IMPHY 600, 600 LC	B166, B168, B564		N06600	2.4816, 2.4817	5.14	Ni Cr16 Fe8	✓	✓	✓	✓	✓		✓
Nickel Alloy	High temperature resistant	IMPHY 601	B166, B168		N06601	2.4851	5.14	Ni Cr23 Fe14 Al1.5	✓	✓	✓	✓	✓		
Nickel Alloy	High temperature resistant	IMPHY 800, H, HC	B409		N08800, N08801	1.4876, 1.4958, 1.4959		Fe Ni31 Cr20 Al Ti	✓	✓			✓	✓	
Nickel Alloy	Soft magnetic alloy	PHYTHERM 260, PHYTHERM series						IEC 404	Fe Ni50 Cr9	✓					
Nickel Alloy	Soft magnetic alloy	PERMIMPHY, series	A753	17405	N14080	2.4545		IEC 404, JIS C2531	Ni Fe14 Mo5	✓	✓	✓	✓		✓
Nickel Alloy	Resistive alloy	IMPHY GILPHY 80, GILPHY series	B344		N06003	2.4869			Ni Cr20 Si	✓	✓	✓	✓		
Iron Nickel	Low expansion alloy	IMPHY DILVER, series	F15, F29	17745, SEW385	K94610	1.3981			Fe Ni29 Co17	✓	✓	✓	✓	✓	✓
Iron Nickel	Low expansion alloy	IMPHY N42, N42E	F30	17745, SEW385	K94100	1.3917			Fe Ni42	✓		✓	✓		
Iron Nickel	Low expansion alloy	IMPHY N48	F30, A753 Type 2	17745	K94840, K94800	1.3922			Fe Ni48	✓		✓			
Iron Nickel	Low expansion alloy	INVAR	A658, F1684	1715, SEW 385	K93600, K93601, K93603	1.3912			Fe Ni36	✓	✓	✓	✓	✓	
Iron Nickel	Low expansion alloy	MI13	Patented							✓					
Iron Nickel	Low expansion alloy	IMPHY N52	F30	17745	N14052	1.3923, 2.4478			Fe Ni52	✓	✓	✓			
Iron Nickel	Soft magnetic alloy	INVAR M	F1684	17405	K93600			IEC 404, JIS C2531	Fe Ni36			✓			
Iron Nickel	Soft magnetic alloy	IMPHY SUPRA 40	F30		K94100			JIS C2531	Fe Ni40	✓					
Iron Nickel	Soft magnetic alloy	IMPHY SUPRA 50, series	F30, A753	17405	K94840, K94800	1.3922, 1.3926		IEC 404, JIS C2531	Fe Ni48	✓	✓	✓			✓
Iron Cobalt	Soft magnetic alloy	IMPHY AFK 1	A801, A801-2		K92650			IEC 404	Fe Co27	✓	✓	✓		✓	✓
Iron Cobalt	Soft magnetic alloy	IMPHY AFK 18, AFK 18E	A801					IEC 404	Fe Co18	✓	✓		✓		✓
Iron Cobalt	Soft magnetic alloy	IMPHY AFK 502, series	A801		R30005			IEC 404	Fe Co49 V2	✓		✓		✓	✓
Copper Alloy	For thermocouple	IMPHY CuNi30, CuNi series				2.0837	SFA5.7	C71581, 413	Cu67 Ni31 Fe Ti		✓				
Nickel Copper alloy	Corrosion resistant alloy	IMPHY NiCu28, NiCu series			N04060	2.4377	A5.7, 5.14		Ni Cu29 Mn3 Ti2		✓				
Iron Chromium Aluminium	Resistive alloy	IMPHY GILPHAL 135, GILPHAL series	B603		K92400	1.4767			Fe Cr22 Al4.5		✓				
Maraging	High yield strength	DURIMPHY			K93120, K93160	1.6354, 1.6358			Fe Ni18 Co9 Mo5 Ti0.5 Al	✓	✓		✓		
Maraging	High yield strength	PHYNOX	F1058		R30003, R30008	2.4711			Co40 Cr20 Ni16 Fe15 Mo7	✓	✓				
Maraging	High yield strength	PHYTIME	Patented							✓					
Bimetal	Thermostatic bimetal	IMPHY AS series	B388	1715					B6M / INVAR	✓					
Bimetal	Thermostatic bimetal	IMPHY R, series	B388						NC4 / Ni or Cu / INVAR	✓					
Bimetal	Thermostatic bimetal	IMPHY IN540	B388	1715					NC19 / NC38	✓					
Bimetal	Thermostatic bimetal	IMPHY SP, series	B388	1715					B72M/Ni or Cu / INVAR	✓					
Special Stainless	High performance alloy	IMPHY 286, series	A453, A638		S66286	1.4980, 1.4944		AISI660	Fe Ni25 Cr15 Ti2 Mo1.2 Al		✓		✓		✓
Special Stainless	Corrosion resistant alloy	IMPHY 304, series			S30200, S30400	1.4301, 1.4307			Fe Cr18 Ni9		✓		✓		✓
Special Stainless	Corrosion resistant alloy	IMPHY 25-9-4		8556		1.4410	A5.9		Fe Cr25 Ni9 Mo4 N0.25		✓				
Special Stainless	Corrosion resistant alloy	IMPHY 2205			S31803, S32205	1.4462			Fe Cr22 Ni5 Mo3 N0.15						✓
Special Stainless	Corrosion resistant alloy	IMPHY 420 DVM			S42000	1.4028			Fe Cr13 C0.35		✓				
Special Stainless	Corrosion resistant alloy	IMPHY 316, series	F138		S31673	1.4404			Fe Cr18 Ni12 Mo2.5						✓

The main grades are indicated as the reference, "series" means that from the initial one, there is a set of close grades to answer to every requirement.





Imphy Melting shop at night - © David Lebailly



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