



TGK SPECIAL STEEL

INTRODUCTION

About Us

- TGK Special Steel is a Joint Venture Partnership between Kushal Metal & Steel Industries & Tiangong International Company Limited.
- Foundation Stone laid in 2012
- We deal in tool steel, cutting tools & titanium
- Our Sole aim to is to serve to serve the tool room with quality tool steel at reasonable price.
- We are committed to provide quality tool steel with timely delivery & quality service



Our Promise

Mission

- Our main aim is to provide quality tool steel for manufacturing units/tool rooms across India
- Provide service & material to take our clients into a non inventory module
- Being the first choice for our customers

Vision

- Innovate and provide Best Steel Grades from reputed manufacturers around world
- Open up branches across India
- Contribute to India's Growth
- Provide value added services – material machining, cut pieces & tailor made material

History Timeline – Slide Template

1967

1984

1988

2011

2012

2015

2016

18/19

2020

TIANGONG INTERNATIONAL LIMITED

Established in Danyang, Jiangsu China

TGK SPECIAL STEEL

With a JV Signed Between Mr. Kushal Doshi & Mr Zhuxiakun TGK Special Steel was formed

AHMEDABAD

3000 Sq feet warehouse in Ahmedabad

2018/2019

Turnover of Rs 102 Crores
New 2700 office in South Mumbai

DINESH HARDWARE MART

Diinesh Hardware Mart was founded by Mr Avantilal Doshi.

KUSHAL METAL & STEEL INDUSTRIES

Founded by Mr Nitin Doshi to do retail and bulk sales of tool steel

TURNOVER

First Year Turnover Rs 2 Crores
12000 sq ft ware house specially for TGK

NEW PRODUCTS

HSS Cutting Tools & Band saw cutting blades

NEW BRANCH

Bangalore branch opening shortly

FOUNDERS



Mr. Zhu Xiaokun



Mr. Nitin Doshi



Mr. Kushal Doshi

Our Locations In India



Mumbai

- Head Office 2200 sq ft at Majestic Shopping center at Opera House(South Mumbai)
- 2 Warehouses of 24000 sqft in Bhiwandi
- 1 ware house of 6000 sq ft in Darukhana with 2000 sqft office



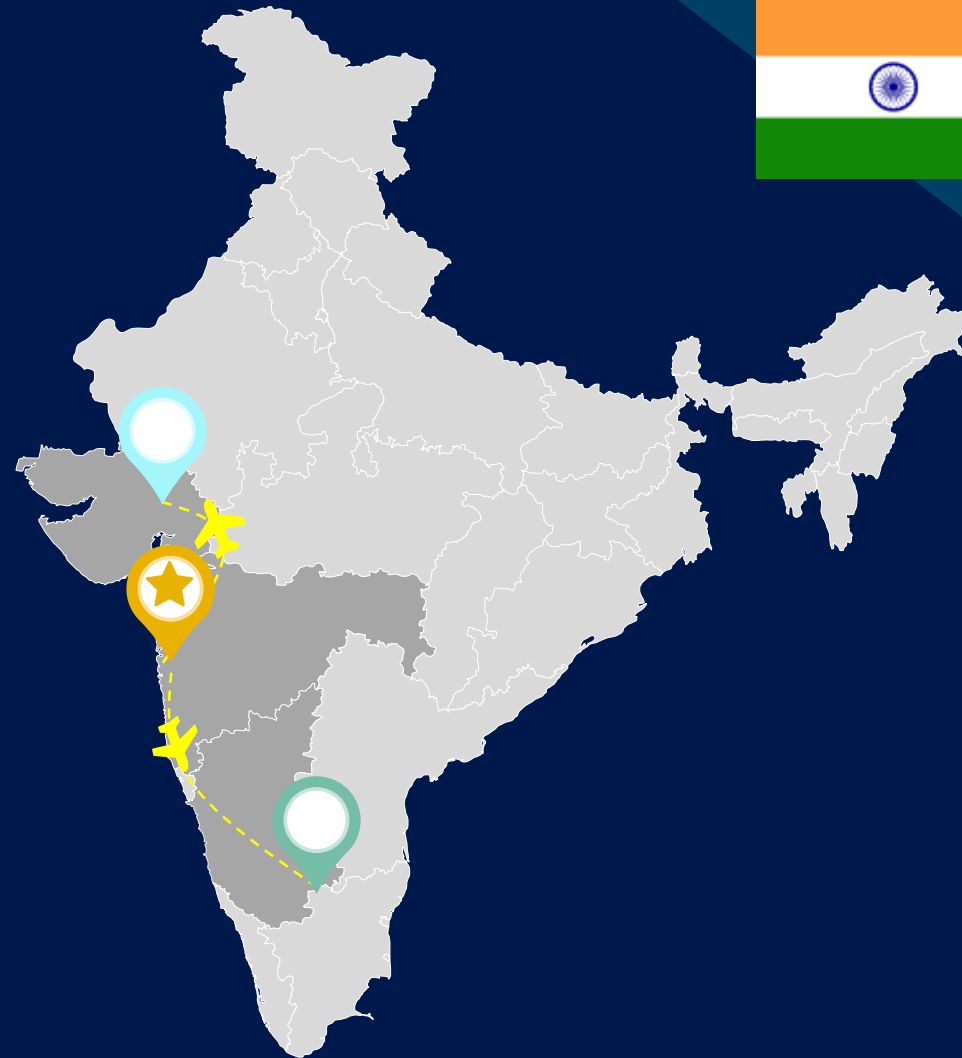
Ahmedabad

- 3000 sqft ware house
- 3 band saw machines



Bangalore

Branch opening in 2020



HEAD OFFICE



South Mumbai
2,200 sqft office
26 Employees

TGK SPECIAL STEEL (DARUKHANA)



Darukhana

6000 sqft warehouse
2000 sqft office Area
3 Rail Crane Lifts
2 Band saw Machine

TGK SPECIAL STEEL



Bhiwandi

12,000 sqft warehouse
1000 sqft office area
3 rail crane lifts
2 band saw machine

AHMEDABAD



Ahmedabad

3000 sqft Warehouse

1000 sqft Office Area

2 rail crane lifts

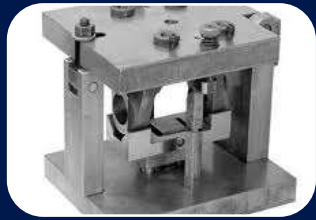
3 band saw machine



TGK Special Steel

Products

INDUSTRIES SERVED



Jigs & Fixtures



Aluminium Extrusions



Plastic Manufacturing



HSS Cutting Tools



Die Casting



Punches



Tablets/Pharma



Press Tools



Fasteners



Hobbs & Broaches



Ejector Core Pins



Thread Rolling



Industrial Knives & Blade

PRODUCTS WE DEAL IN

High Speed Steel

- M-2
- TGM-2A
- TGM-2B
- M-35
- M-35A
- M42
- 4241
- 4341
- Powder metallurgy grades

Hot Work Steel

- H-11 & H11M
- 1.2367
- H-13 & H13M
- TGE-13
- TGGP-13
- TGE-23
- 1.2714
- Powder metallurgy grades

Cold Work Steel

- D-2
- D-3
- DC-53
- S-7
- O1
- 1.2510
- Powder metallurgy grades

Plastic Mould

- 1.2738
- 1.2311
- 1.2316
- NAK 80
- 1.2767

Corrosion Resistant Steel

- 1.2083
- 1.2085
- 1.2316

Titanium Products

- Gr1
- Gr2
- Gr3
- Gr4
- Gr5
- Gr6
- Gr7
- Gr9
- Gr11
- Gr12
- Gr 23

Cutting Tools

- HSS Cutting Tools
- Carbide Cutting Tools

Above Grades available in the below shapes



Rods



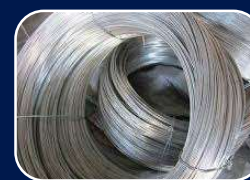
Blocks



Square



Sheets



Coils



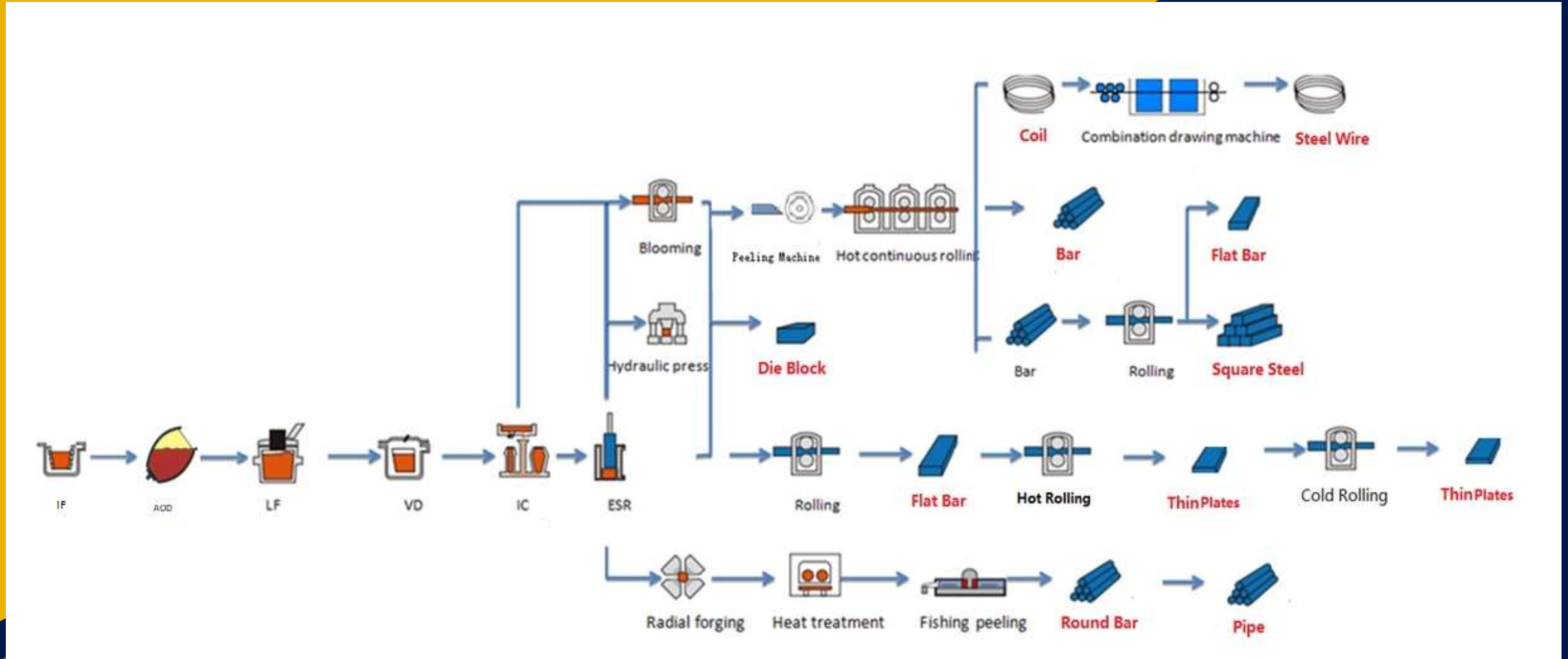
Flats

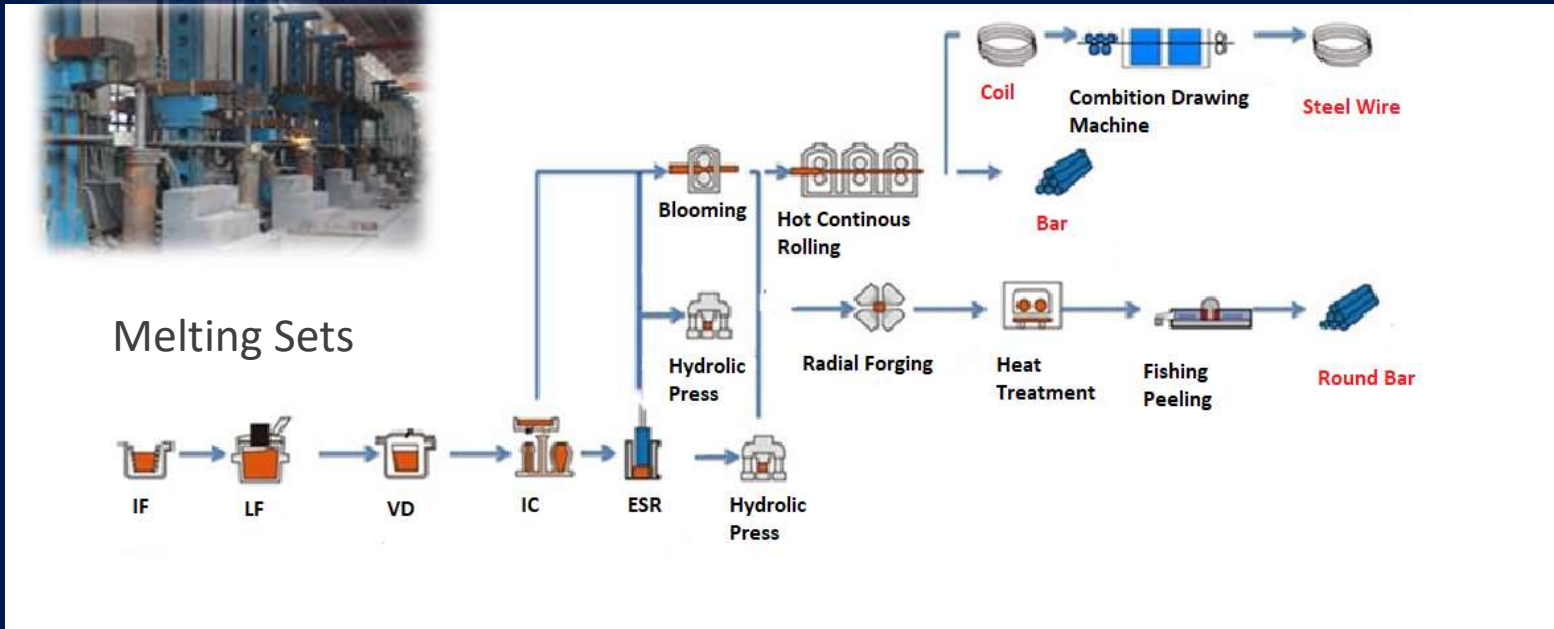
TGK TOOL STEEL PRODUCT LIST

Type	Size	Delivery condition
Coils	φ1.0-φ22mm	Cold Drawn
Rounds	φ1.0-φ14.4mm	Cold Drawn/Center less ground
Rounds Hot Rolled	φ14.5-φ80.0mm	Hot Rolled, Annealed, Peeled
Rounds-Forged Bars	φ81.0-φ810.0mm	Forged, Annealed, Turned
Small flat bar/square bar	(3-40)X(10-150)mm	Sand Blasted
Flat Bars-Hot Rolled	(12-120)X(150-810) mm	Sand Blasted
Sheets-Hot-rolled	(3-10)X(410-1000) mm	Black
Sheets-Cold-rolled	(0.5-5)X(410-1000)mm	Grey
Block	(100-550)X(200-1200)mm	Black/Machined

