



Iron and alloyed  
powders



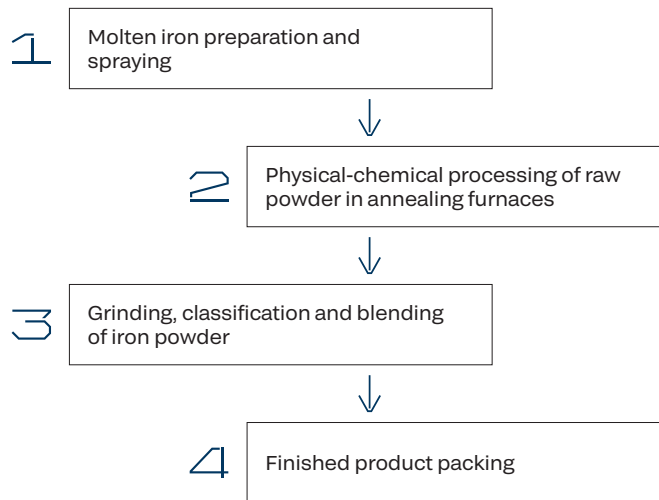


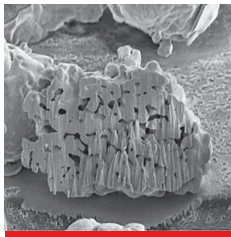
SSM-Tyazhmash Machine Building Center is a manufacturing enterprise with a complete production cycle. It is part of PAO Severstal, one of the world's largest vertically integrated steelmaking and mining companies with assets in Russia and other countries.

One of the business activities of the center is manufacture of iron powders. The company has been producing iron powders using production facilities of Cherepovets Steel Mill (CherMK) for more than 20 years. Throughout its operation, the company maintains a high level of product quality.

The products are manufactured at up-to-date process equipment enabling flexible approach to customer needs. The technology is based on the use of iron produced at Cherepovets Steel Mill as a raw material, which ensures high chemical purity of manufactured iron powders. The company's quality management system is certified for compliance with ISO 9001, IATF 16949.

## Iron powder production process





#### Chemical composition

Powder grade	C	Si	Mn	P	S	O <sub>(total)</sub>	Residue insoluble in hydrochloric acid
GAIP 2.200.26	≤ 0,02	≤ 0,05	≤ 0,15	≤ 0,020	≤ 0,02	≤ 0,25	≤ 0,25
GAIP 3.200.26	≤ 0,05	≤ 0,08	≤ 0,20	≤ 0,025	≤ 0,02	≤ 0,50	≤ 0,30

#### Physical properties

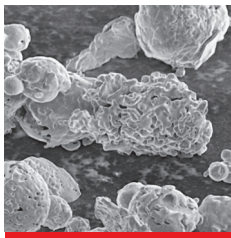
Powder grade	Apparent density	Flow	Density at P=700 MPa	Strength at density 6,5 g/cm <sup>3</sup>
	g/cm <sup>3</sup>	s/50 g	g/cm <sup>3</sup>	N/mm <sup>2</sup>
GAIP 2.200.26	2,51 - 2,70	≤ 37	≥ 7,05	≥ 18
GAIP 3.200.26	2,51 - 2,70	≤ 37	≥ 7,0	≥ 18

#### Size distribution

Powder grade	from 250 to 200	from 200 to 160	from 160 to 100	from 100 to 71	from 71 to 45	below 45
GAIP 2.200.26	0 - 1,5	0 - 15	The rest			10 - 25
GAIP 3.200.26	0 - 1,5	0 - 15	The rest			10 - 25



**Application:** gears, damping group parts, sliding bearings, connecting rods, bushes, body parts, couplings, bosses, furniture plates, tractor parts.



#### Chemical composition

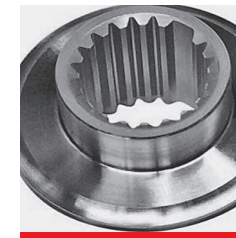
Powder grade	C	Si	Mn	P	S	O <sub>(total)</sub>	Residue insoluble in hydrochloric acid
GAIP 2.200.28	≤ 0,02	≤ 0,05	≤ 0,15	≤ 0,020	≤ 0,02	≤ 0,25	≤ 0,25
GAIP 3.200.28	≤ 0,05	≤ 0,08	≤ 0,20	≤ 0,025	≤ 0,02	≤ 0,50	≤ 0,30

