



# Yamato Gokin

*Special Copper Alloy Maker*

第14回核融合エネルギー連合講演会

# A Pioneer in Special Copper Alloys



# A Pioneer in Special Copper Alloys

Yamato Gokin was established in 1953 as a ...

Headquarters: Miyoshi, Saitama (legal office in Itabashi, Tokyo)

Miyoshi Gokin Factory (Miyoshi Gokin Kogyo, Co., Ltd) and Asaka Factory located in Saitama

Fields of Expertise: Development, manufacturing, machining and fabrication

- \* Characteristics
    - Unique expertise in special copper alloys
    - Start-to-finish production; high-mix low-volume production in short lead time
    - An R&D-focused company
    - Craftsmanship and HR development
- (Frequent seminars by external lecturers, study groups; proactive in joining external training; frequent job rotation)

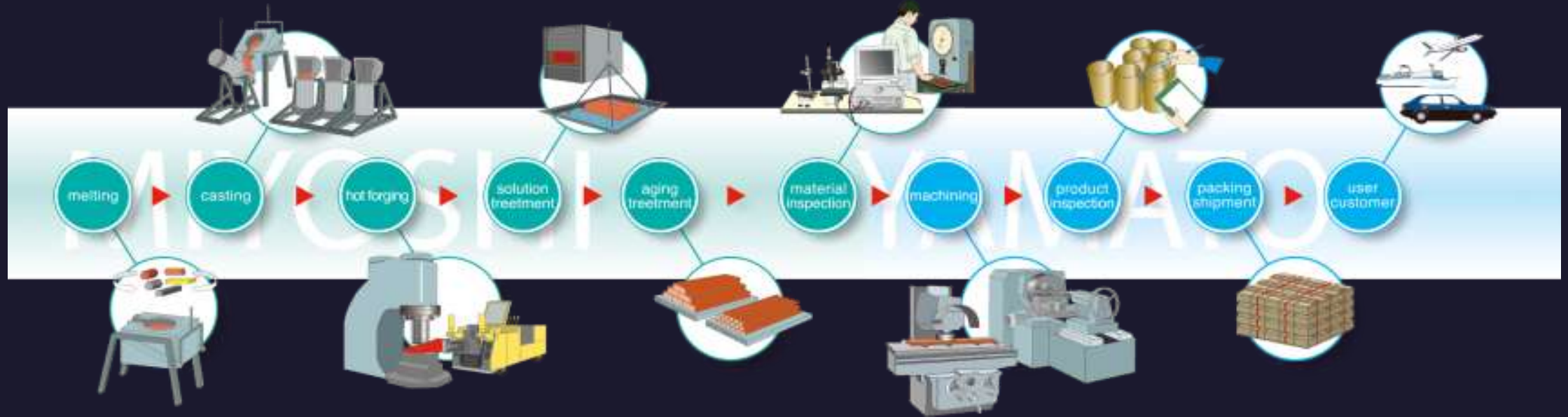
# Capacity and Technology

- **One-stop Solution** offering in-house, intermediate, and external manufacturing
- **Customization** of products according to customer needs and requirements

<u>Equipment</u>	<u>Advantage</u>
<b>Melting &amp; Casting (Production Capacity: 1300 tons per month)</b>	
<ul style="list-style-type: none"> <li>• High-frequency Induction Furnace : 10kg (1), 30kg (1), 150kg (1), 1000kg (2)</li> <li>• Middle-frequency Induction Furnace: 3000kg (1)</li> <li>• Gas furnace : 200kg (1), 400kg (1)</li> </ul>	<p>Alloy design</p> <p>We can customize the casting method and chemical composition to produce a range of physical and mechanical properties according to the needs of the customer.</p>
<b>Forging &amp; Extrusion (Production Capacity: Forging 1500 tons / Extrusion 2700 tons per month)</b>	
<ul style="list-style-type: none"> <li>• 1 1500-ton forging press</li> <li>• 3 Air hammers: 500kgs, 1000kgs, 2000kgs</li> <li>• 2700-ton Extrusion press</li> </ul>	<p><b>Grain refinement technology</b></p> <p>Elevate mechanical properties through grain refinement.</p>
<b>Heat Treatment (Production Capacity: Solution 200 tons/ Aging 425 tons per month)</b>	
<ul style="list-style-type: none"> <li>• Gas furnace</li> <li>• Electrical furnace</li> </ul>	<p><b>Structural control technology</b></p> <p>Improve structure through optimum temperature and cooling methods.</p>