Process & Equipment Capabilities

Products include : hot-rolled coil, wire (QT), round bar, small flat bar(sliding vane), small square bar, block (QT), flat bar, hot-rolled sheet, cold-rolled sheet, big round bar, pipe





Continous rolling machine



750 Precision Forging Machine



Bar



Round Bars

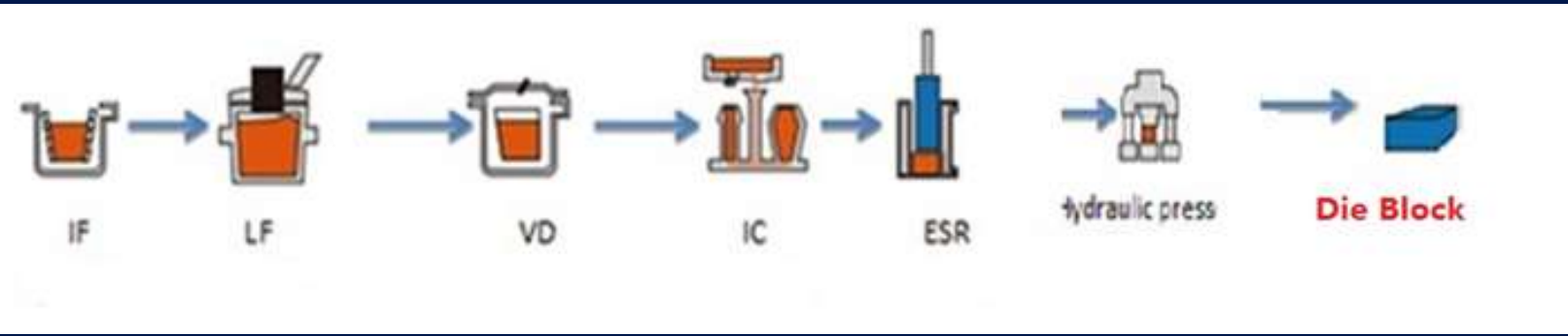


Wire



Induction Heating

Technological process and Equipment capability



4500T quick forging unit



15 ton medium frequency furnace

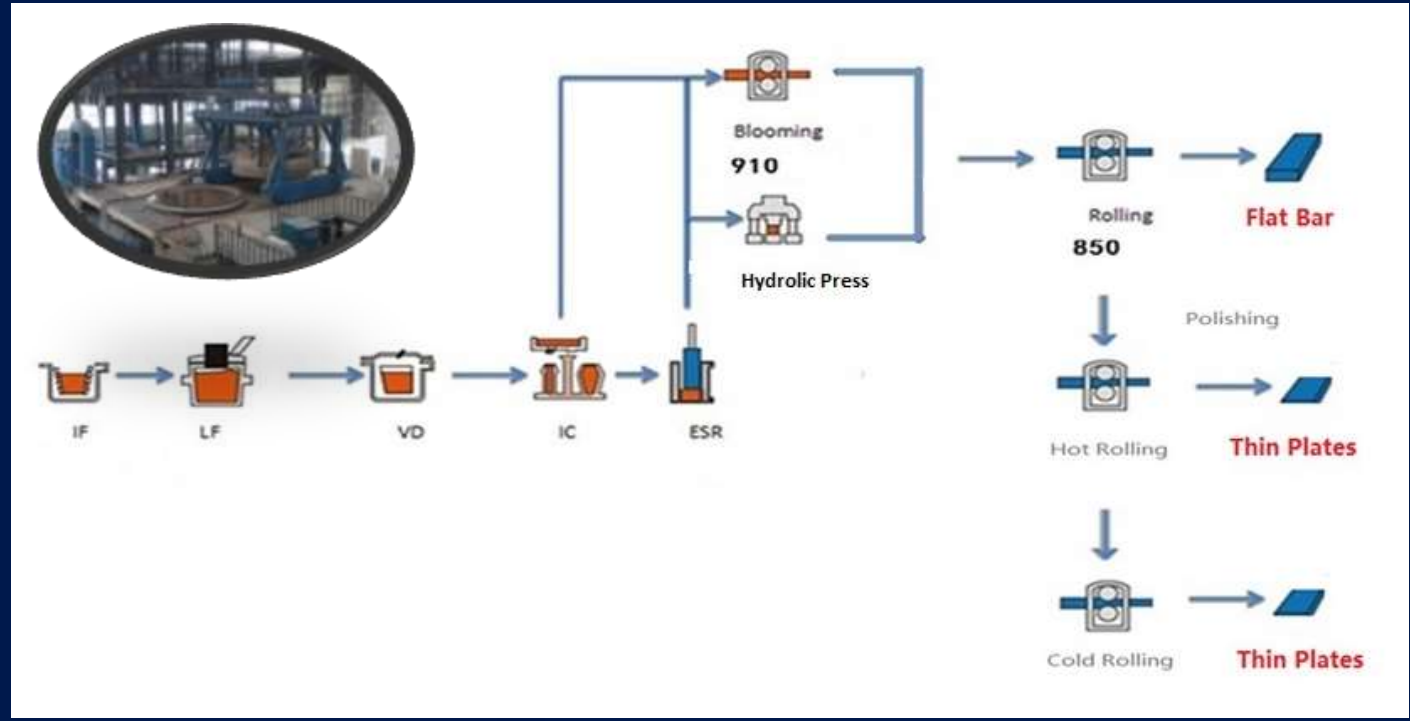


20 ton Electroslag ingot



Block

Manufacturing process of Flat Products



850 Rolling mill



Sheet



Hot Rolling Machine



910 Rolling mill



Block



Flat bar

Inspection equipment



Infrared carbon sulfur analyzer



Direct reading spectrometer



Zeiss metallographic microscope



Specific surface area testing equipment



EVO-MA25 Zeiss SEM



Impact energy testing machine



MTS universal material testing machine



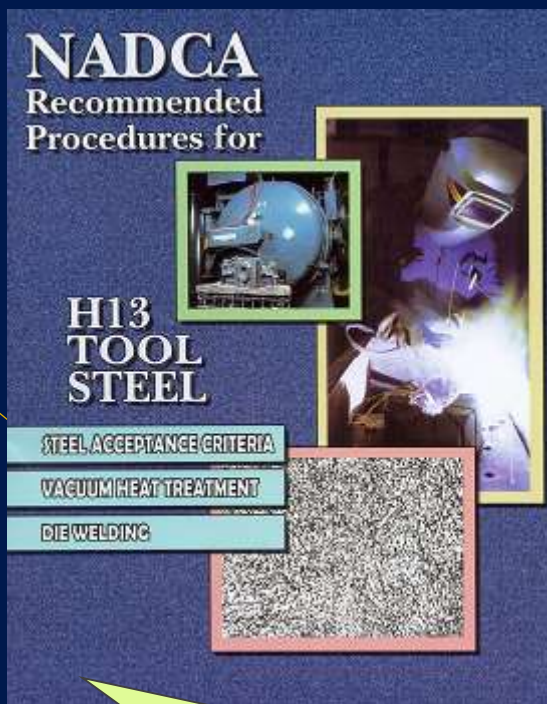
Digital Rockwell hardness tester



Panaco X-Ray Fluorescence analyser

Establish a complete set of quality assurance system

Standards



NADCA 207-2016 FOR HIGH PERFORMANCE H13



GB/T 1299-2014 FOR TOOL STEEL

NADCA 207#-2016
GB/T 1299-2014
GB/T 9943-2008
SEP1614
SEP1615
ISO 4957

FEATURED PRODUCTS

Comparison table of steel grades for supreme hot work tool steel

TG	STANDARD			SIMILAR GRADES		APPLICATION
	NADCA	AISI	DIN	UDDEHOLM	KIND&Co	
TGGP13				ORVAR SUPREME (8407)	USD	DIE-CASTING MOULD AND EXTRUSION MOULD
TGE23	2367 MOD			DIEVAR	RPU	
TGE21					TQ1	
TGE01					HP1	
TGE11	H11 MOD			VIDAR SUPEIOP	USN	PLASTIC MOULD
TGE13	H13 SUPERIOR	H13	1.2344		USD	

Featured Products

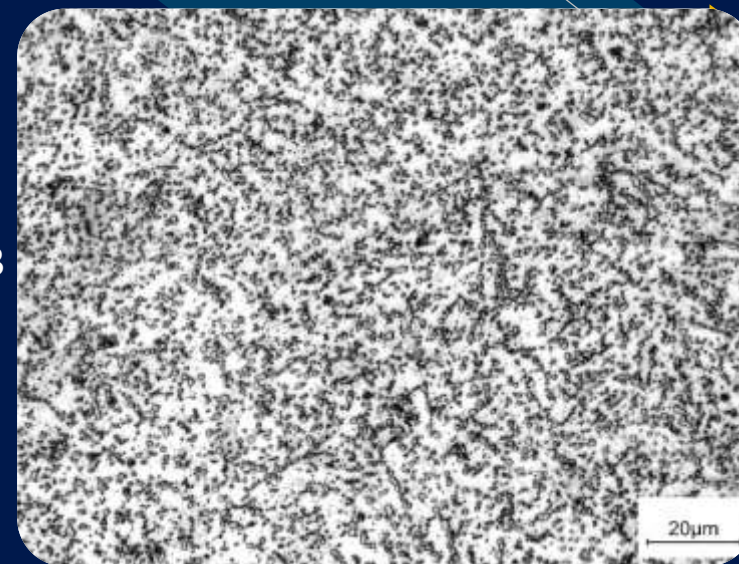
TGGP13 (Similar to 8407)

TGGP13, Cr-Mo-V tool steel, with advantage of:

- High heat resistance and thermal fatigue
- Excellent high temperature strength
- Good ductility for all directions
- Excellent dimensional stability after heat treatment

Composition %	C	P	S	Cr	Mo	V	Others
	0.39	≤0.010	≤0.001	5.00	1.45	0.95	
Melting Process	EAF+LF+VD+ESR under protective atmosphere						
Production Process	Ingot→Diffusion Annealing→Longitudinal Forging→ultra-fine annealing→Spheroidizing Annealing						
Application	Parts						
Die-casting Mould	Insert, Core、 Bush						
Extrusion Mould	Core, Holder、 Gasket etc.						
Others	Wear-resisting Parts						