#### Physical properties

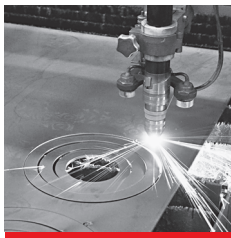
Powder grade	Apparent density	Flow	Density at P=700 MPa	Strength at density 6,5 g/cm <sup>3</sup>
	g/cm <sup>3</sup>	s/50 g	g/cm <sup>3</sup>	N/mm <sup>2</sup>
GAIP 2.200.28	2,71 - 2,90	≤ 34	≥ 7,05	≥ 14
GAIP 3.200.28	2,51 - 2,70	≤ 37	≥ 7,0	≥ 14

#### Size distribution

Powder grade	from 250 to 200	from 200 to 160	from 160 to 100	from 100 to 71	from 71 to 45	below 45
GAIP 2.200.28	0 - 1,5	0 - 15	The rest			10 - 25
GAIP 3.200.28	0 - 1,5	0 - 15	The rest			10 - 25



**Application:** valve guide bushings, gearbox parts, sliding bearings, connecting rods, transmission parts, crankshaft and camshaft sprockets, bushings, piston rings, housing parts, couplings, bosses, tractor parts.



#### Chemical composition

Powder grade	C	Si	Mn
GAIP 2.450.28 GAIP 2.450.30	≤ 0,02	≤ 0,05	≤ 0,15
GAIP 3.450.28 GAIP 3.450.30	≤ 0,05	≤ 0,08	≤ 0,20

#### Physical properties

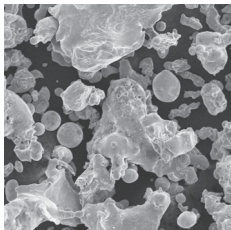
Powder grade	Apparent density g/cm <sup>3</sup>	Size distribution		
		from 630 to 450	from 450 to 315	from 315 to 250
GAIP 2.450.28 GAIP 3.450.28	2,71 - 2,90	0 - 5	The rest	
GAIP 3.450.30 GAIP 3.450.30	Above 2,91	0 - 5	The rest	

P	S	O <sub>(total)</sub>	Residue insoluble in hydrochloric acid
≤ 0,020	≤ 0,02	≤ 0,25	≤ 0,25
≤ 0,025	≤ 0,02	≤ 0,50	≤ 0,50

from 250 to 200	from 160 to 100	from 100 to 71	from 71 to 45	below 45
The rest	0 - 30			0 - 10
The rest	0 - 30			0 - 10



**Application:** chemical industry, metallurgy, flame cutting (scarfing).



## Chemical composition

Powder grade	Fe	Cr	Ni
WAP 304. 200	base	18,0-20,0	10,5-12,0
WAP 316.200	base	16,0-18,0	10,0-14,0
WAP-Mo	base	-	-
WAP-85 Mo	base	-	-
WAIP 200.30	base	-	-

## Physical properties

Powder grade	Apparent density	Flow	Density at P=600 MPa
	g/cm <sup>3</sup>	s/50 g	g/cm <sup>3</sup>
WAP 304. 200	2,90-3,10	≤ 40	≥ 7,00
WAP 316.200	2,90-3,10	≤ 40	≥ 7,00
WAP-Mo	2,90-3,10	≤ 35	≥ 7,00
WAP-85 Mo	2,90-3,10	≤ 35	≥ 7,00
WAIP 200.30	2,90-3,10	≤ 30	≥ 7,05

Mo	Si	O	C
	0,5-1,0	≤ 0,4	≤ 0,02
2,0-3,0	0,5-1,0	≤ 0,4	≤ 0,02
1,4-1,6	≤ 0,05	≤ 0,3	≤ 0,02
0,8-0,9	≤ 0,05	≤ 0,3	≤ 0,02
-	≤ 0,05	≤ 0,25	≤ 0,02



Chemical composition may be adjusted on customer request. Powder properties are specified in the quality certificate. Additional alloying of water-atomized powders is possible on customer request.

**Application:** automotive parts of different configuration and degree of complexity, parts for oil and gas industry (oil pump stages).