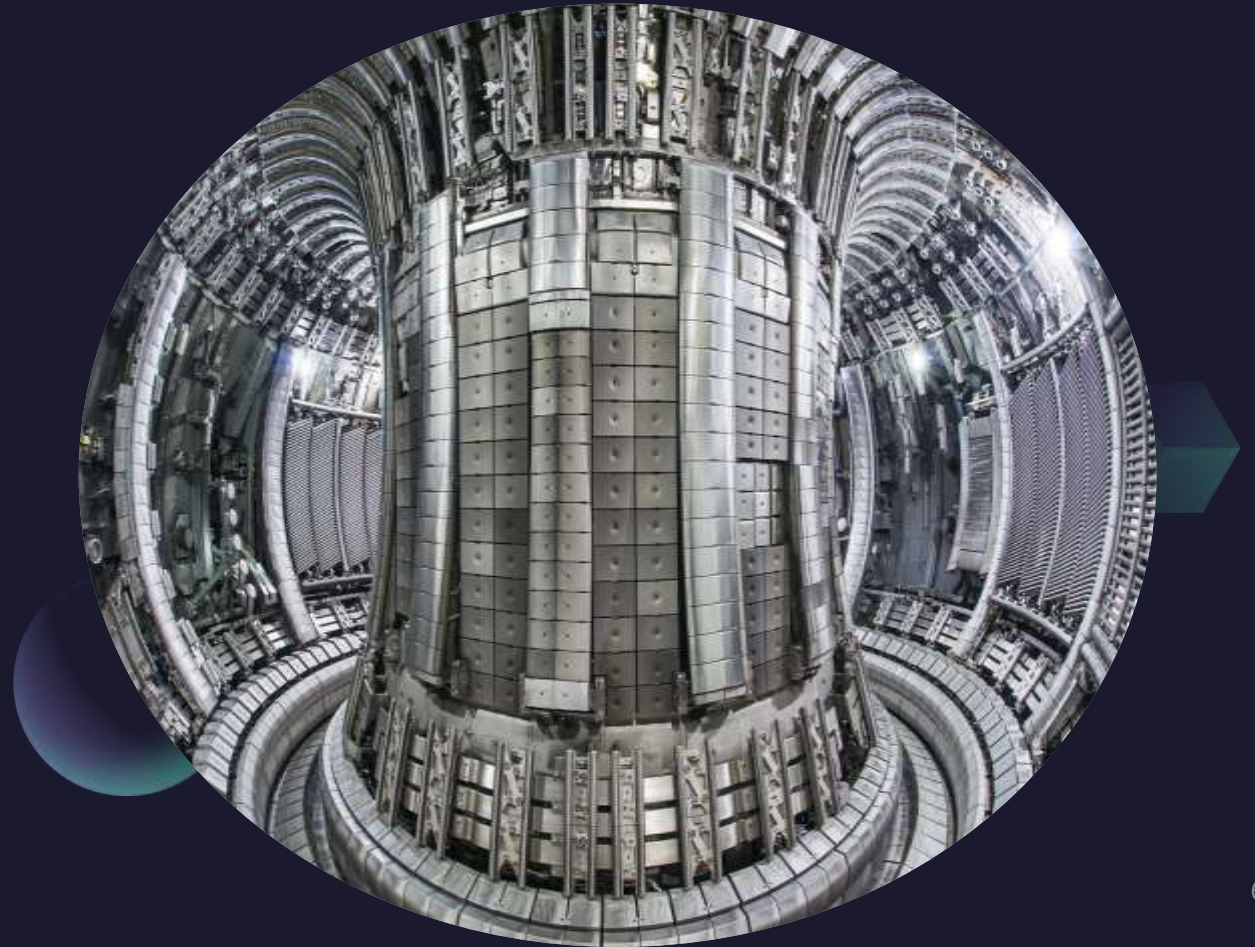


# Integrated Manufacturing System



# Realizing Fusion Energy

ITER/IO

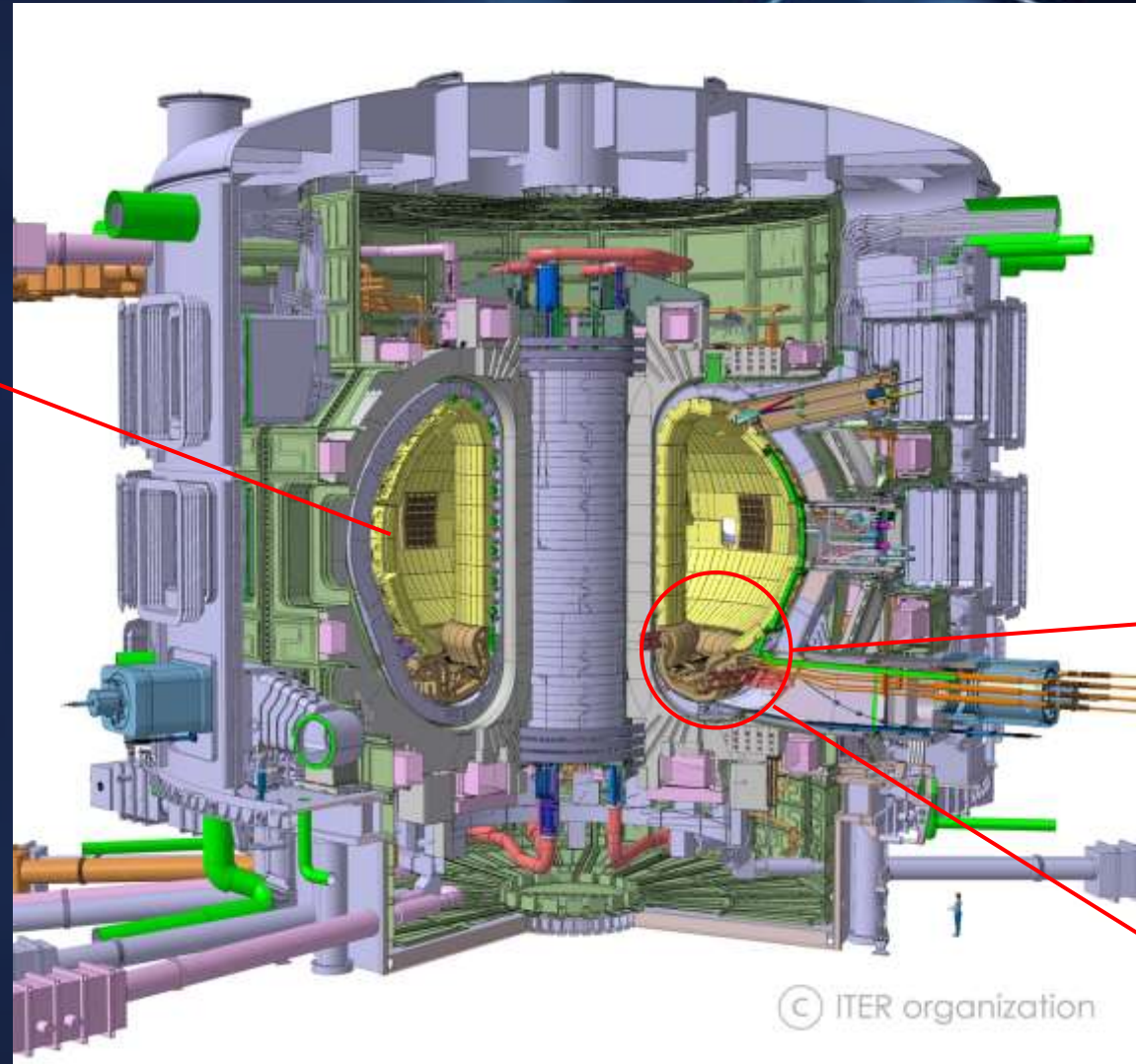




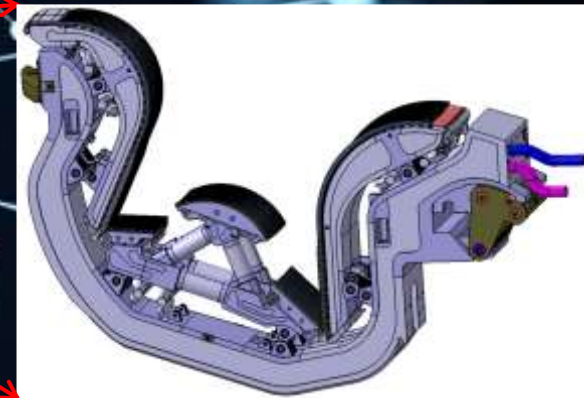
# Hydrogen Fusion (Fusion Energy): The ITER Reactor

Blanket

The blanket is the outside wall that converts heat, shields and conducts fuel breeding. They are designed to withstand the heat flux from the plasma.