GA3

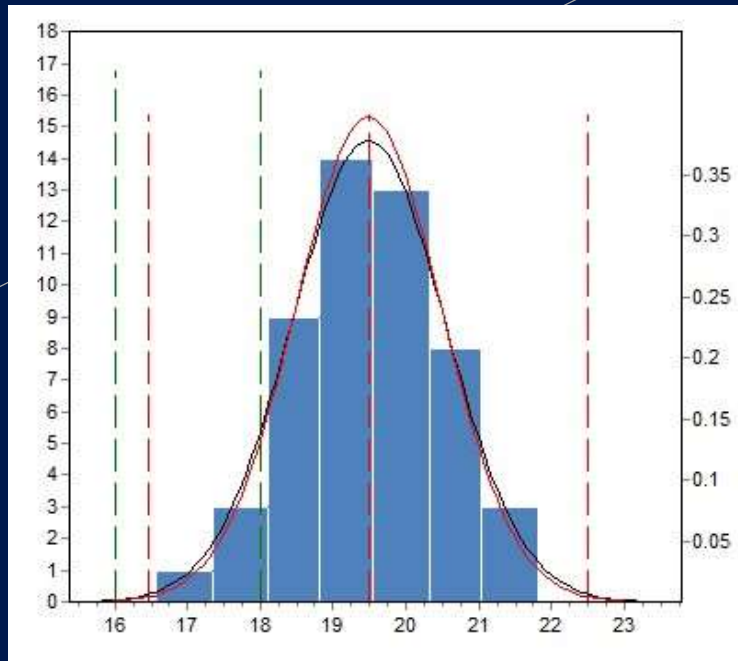


TGGP13-340mm*910mm

SA2

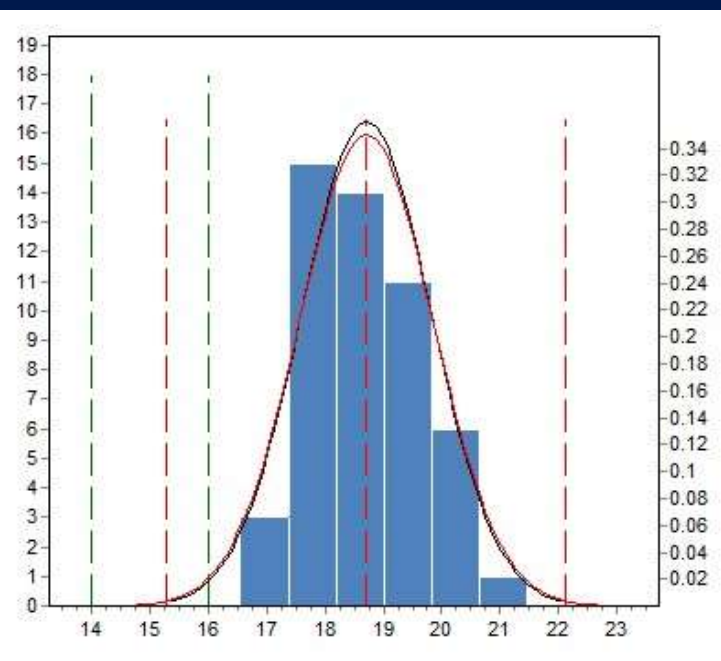


Featured Products



Specimen	51	Cpk	1.67
Aiming J	>18	Avg. J	19.484
Max J	21.8	Min J	16.6
Size Range	(110-250) * (600-910)		

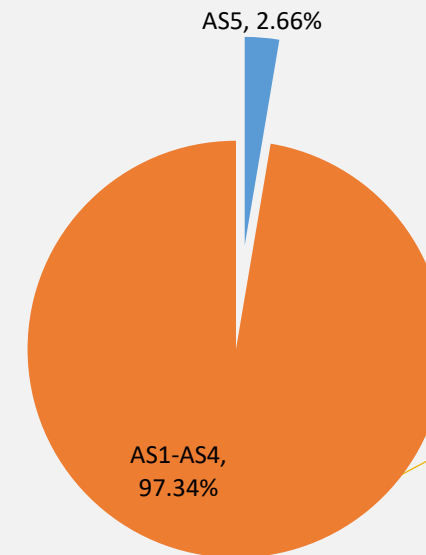
**Thickness of block :
110~250mm**



Specimen	51	Cpk	1.41
Aiming J	>16	Avg. J	18.707
Max J	22.26	Min J	16.56
Size Range	(251-400) * (600-910)		

**Thickness of block:
251~400mm**

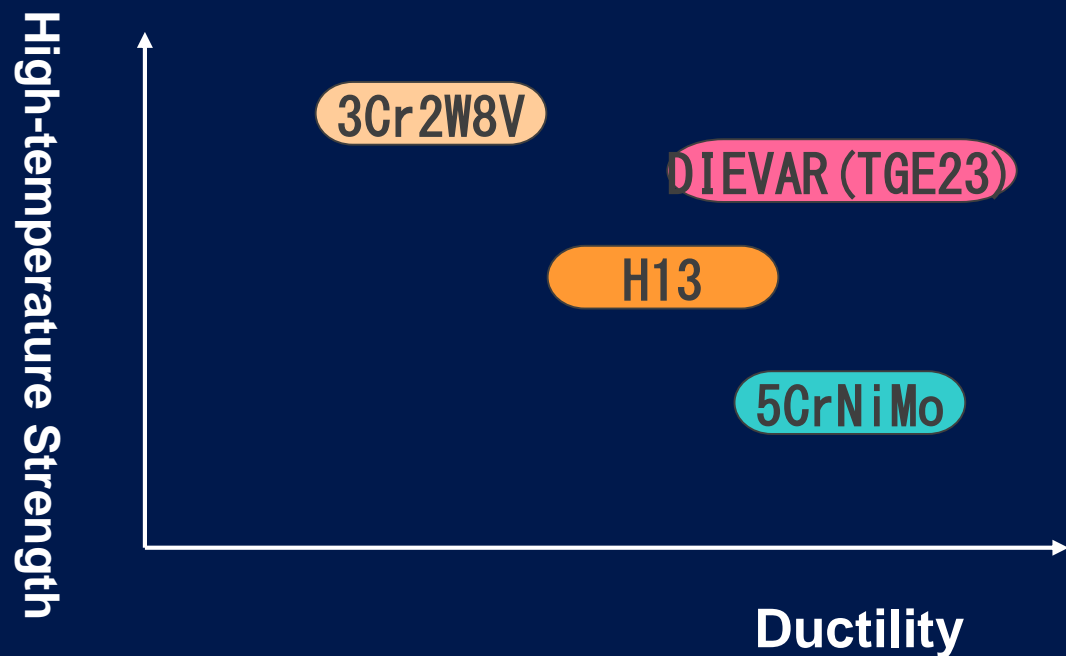
□ TGGP13 Transverse Microstructure



AS1-AS4,
97.34%

AS5, 2.66%

Upgraded Products for Die-casting Mould



DIEVAR----- (Mo↑ V ↓)
Compared with H13

Mo₂C
Massive Carbide



Thermal Stability

Impact Toughness

TGE23(similar to DIEVAR)

TGE23 chemical composition :

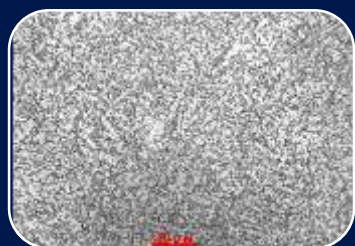
Grade	C	Si	Mn	P	S	Cr	Mo	V
TGE-23	0.36%	0.30%	0.45%	≤0.012%	≤0.001%	5.00%	2.30%	0.50%



TGE 23 Annealed Structure



TGE 23 Segregation



Foreign Annealed Structure



Foreign Segregation

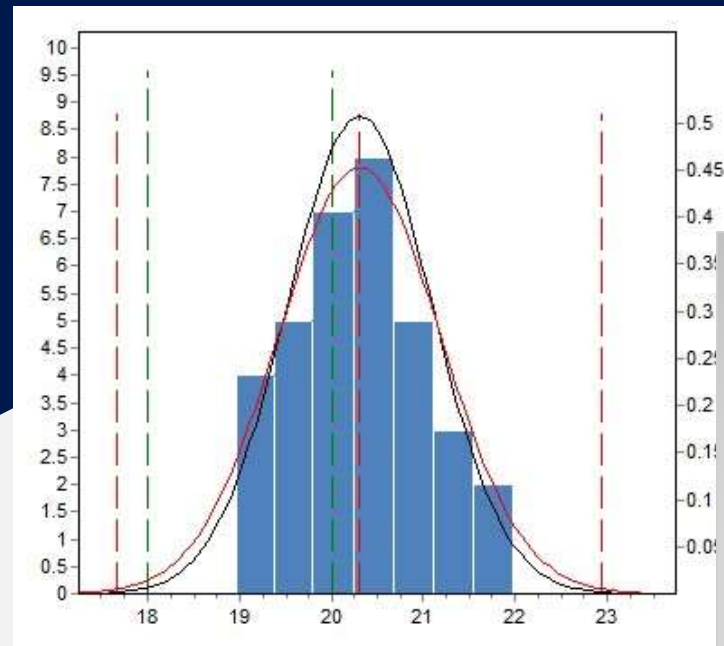
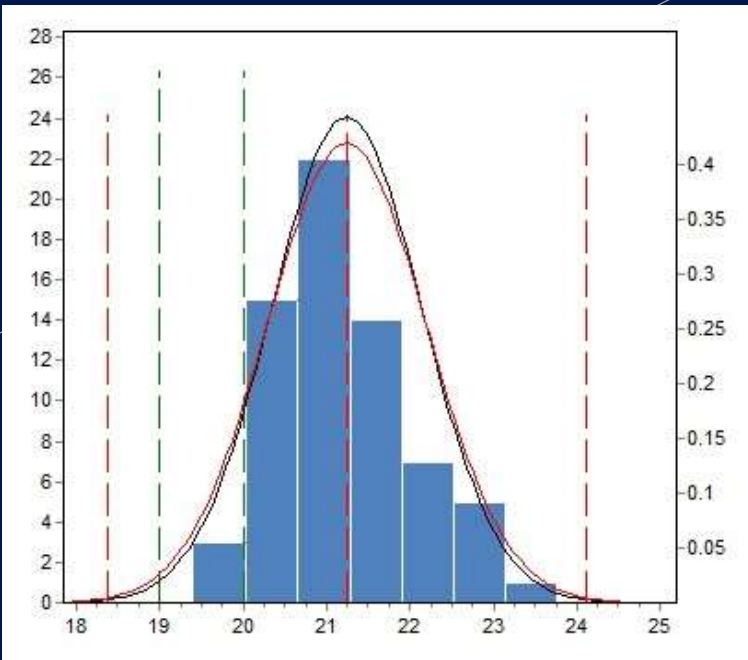
Ultrasonic testing: acc. to GB/T4612 class A, Flat-bottomed hole ≤ Φ2mm,)

Size : 300*810mm

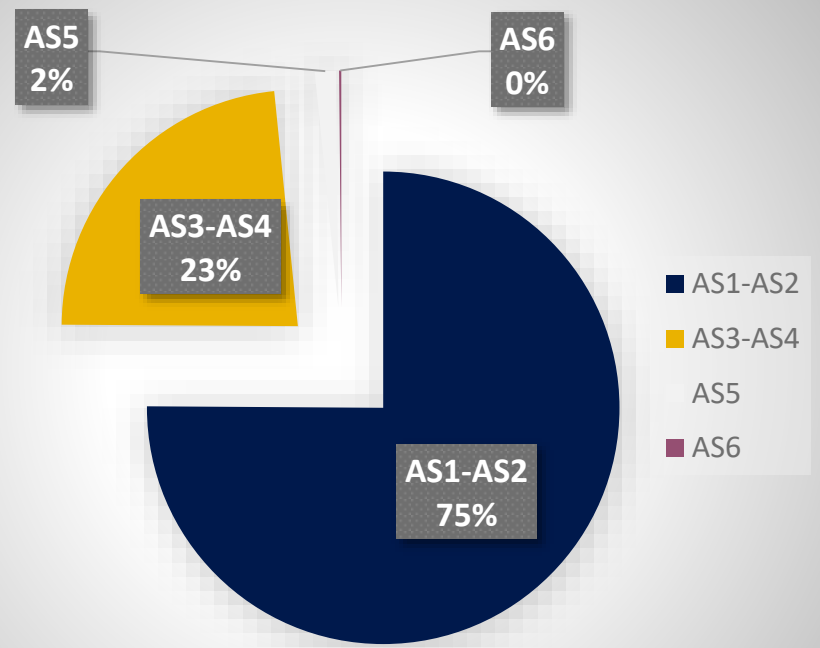
Delivery Hardness ≤ 229HB

Macrostructure: center porosity & segregation ≤ 2

TGE23 Impact Akv



□ TGE23 Transverse microstructure



Samples	68	CPK	1.69
Target J	>20	AVG J	21.241
Max. e J	23.77	Min. J	19.42
Size	(110-300)* (600-910)		

Samples	35	CPK	1.43
Target J	>20	AVG J	20.308
Max. e J	21.97	Min. J	18.96
Size	(301-400) * (600-910)		

High Polish Plastic Mould Steel

Grade	C	Si	Mn	P	S	Cr	Mo	V	N	H	O
TGE11	0.38%	1.05%	0.43%	0.015%	0.001%	5.1%	1.25%	0.45%	200ppm	1.3ppm	20ppm
TGE01	0.37%	0.50%	0.30%	0.015%	0.001%	5.1%	1.35%	0.42%	200ppm	1.3ppm	20ppm