#### Chemical composition

Powder grade	C	Si	Mn	P
PAAIP-4Ni2CuMo	≤ 0,02	≤ 0,05	≤ 0,15	≤ 0,020
PAAIP-4Ni2Cu1Mo	≤ 0,05	≤ 0,08	≤ 0,20	≤ 0,025

#### Physical properties

Powder grade	Apparent density	Flow	Density at P=600 MPa	Strength at density 7,0 g/cm <sup>3</sup>
	g/cm <sup>3</sup>	s/50 g	g/cm <sup>3</sup>	N/mm <sup>2</sup>
PAAIP-4Ni2CuMo-27	2,60 - 2,80	≤ 37	≥ 6,95	≥ 25
PAAIP-4Ni2CuMo-29	2,81 - 3,05	≤ 34	≥ 7,0	≥ 22

#### Size distribution

Powder grade	from 250 to 200	from 200 to 160	from 160 to 100	from 100 to 71	from 71 to 45	below 45
PAAIP-4Ni2CuMo-27	0 - 1,5	0 - 10	The rest			10 - 30
PAAIP-4Ni2CuMo-29	0 - 1,5	0 - 10	The rest			10 - 30



S	O <sub>(total)</sub>	Ni	Mo	Cu
≤ 0,02	≤ 0,25	3,6 - 4,4	0,4 - 0,6	1,3 - 1,7
≤ 0,02	≤ 0,50	3,6 - 4,4	0,9 - 1,5	1,3 - 1,7

**Application:** small-sized starter reduction gears, pump stages and other high-strength sintered products of a particularly complex configuration.



#### Chemical composition

Powder grade	C	Si	Mn	P
PAAIP-6CoMoNi-28	≤ 0,02	≤ 0,05	≤ 0,15	≤ 0,020
PAAIP-6CoMoNi-30	≤ 0,02	≤ 0,05	≤ 0,15	≤ 0,020

#### Physical properties

Powder grade	Apparent density	Flow	Density at P=700 MPa	Strength at density 6,5 g/cm <sup>3</sup>
	g/cm <sup>3</sup>	s/50 g	g/cm <sup>3</sup>	N/mm <sup>2</sup>
PAAIP-6CoMoNi-28	2,70 - 2,90	≤ 33	≥ 7,05	Not defined
PAAIP-6CoMoNi-30	2,91 - 3,10	≤ 30	≥ 7,05	Not defined

#### Size distribution

Powder grade	from 250 to 200	from 200 to 160	from 160 to 100	from 100 to 71	from 71 to 45	below 45
PAAIP-6CoMoNi-28	0 - 1,5	0 - 15	The rest			15 - 35
PAAIP-6CoMoNi-30	0 - 1,5	0 - 15	The rest			15 - 35

S	O <sub>(total)</sub>	Ni	Mo	Co
≤ 0,02	≤ 0,25	1,0 - 2,0	1,0 - 2,0	6,0 - 7,0
≤ 0,02	≤ 0,25	1,0 - 2,0	1,0 - 2,0	6,0 - 7,0



**Application:** exhaust valve seats, high-strength wear- and heatresistant parts, such as guide rollers for long product mills.

# Partially alloyed atomized iron powder PAAIP-2Ni2CuMo, PAAIP-3Cu, PAAIP-2NiMo



## Chemical composition

Powder grade	C	Si	Mn	P
PAAIP-2Ni2CuMo	≤ 0,02	≤ 0,05	≤ 0,15	≤ 0,02
PAAIP-3Cu	≤ 0,02	≤ 0,05	≤ 0,15	≤ 0,02
PAAIP-2NiMo	≤ 0,02	≤ 0,05	≤ 0,15	≤ 0,02

## Physical properties

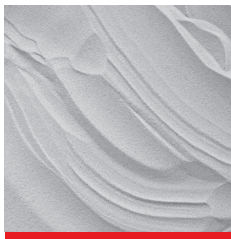
Powder grade	Apparent density	Flow	Density at P=700 MPa	Strength at density 6,5 g/cm <sup>3</sup>
	g/cm <sup>3</sup>	s/50 g	g/cm <sup>3</sup>	N/mm <sup>2</sup>
PAAIP-2Ni2CuMo	2,7 - 2,9	≤ 37	≥ 7,05	≥ 20
PAAIP-3Cu	2,7 - 2,9	≤ 30	≥ 7,05	≥ 20
PAAIP-2NiMo	2,5 - 2,7	≤ 37	≥ 7,05	≥ 25

S	O <sub>(total)</sub>	Ni	Cu	Mo
≤ 0,015	≤ 0,25	1,0 - 3,0	1,0 - 3,0	0,3 - 0,7
≤ 0,015	≤ 0,25		2,5 - 3,0	
≤ 0,015	≤ 0,25	1,5 - 3,0		0,5 - 1,0