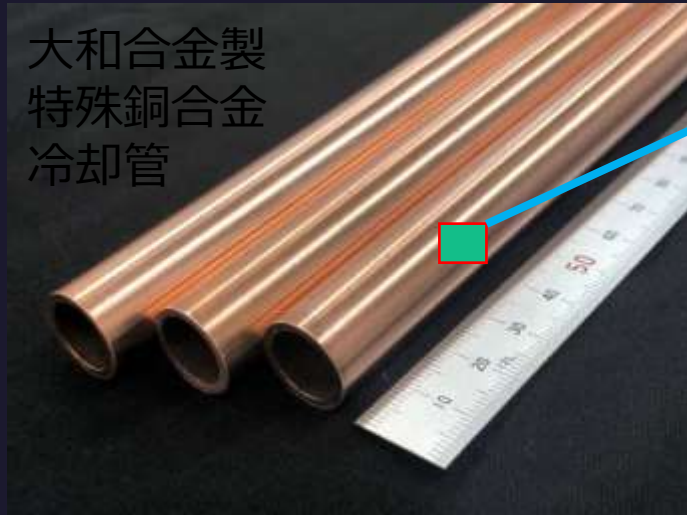


The divertor extracts heat and ash produced by the fusion reactor and minimizes plasma contamination.



Divertor

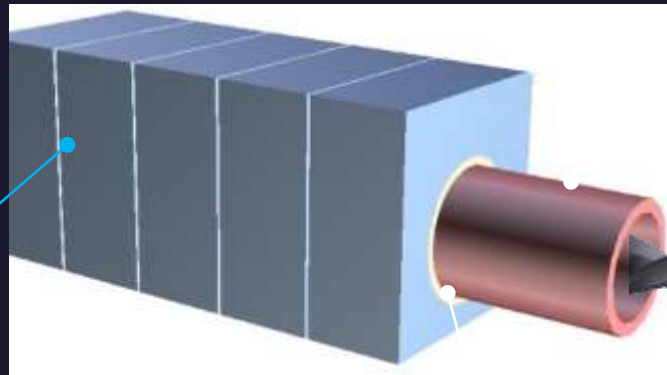
# Supply Chain of Divertor Materials/Components Procured by Japan



(Optical microscope  
x400 magnification)

Special copper alloy cold-drawn tube (made in Japan by Yamato Gokin)

Divertor assembly



Tungsten monoblock  
(Made in Japan)  
【A.L.M.T. Corp.】

Oxygen-free copper  
(made in Japan)

Swirl tape

Swirl tape (made in Japan  
by Kikuchi Seisakusho)

Japanese  
SMEs



# Our contributions to ITER Divertor's OVT

2006 Contacted by QST following an introduction from Mitsubishi Materials

2008 Initially unable to fulfill grain-size requirement set out by ITER; production process overhauled

2009年 After many trials, the current manufacturing method created as a base.

2014年 After several years of adjustments to the conditions of manufacturing, the manufacturing process was fixed.

2016年 The test divertor using our special copper alloy cold-drawn tubes was the first in the world to pass qualification trials.

2016年 Our patent describing our method of producing special copper alloy cold-drawn tubes was approved in Japan.

2019年 Our patent was approved in U.S., Russia, South Korea, China, and the EU.

2021年 Began mass production of special copper alloy cold-drawn tubes and aluminum bronze rods for ITER Divertor Outer Vertical Target (roughly 1800 tubes and 1000 rods)



Using years of experience and learning from many mistakes, we developed alloys that could meet the various needs of our customers, not only in the fusion energy sector, but also a wide range of other industries.