Electric Furnace
Melting



Furnace
Refining



LF Ladle
Refining



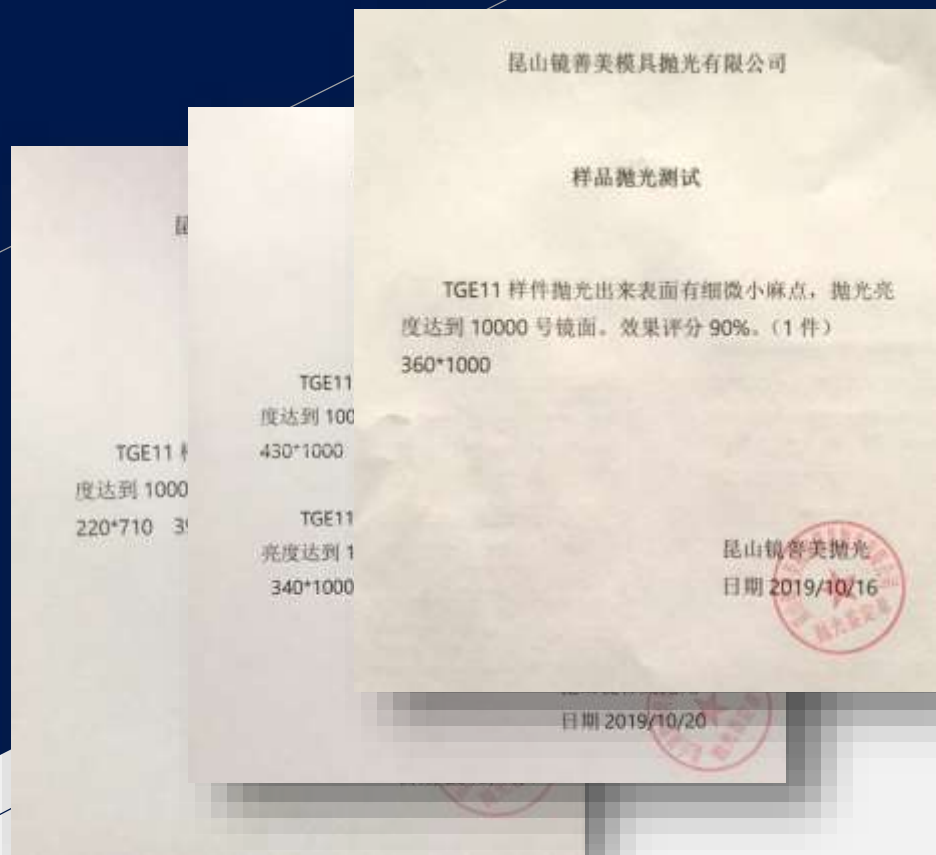
VD Vacuum
Degassing



IC protection
pouring



High polish Plastic mold steel



Product polishing test results



Automotive air conditioning tissue mold
 Grade: TGE11
 working life: 80—100 thousand times



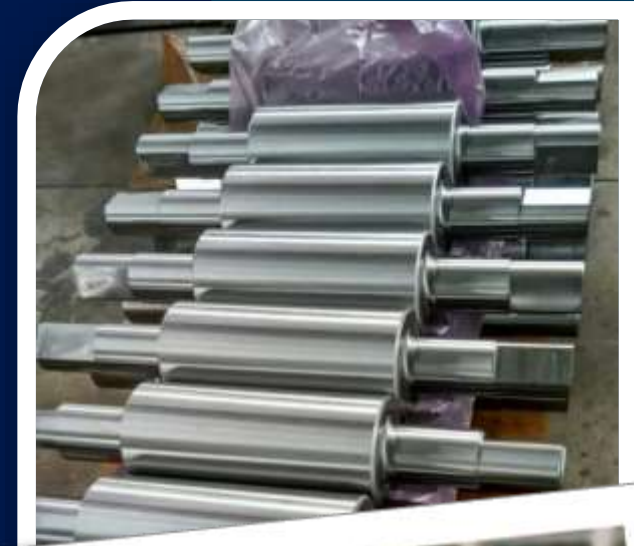
Dashboard mold
 Grade: TGE11
 working life: 80—100 thousand times

Roller steel

Featured Grade : D2.D2Co,
5H12,etc.

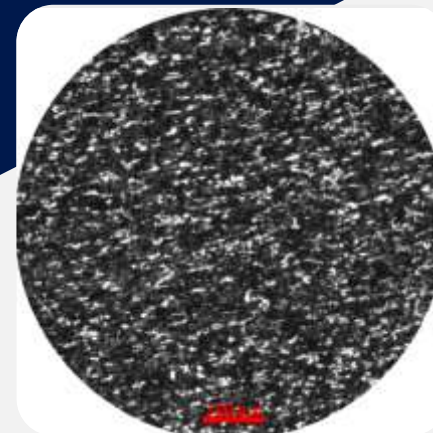
Quality point :

- acc. to GB/T13314 class A, Work surface is not allowed to have grass wave defects
- O、N、H strict control
- fixed length, configure reasonable ingot type。

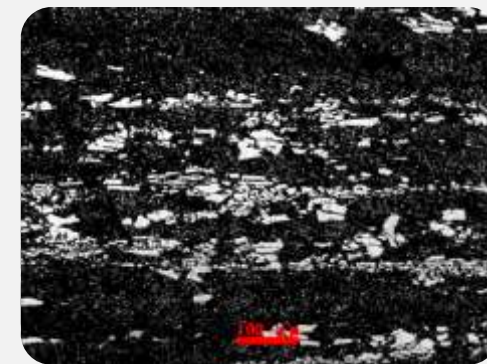


Roller Steel Cold Roll

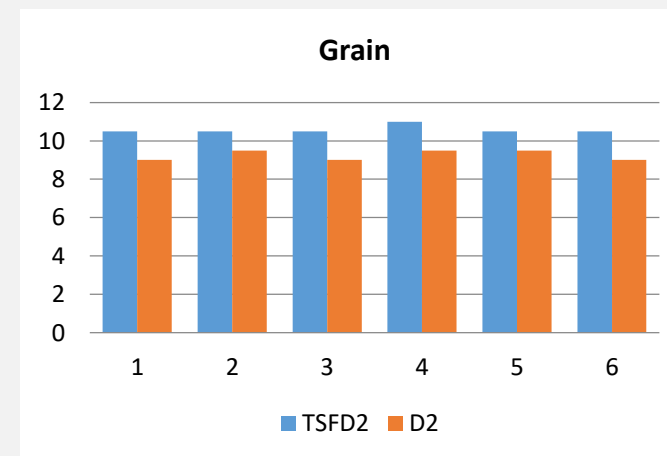
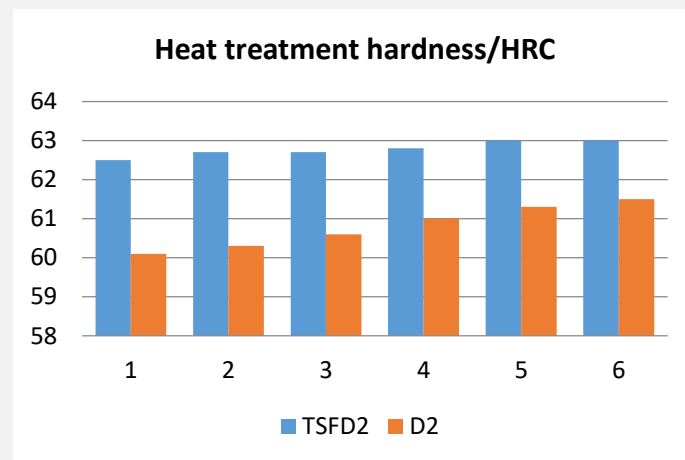
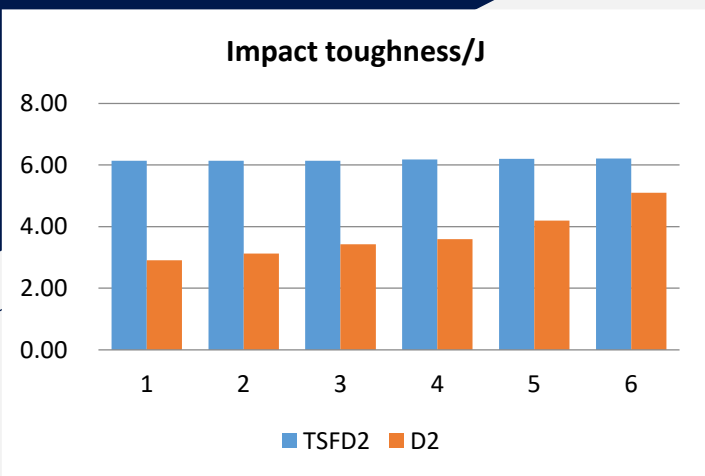
Brand	Specification	Smelting method	Eutectic carbide non-uniformity
TSFD2	Φ106mm	Injection molding	level 1-picture 1
D2	Φ120mm	Electroslag remelting	level 3-picture 2



Picture 1

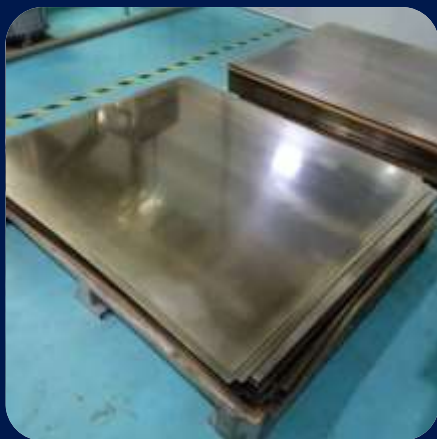


Picture 2



Precipitation hardening martensitic stainless steel

Brand	C	Si	Mn	P	S	Cr	Ni	Cu	Nb+Ta	N
17-4PH (0Cr17Ni4Cu4 Nb)	0.06%	0.35%	0.30%	≤0.022%	≤0.005%	16.00%	4.80%	3.40%	0.18%	0.016%



Sample

Quality point :

- Characteristics: After heat treatment, it can reach the compressive strength (20 ° C ~ 300 ° C) up to 1100-1300 Mpa. It has good corrosion resistance to the atmosphere and diluted acid or salt. Its corrosion resistance is the same as that of 304 and 430.
- Uses: turbine blades, food industry, offshore platforms, helicopter decks, nuclear waste barrels, etc.



Microstructure (annealed state)

Cylindrical die \ Threading rolling die

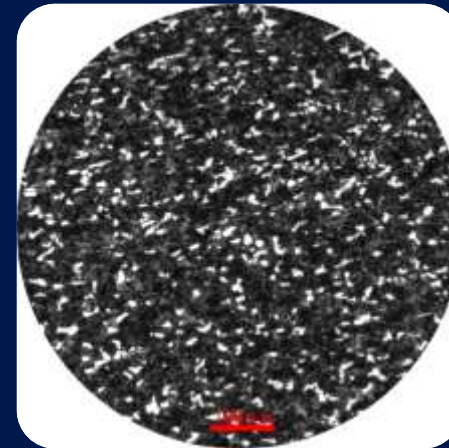
Featured Grade : Cr12MoV, DC53 & M2 etc.

Material characteristics :

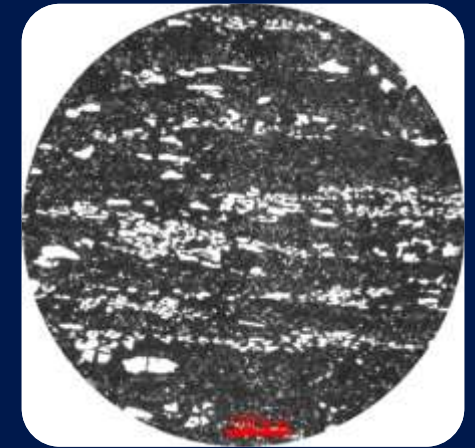
- Higher alloying element content, more carbides, higher matrix hardness
- High wear resistance
- High compressive strength and toughness
- Good hardenability and process ability
- The powder metallurgy steel corresponding to the same grade has a more uniform carbide distribution, a larger quantity and a smaller particle size. It is an ideal material for the rolling wheel and the rolling plate.



Physical product



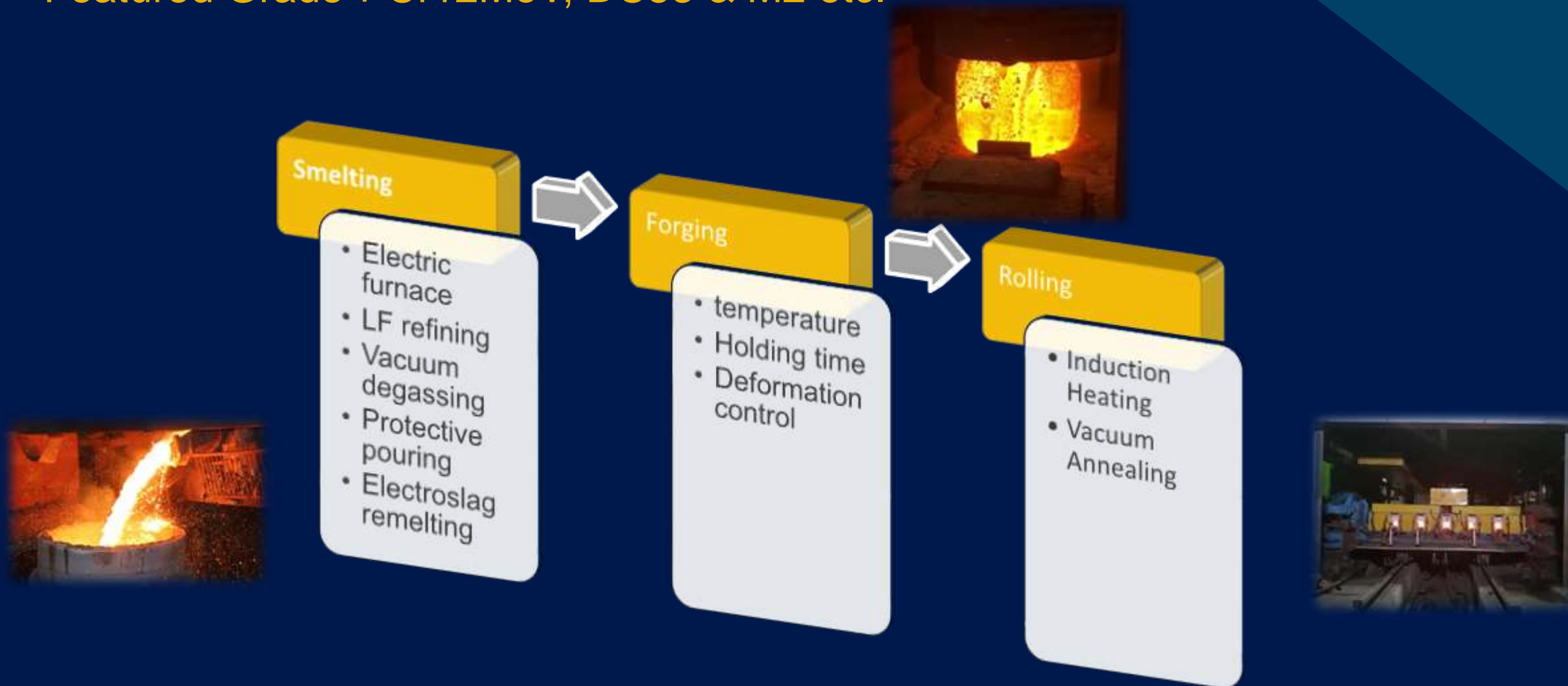
Spray Steel



Ordinary

Cylindrical die \ Threading rolling die

Featured Grade : Cr12MoV, DC53 & M2 etc.



