



Heat Resistant
STEEL CASTING
M2528

General Information

Initial Situation



Key cost driver for traditional heat resistant steel castings is the high nickel content for the commonly used alloys (focus on Turbine Housings and Exhaust Manifolds for internal combustion engines). Nickel is in general relatively expensive and very volatile.

Target



Development of alternative heat resistant steel with lower raw material cost but without further disadvantages or restrictions to replace existing alloys used on the market.

Outcome – M2528



MEITA developed over recent years and finally patented a low nickel (7%) heat resistant steel with high mechanical properties, high rigidity, high thermal conductivity and low density compared to traditional heat resistant steels used for turbine housing and exhaust manifold parts. High temperature oxidation is also showing good performances.

Product Examples Produced in Serial Conditions



A

Customer: TIER1
OEM: German (Premium)
Cast-Weight Original: 4,63kg
Cast-Weight M2528: 4,55kg

Finishing operations are similar to usual steels, but the resulting surface finish is slightly better.

Customer: TIER1
OEM: German (Premium)
Cast-Weight Original: 5,02kg
Cast-Weight M2528: 4,85kg



B

Casting Feasibility



M2528 material demonstrated a good flowability and a global shrinkage ratio similar to traditional heat resistant steels. The gating system needs to be adjusted compared to other austenitic steels, utilizing conventional casting processes.

M2528 reduces cost, weight & will improve durability for an equal design!

Technical Material Details

Chemistry

Nominal contents are showed below in weight percentages:

C	Si	Cr	P	S	Ni	Mn	N
0,40	1,20	25,00	0,025	0,010	7,00	3,50	0,25

Up to 0,60 % of niobium might be added to the composition for applications requesting strong resistance to creep.

Mechanical Properties

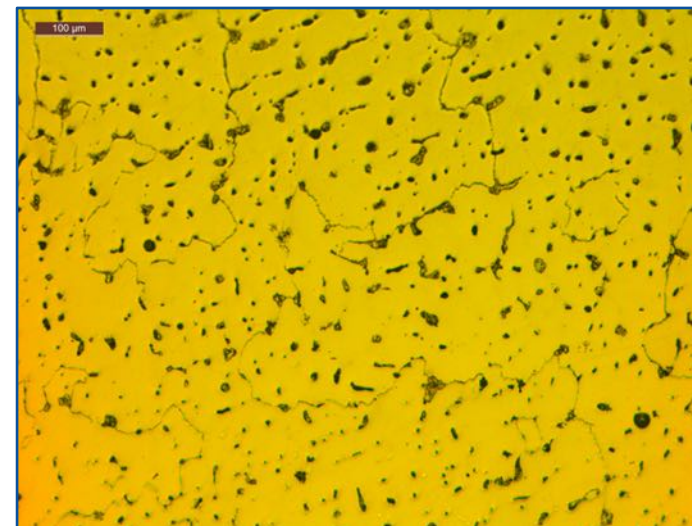
The following mechanical properties at room temperature are typically measured on M2528 cast parts:

Tensile Strength	0,2% Proof Stress	Elongation	Hardness
≥ 700 MPa	≥ 430 MPa	≥ 12 %	160~280 HB

No heat treatment is required to ensure proper microstructure or mechanical characteristics.

Microstructure

This is a fully austenitic steel with complex carbides:



Specification

Designation according to European Standard would be: GX40CrNiMnSiN24-7-4

The new M2528 material from MEITA is covered internally with the standard NW-MS-019 and owns HRSA 700-12 designation.

Test Results

Material Properties

M2528 was carefully designed in order to ensure a stable microstructure across the full range of temperatures. Its composition was optimized to maximize the key properties of such a material used in components containing high temperature exhaust gases.

The full set of properties was determined on standardized specimen for mechanical properties, physical and thermal characteristics. Low cycle fatigue, creep and oxidation tests have also been conducted to compare M2528 with current known materials.

Current status (Engine Tests)



Tests are also on-going on German OEM engine to assess the behaviour of M2528.

Until now, all the test results permit to draw the conclusion that M2528 is performing at least equivalent to the actual materials in use.

M2528 performs equivalent or better than 1.4849 steel!

Components tests (Gas Stand)



Several tests have been conducted with M2528 turbine housings in partnership with Tier1 customers on gas stand. Thermal shocks durability tests at 1050°C allowed the comparison of M2528 with 1.4848 or 1.4849 heat resistant steels. Results proved that M2528 material demonstrated a very good resistance in severe test conditions.