• Our core technology and skills:

- ① ability to control grain size
- ② ensure superior mechanical properties



# Our Contributions to ITER Divertor's IVT







**ANSALDO**  
(Genoa, Italy)

**ATMOSTAT**  
(Villejuif, France)

**CNIM**  
(Toulon, France)

**RI**  
(Cologne, Germany)

CuCrZr-IG Tube Procurement	Procurement by each participating country (European organization, F4E, is not a direct buyer.)			
Tube Manufacturer	German 'K'			
Method of joining	HRP	HIP	Brazing	Brazing
Start of Tube Procurement Period	Under review		Mid-2022	
Procurement Amount	Approx. 1.000 tubes (calculated at 2,000 mm: 58 cuts, 16 tubes/PFU)			
Swirl Tape	Under review		Under review	
				

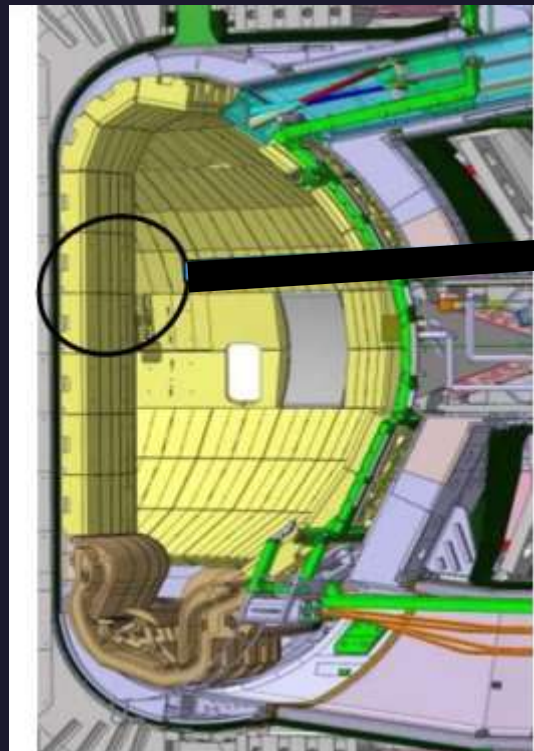


# ITER First Wall Panel

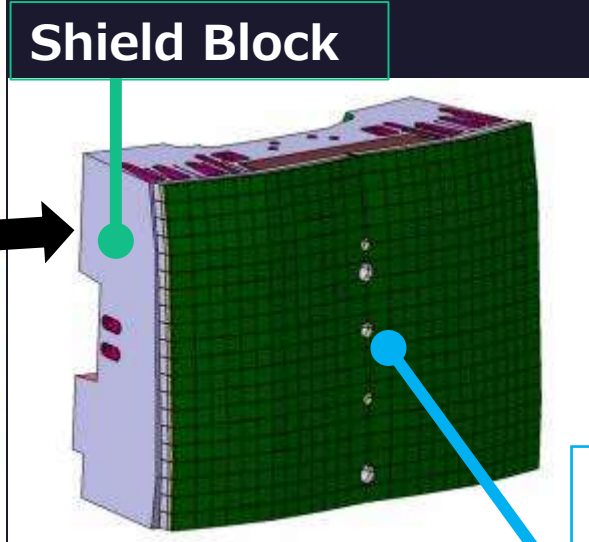
2019: We applied our core technology to the development of special copper alloy plates for the Blanket First Wall.

2020: Qualified as a material supplier for European DA (ITER)

2021: Started supplying First Wall Panels (FWP) !!



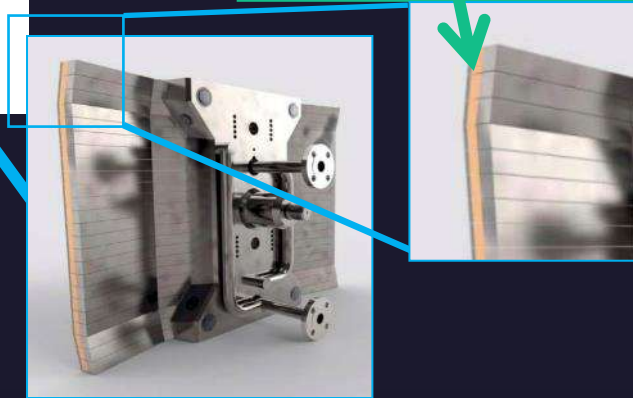
440 Shield Blanket Modules



Shield Blanket Module

460 tons of special copper alloy are needed for the Blanket, roughly half (48%) supplied by Europe/F4E.

Special copper alloy plate







Thank you  
for listening.