HSS Grades

TG Grade	Tool bits	Drill Bits	End Mill	Wood working tools	Threaded Cutter	Hobs	Broaches	Saws	Slip Sheet	Punch	Glib	Barrel	Cylindrical Die rolls	Thread Rolling Die
6542		✓		✓					✓	✓	✓	✓		✓
TGM2B	✓	✓	✓			✓	✓		✓	✓				
TGM2A		✓			✓									
9341		✓		✓										
W18	✓													
4341		✓												
TG4241		✓												
4241		✓												
TGM42	✓	✓	✓			✓	✓							
M42	✓	✓	✓		✓	✓	✓	✓						
TGM35	✓	✓	✓		✓	✓	✓							
M35		✓		✓	✓					✓				
6542								✓						
TGM2AI		✓				✓	✓						✓	



TG International

Infrastructure & Products

TG Main Facilities



Melting

- 2 sets of 15T IF
- 2 sets of 20T LF
- 1 sets of 20T VD
- 3 sets of 30T EAF
- 2 sets of 30T LF
- 2 sets of 30T VD

Quick forging machine

- 1 set of 4500T
- 1 set of 2000T
- 2 sets of 1250T

GMF precision forging machine

- 1 set of 1300T
- 1 set of 750T
- 1 set of 500T

Rolling machine

- 1 set of 910 rolling
- 1 set of 850 rolling
- Others
- 650/400/350/300

TG Melting Process



3 Sets

30T EAF



2 Sets

30 T LF



2 Sets

30 T VD

ESR Process



We have in total more than 80 sets with style from 300kg to 20 tons

Forging Process



The productivity of HSS/TSS and Titanium materials is about 60,000T in one year.

Hot Rolling Process



These facilities can produce flats size thickness 10-160mm with width 205-810mm

Rolling Process



Rolling mill can produce HSS/TSS and Titanium materials with the productivity 100,000T one year

Product Categories



High Speed Steel

- High speed steel is a kind of tool steel with high hardness, high wear resistance and high heat resistance



Tool Steel

- Die steel is another type of special steel that is mainly used for the production of dies and moulds



Titanium

- Titanium alloys are metals which contain a mixture of titanium and other chemical elements



Cutting Tools

- TG Produces cutting tools including drill bits, cutters, end mills and taps

High Speed Steel

Grade	Size Range(mm)
M-2/1.3343	2.50 to 25mm
M-3	2.50 to 160mm
M-35/1.3243	2.50 to 205mm
M-42/1.3247	15 to 120mm
W-18/T1/1.3355	15 to 205mm
M-1	2.50 to 205mm
M-52	2.50 to 205mm
M-4	15 to 160mm
M-7	15 to 80mm
W-9	3 to 160mm

Size	MOQ
2.50-20	500 Kgs
21-160	1,000 Kgs
161-250	1,500 Kgs

We Can produce



Rods



Blocks



Square



Sheets



Coils



Flats

Tool & Die Steel (Rounds)

Grade	Size Range(mm)
H-13/SKD-61	3.30 to 900 mm
H-11/1.2343	15 to 900 mm
D-2/SKD-11	5.5 to 700 mm
TGX-8	5.5 to 400 mm
H-10/1.2365	15 to 600 mm
H-10A	15 to 600 mm
1.2367	15 to 600 mm
DC-53	5.5 to 450 mm
A-2/1.2363	15 to 450 mm
D3/1.2080	15 to 600 mm
O1/1.2510	15 to 300 mm
O2/1.2842	15 to 600 mm
420ESR/1.2083	15 to 400 mm
L6/1.2714	20 to 1000 mm
S-7	9.5 to 400 mm
D-6/1.2436	15 to 400 mm

Size	MOQ
2.50-20	500 Kgs
21-160	1,000 Kgs
161-212	1,500 Kgs
213-290	2,500 Kgs
291-450	3,000 Kgs
451-800	6,000 Kgs



MAX DIA

- Hot Work 900 mm
- Cold Work 700 mm

Tool & Die Steel (Rounds)

Grade	Width(mm)	Thickness(mm)
H-13/SKD-61	150-810 mm	12-120 mm
S-7	150-810 mm	12-120 mm
H-11	150-810 mm	12-120 mm
D-2/SKD-11	150-810 mm	12-120 mm
O-1	150-810 mm	12-120 mm
H-10	150-810 mm	12-120 mm
O-2	150-810 mm	12-120 mm
A-2	150-810 mm	12-120 mm
420ESR/1.2083	150-810 mm	12-120 mm
A-8	150-810 mm	12-120 mm
D-3	150-600 mm	12-80 mm
DC-53	150-600 mm	15-50 mm

Grade	Width(mm)	Thickness(mm)
H-13/SKD-61	350-100 mm	130-600 mm
H-11	350-1000 mm	130-500 mm
D-2/SKD-11	350-1000 mm	130-400 mm

Size	MOQ
(14-45)mm*(300-400)mm	2,000 Kgs
(46-120)mm*(300-400)mm	2,400 Kgs
(14-45)mm*(401-470)mm	2,400 Kgs
(46-120)mm*(401-470)mm	3,200 Kgs
(14-45)mm*(471-620)mm	3,200 Kgs
(46-120)mm*(471-620)mm	4,000 Kgs
(14-45)mm*(621-810)mm	4,000 Kgs
(46-120)mm*(621-810)mm	4,300 Kgs

Size	MOQ
All Sizes	10,000 Kgs
All Sizes	10,000 Kgs
All Sizes	10,000 Kgs



MAX DIA

- Hot Work-600X800 mm
- Cold Work-400X800 mm

HSS/Die Steel Sheets

Grade	Width(mm)	Thickness(mm)	MOQ
A-2	<=1000 mm	1.00-12.00 mm	1000 Kgs per size
A-8	<=1000 mm	1.00-12.00 mm	
D-2	<=1000 mm	1.00-12.00 mm	
D-3	<=1000 mm	1.00-12.00 mm	
D-6	<=1000 mm	1.00-12.00 mm	
H-11	<=1000 mm	1.00-12.00 mm	
H-13	<=1000 mm	1.00-12.00 mm	
O-1	<=1000 mm	1.00-12.00 mm	
O-2	<=1000 mm	1.00-12.00 mm	
M-2	<=1000 mm	1.00-12.00 mm	



- **TG total invest 0.3 billion to produce this product**
- **The annual capacity is 10000 tons**

Inspection Equipment



- Rockwell hard-tester (left picture)
- Brinell hard-tester (right picture)

Type	Annealed BHN	Cold Drawn BHN
H-10	229	255
H-11	235	262
H-12	235	262
H-13	235	262
H-14	235	262
H-19	241	262
H-21	235	262
H-22	235	262
H-23	255	269
H-24	241	262
H-24	235	262
H-26	241	262

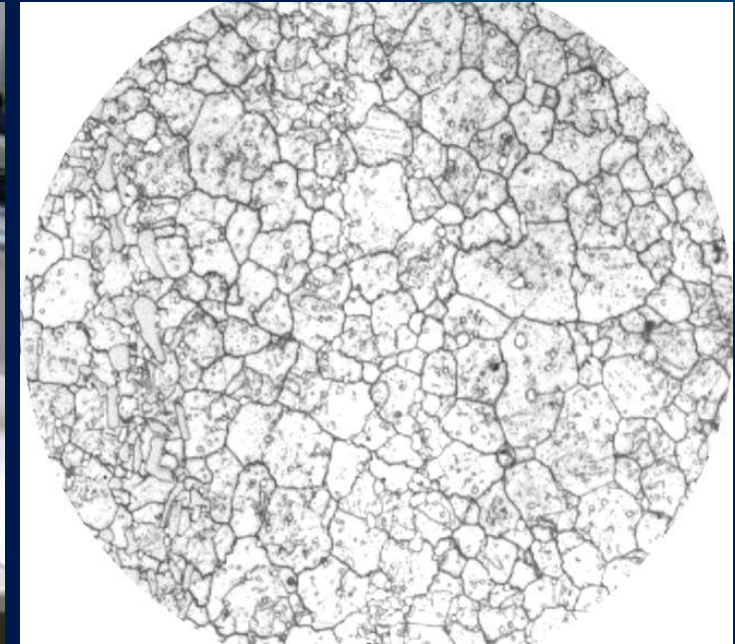
Inspection Equipment



**Metalloscope
ZEISS2000MAT**



**Microscope
ZEISS2000**



Inspection Equipment



Scanning Electro Microscope from Zeiss
Germany



Electronic Universal Testing Machine (right picture)



TG International

Titanium Manufacturing

Titanium

Titanium
Round Bars

Titanium
Plate

Titanium
Wire

Titanium
Tube



Titanium Products



Titanium round bar

- GB/T 2965, ASTM B 348, ASTM F 136,
- GB/T 13810, ASTM F67, AMS 4928,
- MIL-T-9047G, ISO5832-2, ISO5832-3
- Grades:
- Gr1, Gr2, Gr3, Gr4, Gr5, Gr6, Gr7, Gr9, Gr11, Gr12, Gr23
- Diameter : 3mm-350mm length ≤ 6000mm
- Forge/Extrusion/Rolling/Cold drawn
- UT test



Titanium plate

- CP-titanium or Titanium alloy
- GB/T3621, ASTM B265, ASTM F67, ASTM B136, ASTM F1295
- Gr1-Gr19
- T(1-5mm)*W (≤1000mm)*L(≤4000mm)
- T(5-30mm)*W (≤2000mm)*L(≤6000mm)
- T(30-100mm)*W(≤3000mm)*L(≤4000mm)
- Hot rolling / Cold rolling
- UT test
- X-ray test



Titanium Wire

- Grades:
- Gr1-Gr5, Gr7, Gr9, Gr11, Gr12, Gr23, TB5
- Standard
- GB/T3623 GB/T13810
- ASTM B863 ASTM F136 ASTM F1295 ASTM F67 AWS A5.16 ISO5832-2 ISO5832-3
- Condition
- R M Y



Titanium Pipe/Tube

- Seamless /Welded
- GB/T3624, ASTM B338, ASTM B337, ASTM B381
- Grades:
- Gr1, Gr2, Gr3, Gr7, Gr9, Gr11, Gr12, Gr5
- OD ≥ 3mm ; Wall thickness ≥ 0.5mm; Max length 9000mm
- Cold rolling
- Eddy current inspection, UT test



TG International

Cutting Tools

Cutting Tools

**Twist
Drill**

Drill Bits

HSS Taps

**HSS End
mills**



Cutting Tools Manufacturing Facility



Process flute of tap



Process chamfer of tap



**Automatic
Grinding Machine**



**New Production Line
for End mills**

Cutting Tools



Fully Ground Straight
Shank Twist Drill



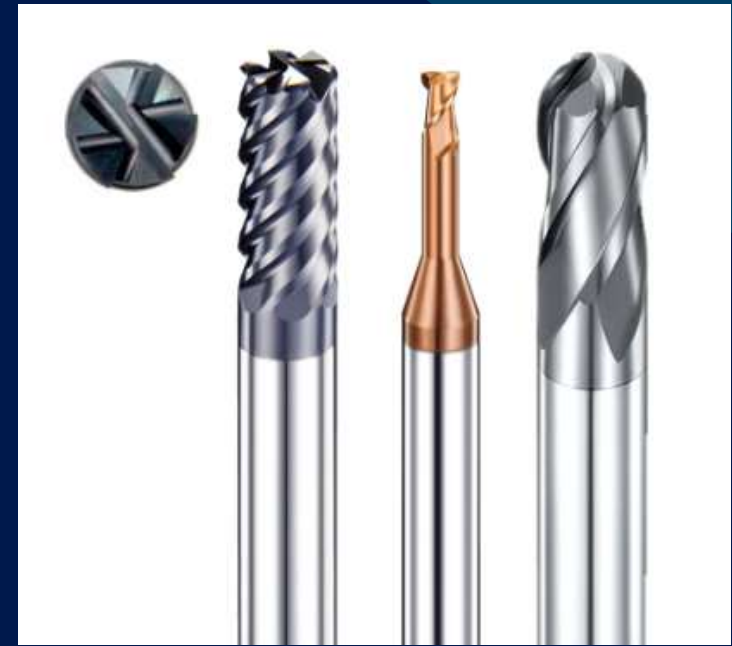
Roll & Forged Twist
Drill Bits



Fully Ground HSS
Taps



HSS End mills



- Precision Carbide Cutting Tools
- Milling Tool / Drilling Tool / High-precision Reamer / Non-standard Cutting Tool
- One product of Milling Tool for hardened Steel
- Applied for hardened steel of HRC 50-65