Turbine housing section after 1650 cycles of thermal shocks between 200°C & 1050°C . M2528 damages are significantly less severe than traditional heat resistant steels.



1.4848



1.4849



M2528

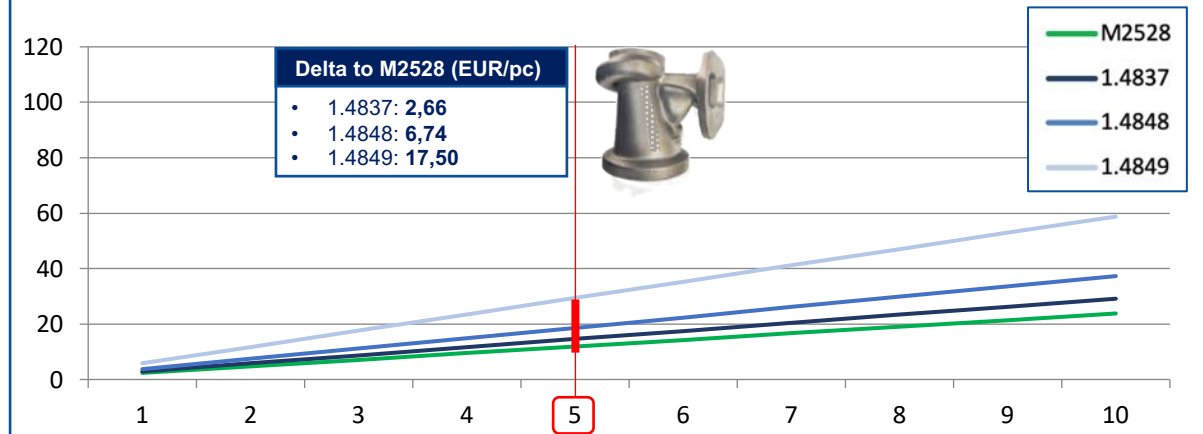
Commercial Evaluation

Boundary Conditions

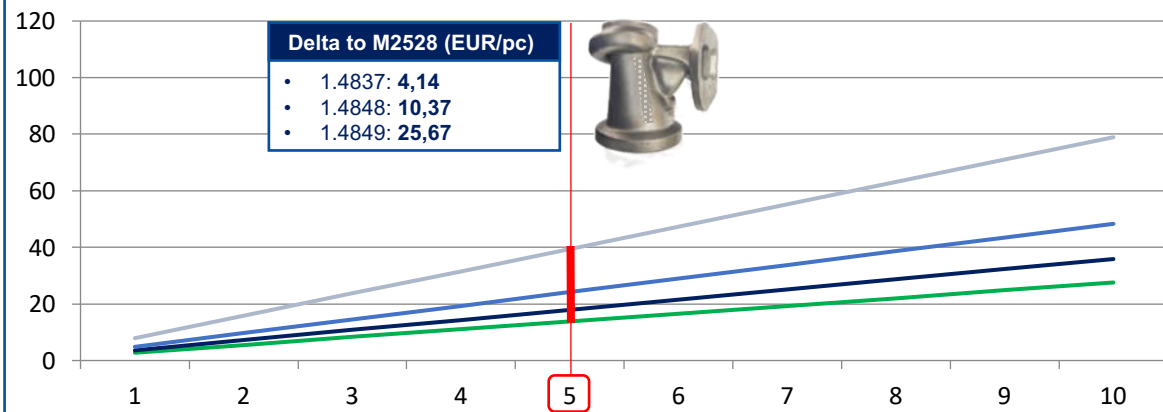
As an example, part A with original cast weight to be used:

- Casting Weight: 5,00 kg
- Steel Scrap: 0,52 EUR/kg (ca. Q2/2021 value)
- Chromium: 1,90 EUR/kg (60% pure – ca. Q2/2021 value)
- Niobium: 25,00 EUR/kg (65% pure – ca. Q2/2021 value)
- X-Axis: Casting Weight (kg)
- Y-Axis: Material Cost (EUR/pc)
- Machining process cost tends to be slightly higher than for std. alloys