## Size distribution

Powder grade	from 250 to 200	from 200 to 160	from 160 to 100	from 100 to 71	from 71 to 45	below 45
PAAIP-2Ni2CuMo	≤ 1,0	≤ 10	The rest			≤ 25
PAAIP-3Cu	≤ 1,0	≤ 10	The rest			≤ 25
PAAIP-2NiMo	≤ 1,0	≤ 10	The rest			≤ 25

# Partially alloyed atomized iron powder PAAIP-MoNi, PAAIP-Mo



## Chemical composition

Powder grade	C	Si	Mn	P
PAAIP-MoNi	≤ 0,02	≤ 0,05	≤ 0,15	≤ 0,02
PAAIP-Mo	≤ 0,02	≤ 0,05	≤ 0,15	≤ 0,02

## Physical properties

Powder grade	Apparent density	Flow	Density at P=700 MPa	Strength at density 6,5 g/cm <sup>3</sup>
	g/cm <sup>3</sup>	s/50 g	g/cm <sup>3</sup>	N/mm <sup>2</sup>
PAAIP-MoNi	2,7 - 2,9	≤ 34	≥ 7,05	≥ 18
PAAIP-Mo	2,7 - 2,9	≤ 34	≥ 7,0	≥ 18

## Size distribution

Powder grade	from 250 to 200	from 200 to 160	from 160 to 100	from 100 to 71	from 71 to 45	below 45
PAAIP-MoNi	≤ 1,0	≤ 10	The rest			≤ 25
PAAIP-Mo	≤ 0,5	≤ 10	The rest			≤ 25

S	O <sub>(total)</sub>	Ni	Cu	Mo
≤ 0,015	≤ 0,25	1,5 - 2,0		1,3 - 1,6
≤ 0,015	≤ 0,25			0,8 - 1,1

Chemical composition and physical and mechanical properties of partially alloyed atomized iron powders may be adjusted on customer request.

**Application:** structural parts with high hardness, highly loaded parts, for example, gears, ring gears operating under conditions of cyclic and alternating loads.

## Stabilized ready-to-use mixtures for compacting

### Component composition

Mixture grade	Fe	Ni	Cu	Mo	MoS2	MnS	C	Fe3P	EBS
SPM-1*	base		2,0 - 4,0		2,0 - 4,0	1,0 - 2,0	0,5 - 1,5		0,5 - 1,0
SPM-2*	base	3,6 - 4,3	1,5 - 2,0	0,8 - 2,0			0,3 - 0,8		0,5 - 1,0
SPM-3*	base		2,5 - 3,0					0,2 - 0,4	0,5 - 1,0

### Physical properties

Powder grade	Apparent density	Flow	Density at P=700 MPa
	g/cm <sup>3</sup>	s/50 g	s/50 g
SPM-1	3,10 - 3,40	≤ 50	≥ 6,9
SPM-2	3,10 - 3,40	≤ 40	≥ 6,9
SPM-3	2,60 - 3,00	≤ 50	≥ 7,0

### Size distribution

Powder grade	from 250 to 200	from 200 to 160	from 160 to 45	below 45
CCП-1	≤ 1,5	≤ 10	The rest	5 - 20
CCП-2	≤ 1,5	≤ 10	The rest	5 - 20
CCП-3	≤ 1,5	≤ 10	The rest	5 - 20

Stabilized mixtures ready for compacting may be manufactured based on produced materials with the use of various additives as per customer requirements.

**Application:** auto parts of various configuration and degree of complexity.

\* SPM – Stabilized powder mixture

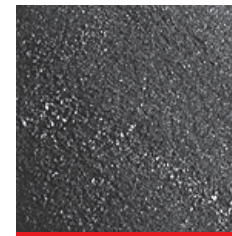
## Cast iron powder

### Chemical composition

Powder grade	C	Si	Mn	P	S	O <sub>(total)</sub>
Raw powder	2,20 - 3,0	≤ 0,1	≤ 0,3	≤ 0,03	≤ 0,03	4,0 - 7,0

### Physical properties

Powder grade	Apparent density	Flow
	g/cm <sup>3</sup>	s/50 g
Raw powder	2,5 - 3,0	≤ 40



Powder size composition may be selected in accordance with customer requirements.