TG International

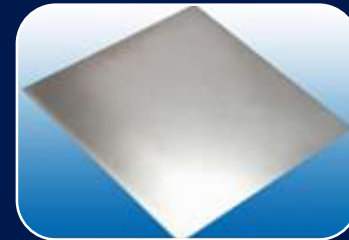
Wire Products

Production Range

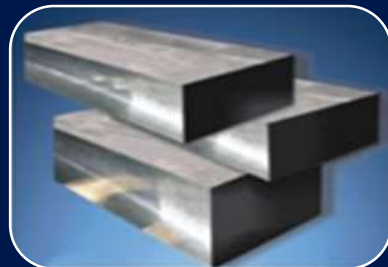
Production Line



Steel Products



Finished Products



Process



HSS Coil



Cold Rolling



Continuous
Annealing(Hydrogen
protect)



Calendering & Flattening



FINISHED & PACKING

Wire and flat Products



Grades

M2

M35

M42

Matrix II

TA1

TA2

TC4

Supplying Range

Round: 0.8-5.0mm

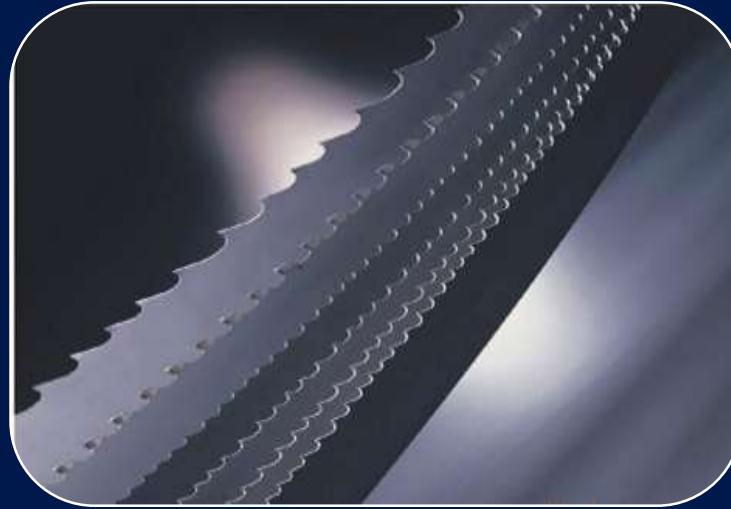
Flat: Thickness: 0.6-2.65mm, Width: 0.8-3.0mm

Tolerance: -0/+0.025MM

Steel Application



BI-METAL HAND-SAW



BI-METAL BAND-SAW
BI-METAL JIG-SAW
BI-METAL RECIP-SAW
BI-METAL MULTI TOOL



WELDING WIRE
3D PRINTING WIRE

Information Notification

- TG keeps on **changing, improving, innovation** to move forward.
- TG insists **quality, integrity and service** for customers.
- TG targets the **best one in China, the first-class level in the world**

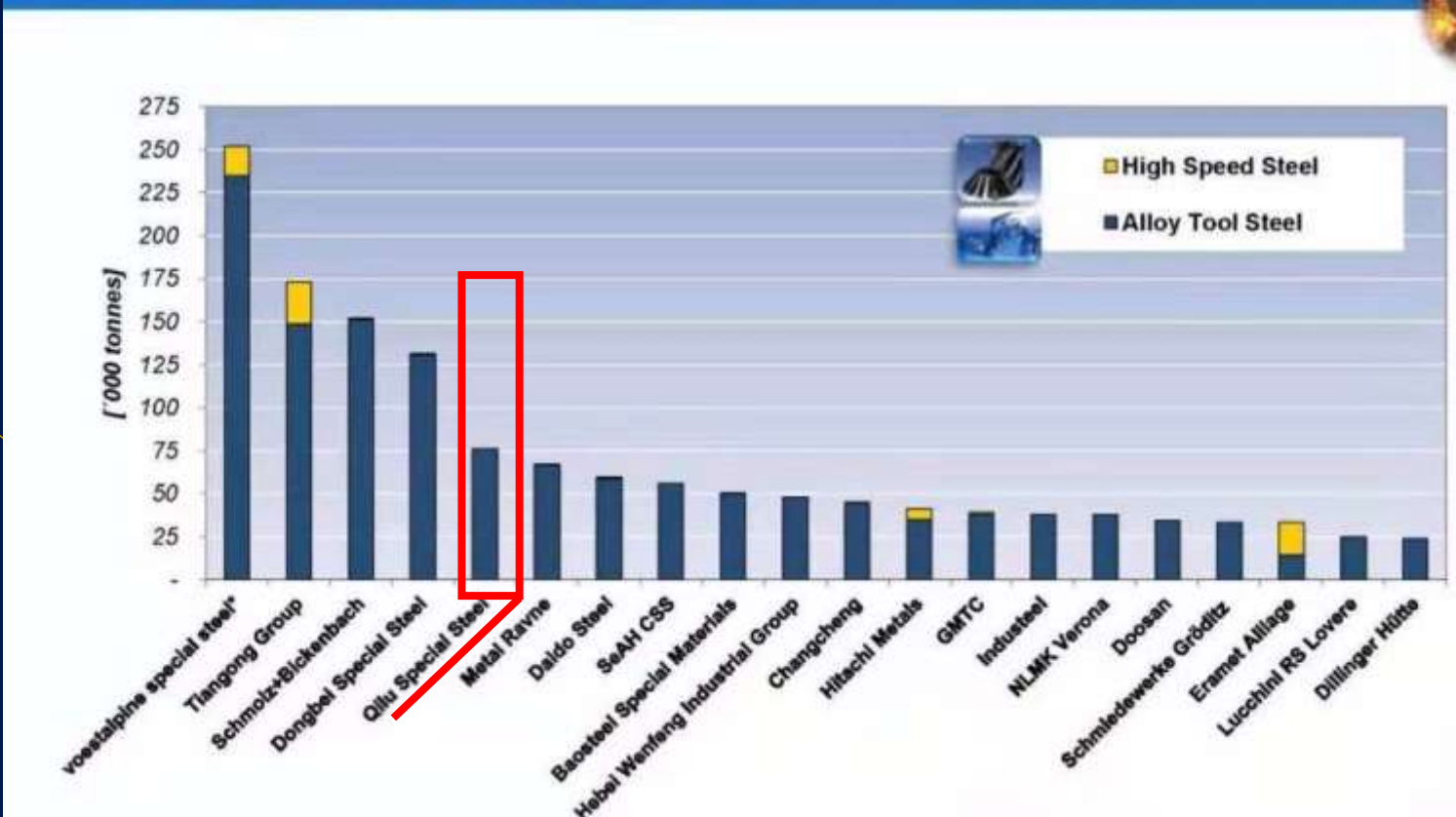


TG International

Powder Metallurgy

Industry Status

'Top 20' Global Alloy Tool Steel Producers 2018
estimated production volumes (finished products)



HSS Rank No- 1

Alloy + Tool Steel Rank No- 2

TG has pivotal position in world Alloy tool steel industry plus the production base of new material in the world.

Background

Promote
corporate
restructuring
and upgrading

Take the road
of high-
quality
development

The world's
leading
manufacturer
of tool steel

Project Objective

The first powder metallurgy tool steel production line in China

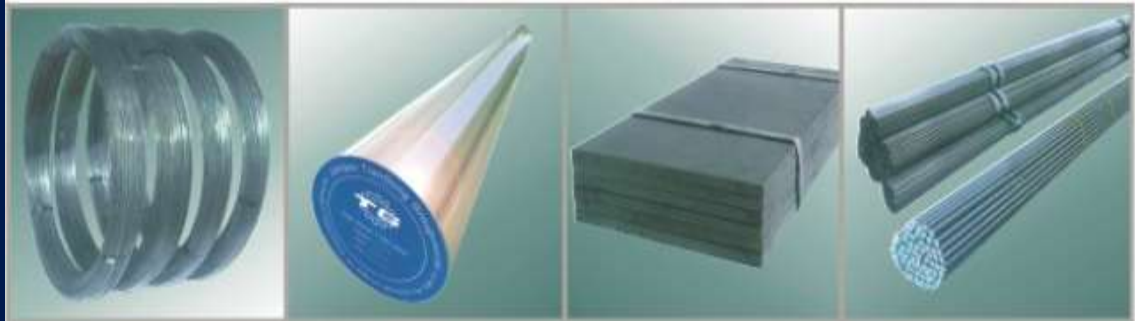
Fill up the gap of powder metallurgy scale production in China

To meet the request of downstream product upgrading

support the development of high-end manufacturing in China

The upgrading of technological level of downstream cutting tools, automobiles, household appliances, electric tools, machinery manufacturing and other industries requires the support of high-performance new materials. Powder metallurgy can support the upgrading of products in downstream industries due to its excellent properties such as purity, homogeneity and corrosion resistance.

Project necessity

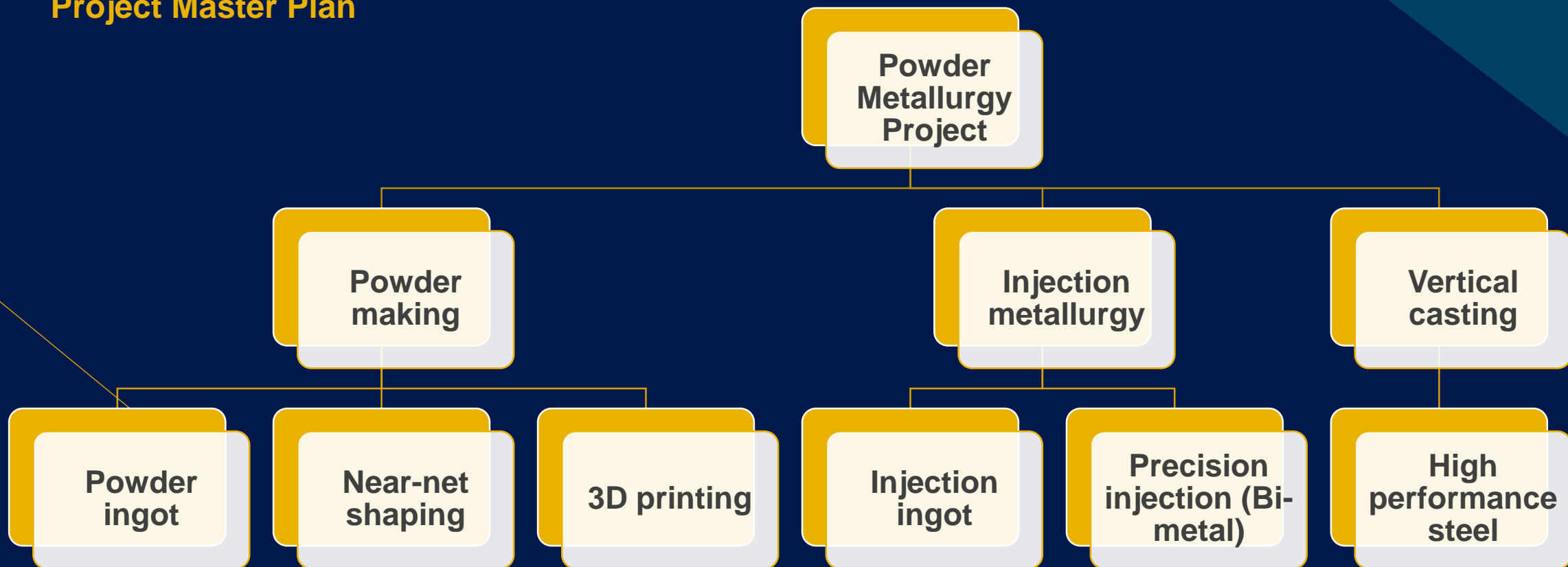


Powder metallurgy characteristics

- Longer Life than die steel
- Good grind ability
- good toughness
- good isotropy
- good heat treatment performance .
- high performance die steel and new die materials has become one of the important development directions to improve the performance of die.

Project Content

Project Master Plan



Project content

Project equipment composition

A total of 59 sets new equipment are needed for the project, including 53 sets of domestic equipment such as thermal isostatic press, vibrating screen system, air separation station and jet molding, and 6 sets of imported equipment such as powder making equipment, laser particle size meter and grading machine.

Project content

Spray Forming—introduction



Spray Forming is one of the molding methods of powder metallurgy ; It is a new technology which integrates metal melting, liquid metal atomization, rapid solidification and jet deposition forming into metal products in a metallurgical operation process. This technology sets the advantages of high efficiency, high quality and low cost, and has a strong competitiveness in the field of high-end products .after nearly ten years of development, spray forming has been became very mature, completely eliminate the early quality defects. Spray Forming production line has been put in use in TG and the output rate are 5000 tons

Project content

Spray Forming-introduction

Project	Production quota
Ingot weight	5tons
Ingot diameter	≤560mm
Output rate	5000tons/year
Product	Cold working die steel, high speed steel, composite special steel
Application	Cutting tools, rollers, saw blades, etc.



2. Project content

Spray Forming—Application

- **Product advantage** : Due to the function of rapid solidification, it has the characteristics of no segregation, uniform composition, better structure, small deformation, excellent wear resistance, and greatly improved service life. Compared with powder steel, it can save process and realize low cost.
- **Main application**: roller, Complex cutting tool, saw blades, etc.