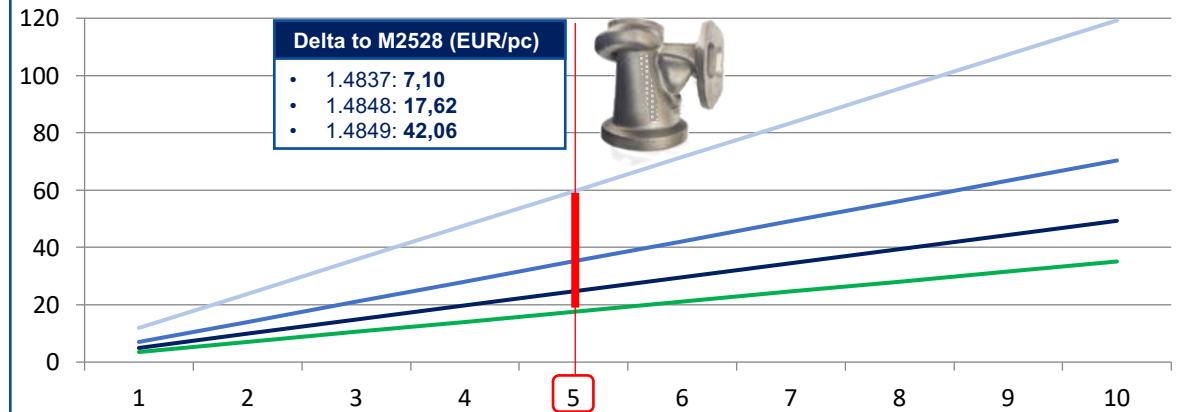
Nickel Rate 10,00 EUR/kg



Nickel Rate 15,00 EUR/kg (e.g. Q2/2021 Value)



Nickel Rate 25,00 EUR/kg



Commercial Simulation (retrospective)

Boundary Conditions

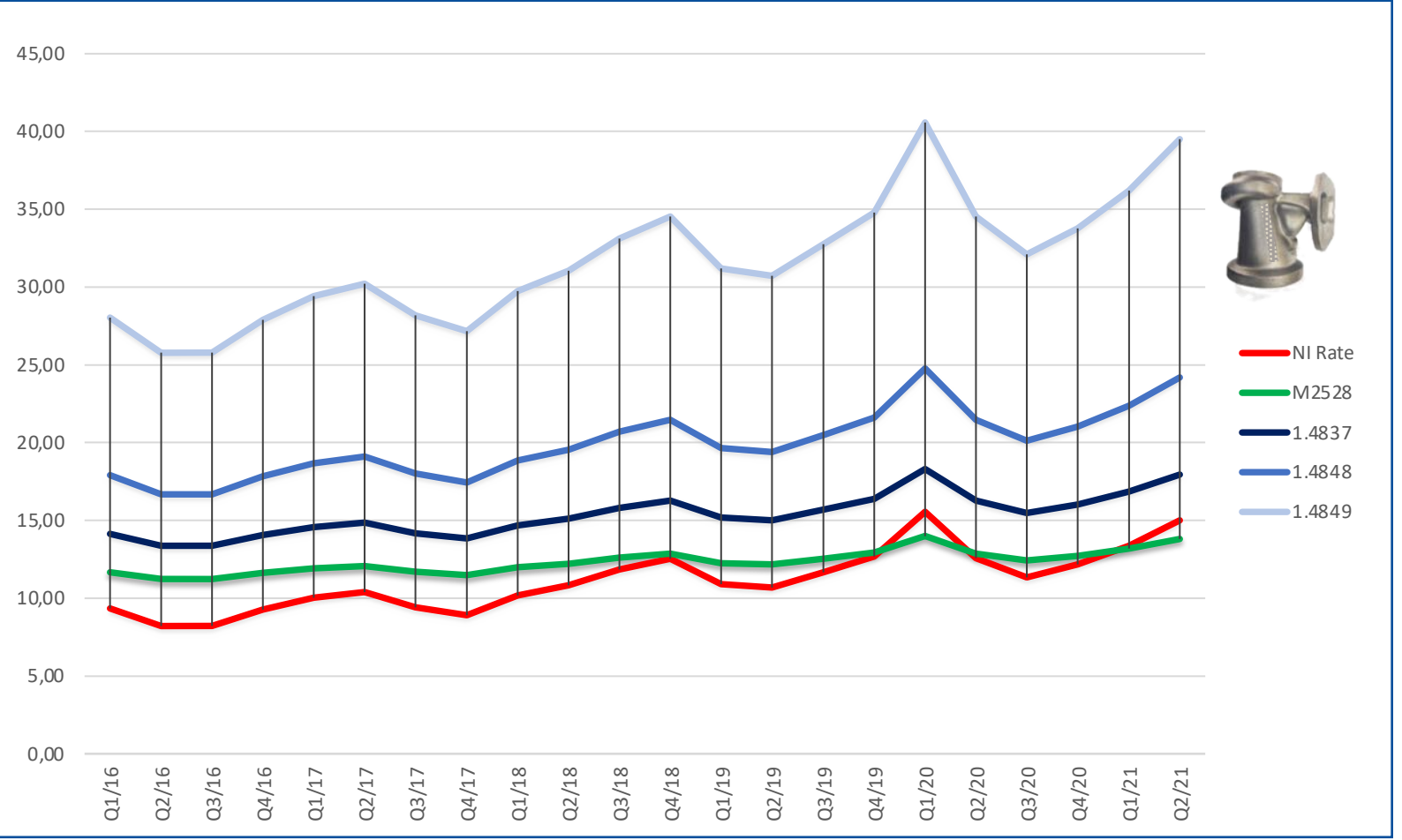
- Casting Weight: 5,00kg
- Steel Scrap, Chromium, Niobium see on slide number 5
- Nickel data from Q1/2016 – Q2/2021
- X-Axis: Quarter & Year
- Y-Axis: Raw Material Cost (EUR/pc) for the alloys & Nickel Price (EUR/kg)