## Key advantages



- Universal characteristics – may be applied for a wide range of components
- Reduced plasticizing agent consumption and compacting force
- High quality of products due to chemical purity
- High compactability – up to  $7.20 \text{ g/cm}^3$  at a pressure of 700 MPa
- Higher density of green compaction – up to 25 MPa at a sample density of  $6.5 \text{ g/cm}^3$
- Possibility to change characteristics as per customer requests

## Application areas

- Manufacture of powder products for antifrictional, structural and electrotechnical applications
- Manufacture of electrodes
- Flux-oxygen cutting of metals
- Manufacture of polygraphic dyes
- As a catalyst and reducing agent in chemical industry
- Magnetic flaw detection
- Manufacture of powder wire
- Manufacture of parts by compacting
- Steelmaking industry



**SSM-Tyazhmash Machine Building Center  
is open to considering manufacture of powders  
with properties required by customers.**

## Summary table of iron powder characteristics

TU 14-1-5365-98

Powder grade	Chemical composition, %						Physical properties			
	C	Si	Mn	P	S	O <sub>(total)</sub>	Apparent density	Flow	Density at P=700 MPa	Strength at density 6,5 g/cm <sup>3</sup>
							g/cm <sup>3</sup>	s/50 g	g/cm <sup>3</sup>	N/mm <sup>2</sup>
GAIP 2.200.26	0,020	0,050	0,150	0,020	0,015	0,25	> 2,51 - ≤ 2,70	< 37	> 7,05	> 18
GAIP 2.200.28	0,020	0,050	0,150	0,020	0,015	0,25	> 2,71 - ≤ 2,90	< 34	> 7,05	> 14
GAIP 2.200.30	0,020	0,050	0,150	0,020	0,015	0,25	> 2,91	< 32	> 7,05	> 10
GAIP 2.450.28	0,020	0,050	0,150	0,020	0,015	0,25	> 2,71 - ≤ 2,90			
GAIP 2.450.30	0,020	0,050	0,150	0,020	0,015	0,25	> 2,91			

Particle size distribution in % with particle size expressed in micrometers (µm)								
below 450	from 450 to 315	from 315 to 250	from 250 to 200	from 200 to 160	from 160 to 100	from 100 to 71	from 71 to 45	below 45
			0 - 1,5	0 - 15	-	-	-	10-25
			0 - 1,5	0 - 15	-	-	-	10-25
			0 - 1,5	0 - 15	-	-	-	10-25
0 - 5	-	-	-	-	0 - 30	0 - 30	0 - 30	0 - 10
0 - 5	-	-	-	-	0 - 30	0 - 30	0 - 30	0 - 10

## Summary table of iron powder characteristics

TU 14-1-5365-98

Powder grade	Chemical composition, %						Physical properties			
	C	Si	Mn	P	S	O <sub>(total)</sub>	Apparent density	Flow	Density at P=700 MPa	Strength at density 6,5 g/cm <sup>3</sup>
							g/cm <sup>3</sup>	s/50 g	g/cm <sup>3</sup>	N/mm <sup>2</sup>
GAIP 3.200.26	0,050	0,080	0,200	0,025	0,020	0,50	> 2,51 - ≤ 2,70	< 37	> 7,0	> 18
GAIP 3.200.28	0,050	0,080	0,200	0,025	0,020	0,50	> 2,71 - ≤ 2,90	< 34	> 7,0	> 14
GAIP 3.200.30	0,050	0,080	0,200	0,025	0,020	0,50	> 2,91	< 32	> 7,0	> 10
GAIP 3.450.28	0,050	0,080	0,200	0,025	0,020	0,50	> 2,71 - ≤ 2,90			
GAIP 3.450.30	0,050	0,080	0,200	0,025	0,020	0,50	> 2,91			

Particle size distribution in % with particle size expressed in micrometers (µm)								
below 450	from 450 to 315	from 315 to 250	from 250 to 200	from 200 to 160	from 160 to 100	from 100 to 71	from 71 to 45	below 45
			0 - 1,5	0 - 15	-	-	-	10-25
			0 - 1,5	0 - 15	-	-	-	10-25
			0 - 1,5	0 - 15	-	-	-	10-25
0 - 5	-	-	-	-	0 - 30	0 - 30	0 - 30	0 - 10
0 - 5	-	-	-	-	0 - 30	0 - 30	0 - 30	0 - 10





**Development of powder metallurgy has been recognized by SSM-Tyazhmash as a strategic activity for the next few years.**

The main steps will include:

- Extending the range of powders
- Purchasing new process equipment
- Setting up an R&D center
- Manufacturing powders for additive technologies



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