2. Project content

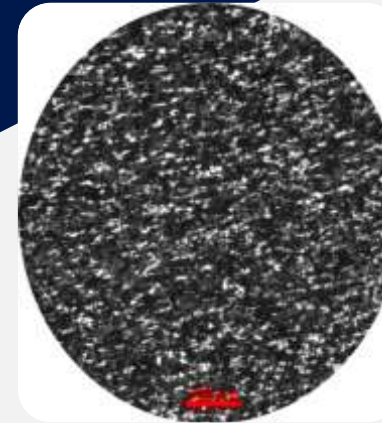
Spray Forming—Quality Comparison

Grade	Size (mm)	Smelting	1/4, Eutectic carbide inhomogeneity
D2	Φ106	Spray Forming	1
	Φ105	ESR	3
M35	Φ128	Spray Forming	2
	Φ130	ESR	5A

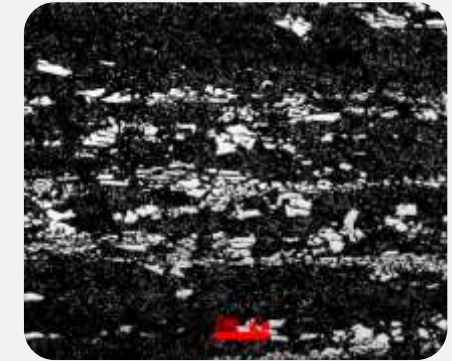
Project Content

Spray Forming- Contrast of cold roll quality

Brand	Specification	Smelting method	Eutectic carbide non-uniformity
TSFD2	Φ106mm	Injection molding	level 1-picture 1
D2	Φ120mm	Electroslag remelting	level 3-picture 2