Observations

- Nickel is very volatile in a range between 8~15 EUR/kg since 2016
- M2528 is less impacted by Ni Volatility due lower content. For 1.4849 raw-material cost vary up to 100%
- Considering volume of 25k units per quarter since Q1/2016, the potential saving for using M2528 would be:









- **1.650.000 EUR (vs. 1.4837)**
- **4.160.000 EUR (vs. 1.4848)**
- **10.640.000 EUR (vs. 1.4849)**

Raw Material Price Simulation with Historical Data



Conclusions

Why decide for M2528 material?

Cost Saving		Tested & Validated		Final Statement			
		<p>M2528 represents a new breed of heat resistant steel material with outstanding properties but much lower cost than the actual used standard alloys. Besides the immediate cost saving effect, M2528 mitigates as well the risk of future significant changes in raw material cost due to the low content of Nickel whose price is very volatile.</p> <p>M2528 has been tested and validated by several OEM and automotive Tier1 customers. The results were each time excellent and showed a high durability, great mechanical properties and rigidity as well as great oxidation results at high temperature. In most of the tests M2528 was outplaying all standard alloys and brought furthermore a slight weight saving due to its lower density.</p> <p>M2528 can help improving standardization on OEM and Tier1 side by combining in one design and material multiple performance classes of housings and components previously cast in different materials in relation to the engine performance and requirements.</p>					
Weight Reduction						Design Equality	
							
Price Stability						Oxidation resistance	
							
Durability		High Performance					
							

Re-think Materials, Start using M2528, Gain Competitive Advantage!

Business Philosophy / 經營理念

Customer is top priority
客戶至上

Honesty comes first
誠信第一

Care for each other
相互關懷

Learn actively
積極學習

Quality Philosophy / 品質政策

Excellent quality
質量第一

On-time-delivery
交期準確

Reasonable price
價格合理

Thoughtful service
服務周到

Thank You

MEI TA INDUSTRIAL CO., LTD.
No. 31 Hsiang Pang Road, Kuei Shan Hsiang, Taoyuan Hsien, Taiwan 33370
Republic of China

TIANJIN NEW WEI SAN INDUSTRIAL CO., LTD.
DA SHIANG PRECISION INDUSTRIAL CO., LTD.
No.2 Jin Fa Road, Shangmatai Industrial Area , Wu Chin District, Tianjin, P.R. China
TEL: +86-22-82289920 ; Fax: +86-22-82289731
Website: www.nws.cn

MTE MEI TA EUROPE INDUSTRIES d.o.o.
Železnička 44v, 11504 Barič, Obrenovac, Serbia
TEL: + 381 11 715 9000
Website: www.meitaeu.com

GREENTECH INDUSTRIES PVT. LTD.
APIIC Multi Product SEZ, Dwarakapuram Village, Naidupet Mandal,
SPSR Nellore District, Andhra Pradesh-524421, India.
TEL: + +91 8623 276000
Website: http://gti-india.com