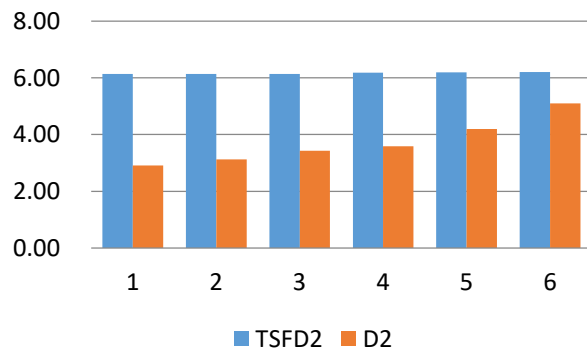


Picture 1

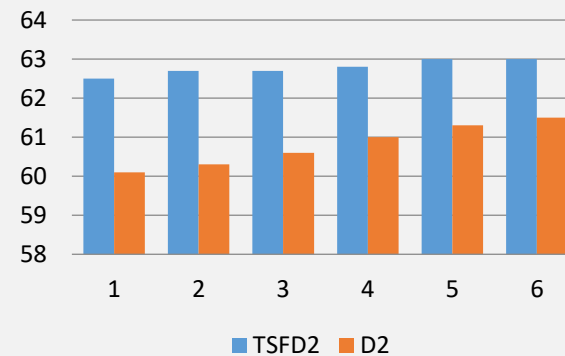


Picture 2

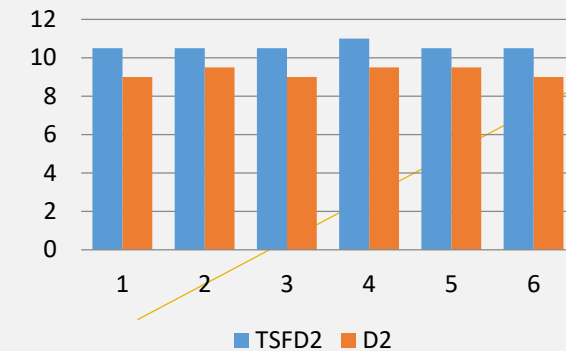
Impact toughness J



HRC

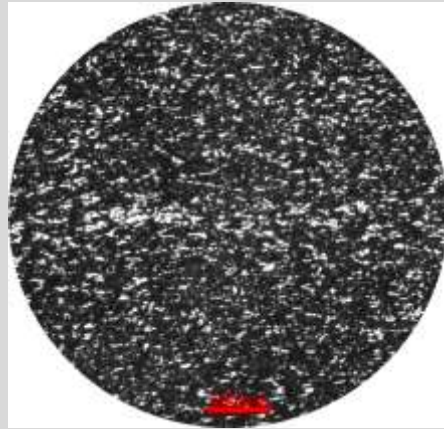


Grain size

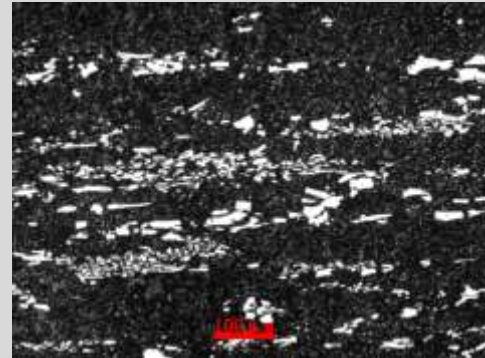


Project content

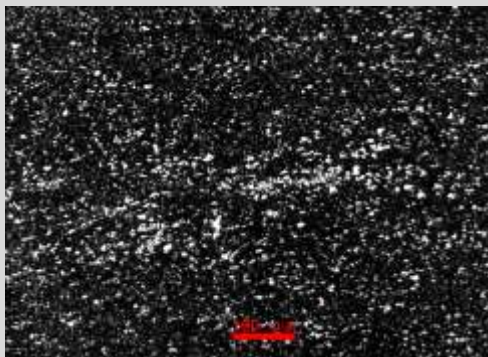
Spray Forming——Quality Comparison



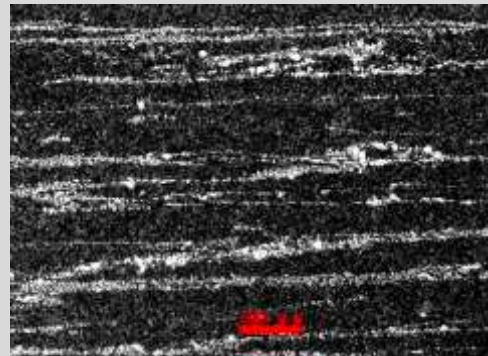
D2 Spray Forming
φ106mm



D2 ESR
φ105mm



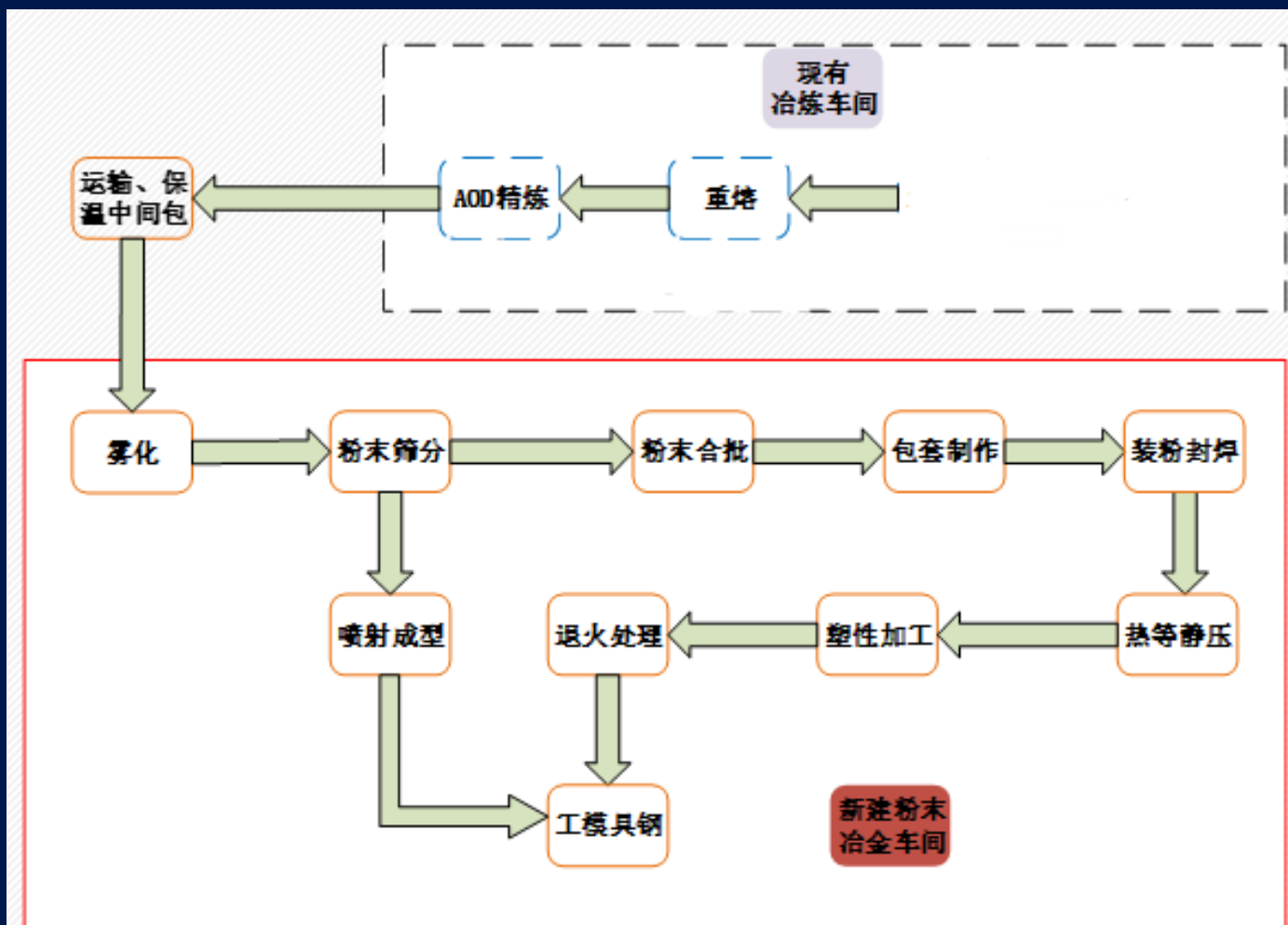
M35 Spray Forming
φ128mm



M35 ESR
φ128mm

Project Content

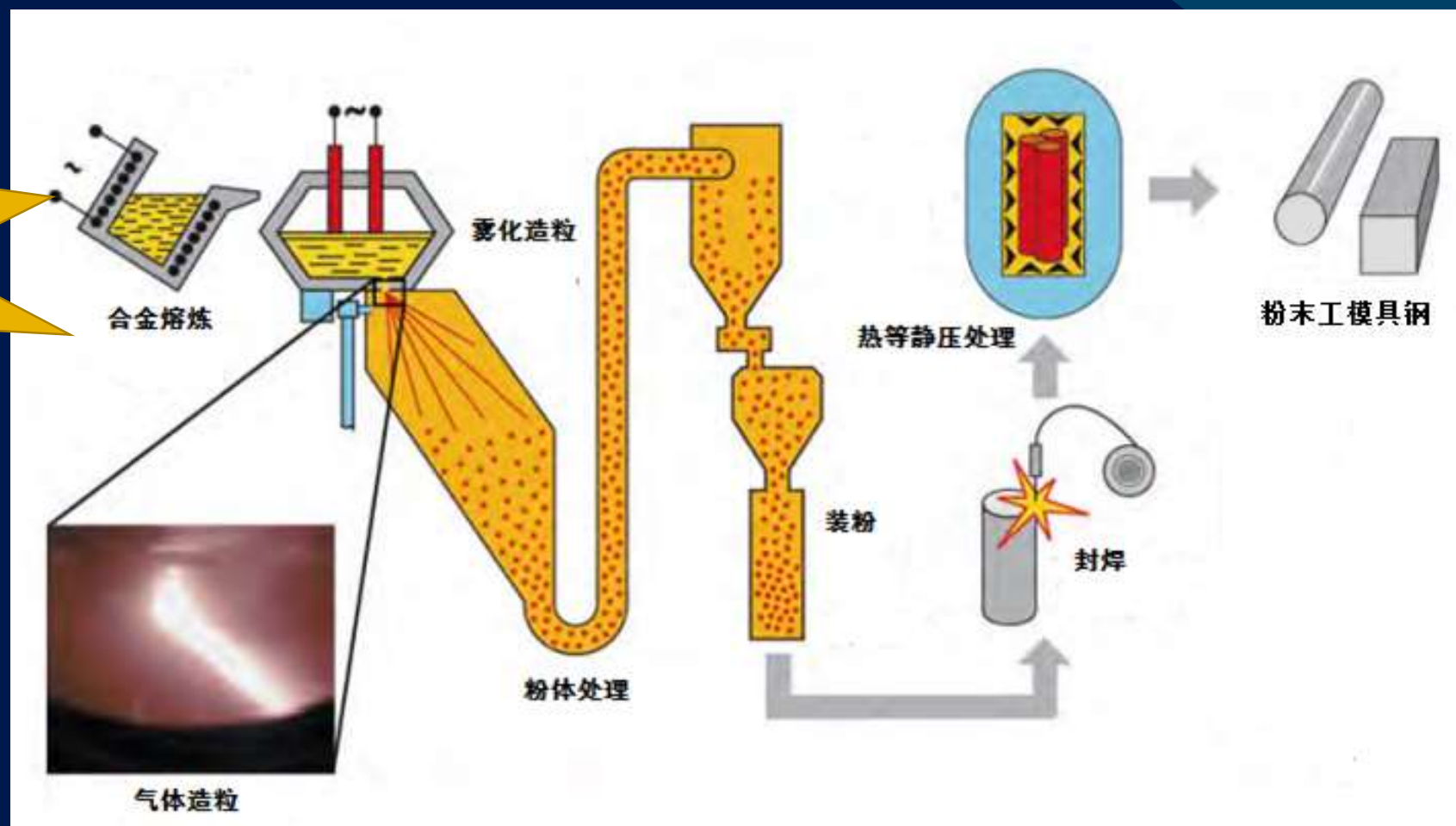
Powder metallurgy - production process



Project content

Powder metallurgy - production process

15T intermediate frequency furnace workshop provides molten steel after refining



Project content

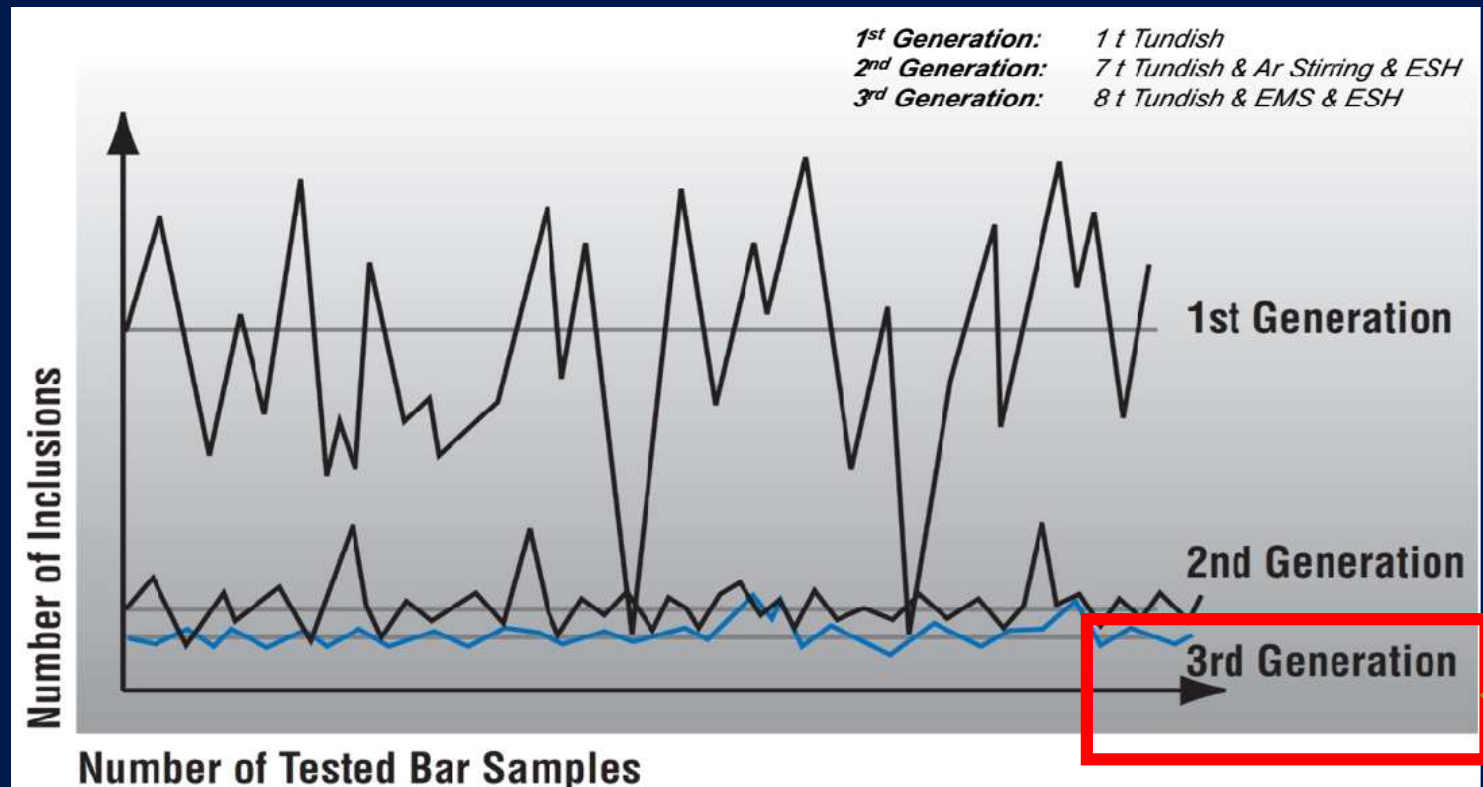
Powder metallurgy—Pulverizing ability

Project	production index
Tundish capacity	8tons
median particle diameter	≤150um
capacity	2000tons/year
production variety	Die steel, high speed steel, special stainless steel, corrosion resistant alloy, etc
application area	Industrial mould, Marine engineering, chemical industry, nuclear power, etc



Project content

Powder metallurgy - three generation powder technology



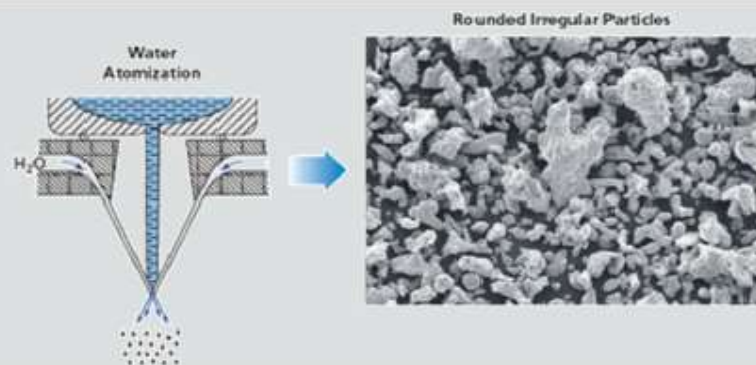
The atomization pulverization technology adopted by tiangong is the most advanced technology for producing the third generation pulverization

Project content

Powder metallurgy - three generation powder technology

Water Atomization

- Dominating technology (80 %) for the mass production of powder for press- and sinter parts for the automotive industry (Fe-based).
- Used for high-yield, low-cost production up to several hundred kg/min using high power water atomization.
- Dewatering and drying units for subsequent drying of the powder.
- Main limitation is powder purity, especially for metals and alloys inclined to oxidation.

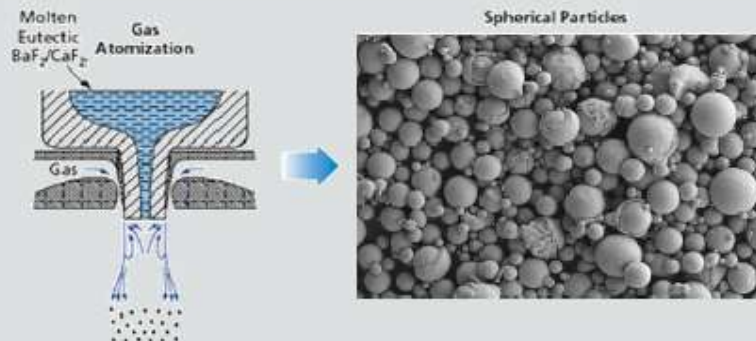


Gas Atomization



Gas atomization, good spherical degree of powder, low oxygen content

- Dominating technology for the production of high quality powder for AM, MIM, HIP (Stainless, HSS, Ni, Co, Ti).
- Up to 50 kg/min producing clean, spherical powder.
- Vacuum Inert Gas Atomization for reactive materials.
- Electrode Inert Gas or Plasma Atomization for crucible free atomization.

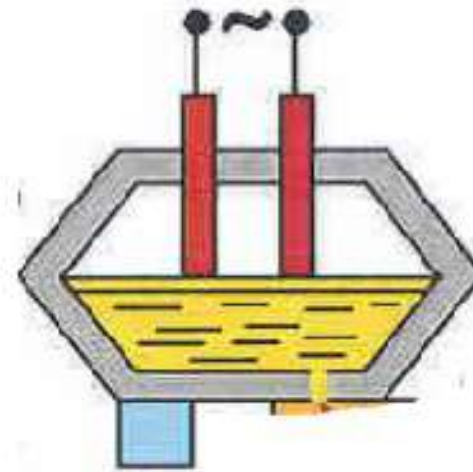


Project content

powder metallurgy—Third generation powder making technology

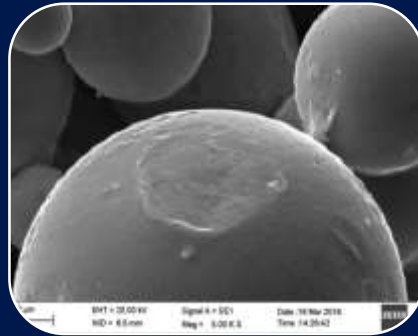
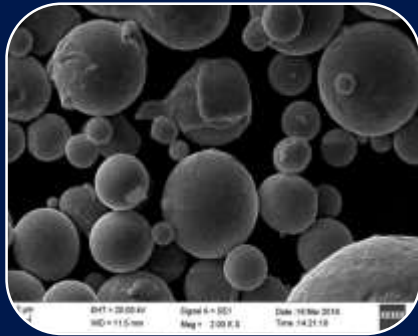
Electromagnetic Stirring

- Undisturbed protective slag slayer
- Very Good stirring efficiency and control
- Low amount of non-metallic inclusions
- Safe process, due to external installation

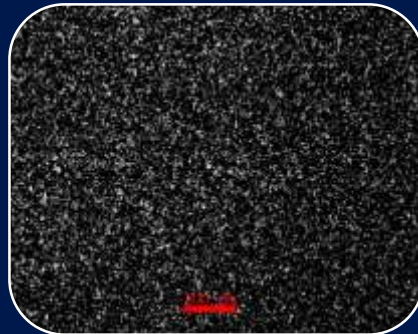
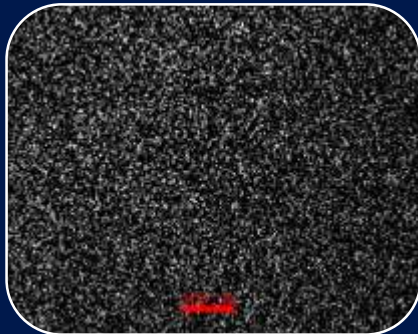


➤ **Tundish electroslag heating technology and Electromagnetic stirring technology, guarantee temperature uniformity and purity of molten steel**

Project content



Aerosolized powder has good sphericity



**The microstructure segregation of powder
HSS is less than 0.5 grade, Carbide
particles are fine**

Project content

powder metallurgy—corollary equipment



Powder sieving & blending



Package making

Project Content

powder metallurgy—hot isotactic pressing



Item	Production
cylinder diameter	φ1250*2000mm
maximum pressure	2000bar
maximum temperature	1400°C
capacity	2000T/Year
Products	Tool Steel, HSS, Special Stainless Steel, anticorrosion alloy, Titanium etc.

HIP is important equipment of Material densification

Project Content

Vertical casting project



Item	Production Index
ingot size	ϕ1050mm
Max ingot	20t
capacity	10000T/Year
Products	Tool Steel, Special Stainless Steel etc.
application area	tool and mold, oceanographic engineering, chemical engineering etc.

Project Content

Vertical casting project



characteristics and functions

- Ar Protection of pouring
- Low casting superheat
- High yield of molten steel
- High production efficiency

Quality Assurance

High standard quality design

- The content of harmful elements in molten steel can be effectively reduced through LF, VD, AOD and other processes;
- Secondary metallurgy of tundish, uniform temperature of molten steel and accurate superheat degree
- Stable Particle Size Control Technology ;
- Advanced package filling technology and equipment ;
- Advanced densification process equipment.

Quality Assurance

Rigorous production process

- High clean production environment
- High-quality technology and operation team
- High standard process operation specifications
- High quality ceramic nozzle
- Highly sealed powder storage environment

Quality Assurance

Intelligent manufacturing — Building Intelligent Factory



Quality Assurance

Build a Powder Metallurgy Research Institute

On the basis of the existing production, teaching and research, we have further developed cooperation with the Chinese branch of the Materials Institute of the Ukrainian Academy of Sciences. Ningbo Wuzhong Vision. At the same time, it absorbs and introduces international experts in powder metallurgy to provide guarantee for the company's powder product service market.

Goal: To build a national provincial key laboratory.



Quality Assurance

Perfect inspection equipment



infrared carbon-sulphur analyser



MTS Electronic Universal testing machine



Germany ZEISS2000MAT Metalloscope

TG has a complete set of quality assurance system



Impact testing machine



Germany ZEISS2000 microscope

Quality Assurance

Perfect inspection equipment



EVO-MA25 Zeiss scan
electron microscope



X-fluorescence
spectrograph



Lacer particle
size detector

Quality Assurance

Tiangong PM Steel grades Compiling rules

What letters represent

T **SF** X X X

T **PM** X X X

T TianGong

SF Spray forming; **PM** Powder Metallurgy ingot

X Range list of basic chemical content, see below form

X "0,1,2,3..." represent V content %

X "0,1,2,3..." represent Co content %

Range list of basic chemical content

Item	The meaning of item number
2	V \geq 2%,W \geq 10%
3	V \geq 2%,W < 10%
5	Co,W \geq 10%
6	Without content Co,W < 10%



TGK SPECIAL STEEL

Thank You!