

Stronger than Steel and as Castable as Polymers

# Amorphous Metals

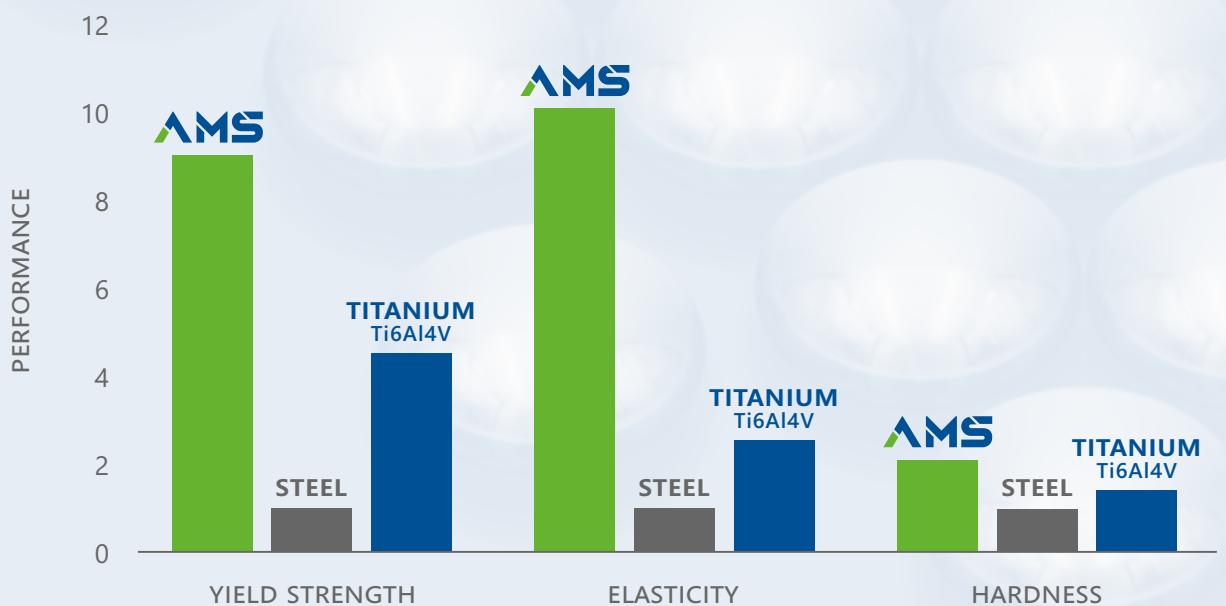


# Basic information

Amorphous metals are an innovation in the field of high-performance metals. They are characterized by a disordered atomic structure, which is why they are also called frozen melts or metallic glasses.

This unique structure results in special properties - such as **high hardness, high strength** and **exceptional elasticity**. At the same time, all AMS alloys are non-magnetic and have **very high abrasion resistance**.

AMS offers a broad and globally unique alloy portfolio. Coupled with strong know-how, this ensures that the advantages of amorphous metals are fully exploited.



# MEDALIUM Z1

## ALLOY COMPOSITION

ELEMENT	CONCENTRATION AT %
Zr	Basis material
Cu	28.8
Al	10.4
Nb	1.5

## PHYSICAL PROPERTIES

PROPERTY	VALUE
Density [g cm <sup>-3</sup> ]	6,62
Hardness [HV5]	467
Yield strength (tension) [MPa]	1.700
Yield strength (bending) [MPa]	2.400
Elast. strain limit (tension) [%]	~ 1,8
Elast. strain limit (bending) [%]	~ 2,5
Plast. fracture strain (bending) [%]	~ 10
Young's modulus [GPa]	82
Fracture toughness [MPa m <sup>1/2</sup> ]	~ 80
Poisson's ratio	0,39
Spec. heat capacity (25°C) [J g <sup>-1</sup> K <sup>-1</sup> ]	0,31
Lin. expansion coef. [µm K <sup>-1</sup> m <sup>-1</sup> ]	~ 10
Thermal conductivity [W K <sup>-1</sup> m <sup>-1</sup> ]	~ 10
Glass transition temperature [°C]	390
Crystallization temperature [°C]	470
Operational temperature [°C]	< 250
Solidus temperature [°C]	877
Liquidus temperature [°C]	920
Electrical resistance [Ω mm <sup>2</sup> m <sup>-1</sup> ]	~ 1,6

## POSSIBLE PART DIMENSIONS:

- min. wall thickness: 200 µm
- max. wall thickness: up to 5 mm wall thickness
- max. mass: up to 20 g

## SPECIAL FEATURES:

- Bio compatibility
- Nickel free
- Very high ductility
- Highest surface quality: Ra = 0,05 µm

## PROCESSING OPTIONS:

- Machinable: very good
- Polishable: very good
- Cold formability: very good

## FIELDS OF APPLICATION:

- Watch casing
- Medical technology (endoscopy, scalpels, implantology)
- Spring material from rolled sheet metal pieces

# MEDALIUM Z2

## ALLOY COMPOSITION

ELEMENT	CONCENTRATION AT %
Zr	Basis material
Cu	17.9
Ni	14.6
Al	10.0
Ti	5.0

## PHYSICAL PROPERTIES

PROPERTY	VALUE
Density [g cm <sup>-3</sup> ]	6,66
Hardness [HV5]	506
Yield strength (tension) [MPa]	1.700
Yield strength (bending) [MPa]	2.600
Elast. strain limit (tension) [%]	~ 1,8
Elast. strain limit (bending) [%]	~ 2,5
Plast. fracture strain (bending) [%]	~ 5
Young's modulus [GPa]	91
Fracture toughness [MPa m <sup>1/2</sup> ]	~ 40
Poisson's ratio	0,39
Spec. heat capacity (25°C) [J g <sup>-1</sup> K <sup>-1</sup> ]	0,33
Lin. expansion coef. [µm K <sup>-1</sup> m <sup>-1</sup> ]	~ 10
Thermal conductivity [W K <sup>-1</sup> m <sup>-1</sup> ]	~ 10
Glass transition temperature [°C]	398
Crystallization temperature [°C]	458
Operational temperature [°C]	< 250
Solidus temperature [°C]	795
Liquidus temperature [°C]	852
Electrical resistance [Ω mm <sup>2</sup> m <sup>-1</sup> ]	~ 1,6

## POSSIBLE PART DIMENSIONS:

- min. wall thickness: 200 µm
- max. wall thickness: up to 6 mm wall thickness
- max. mass: up to 20 g

## SPECIAL FEATURES:

- Bio compatibility
- Good castability of the alloy
- Manufacturing tolerances: +/- 5 µm
- Highest surface quality: Ra < 0,05 µm

## PROCESSING OPTIONS:

- Machinable: very good
- Polishable: very good
- Cold formability: good

## FIELDS OF APPLICATION:

- Watch casing
- Medical technology (endoscopy, scalpels, implantology)

# MEDALIUM C1

## ALLOY COMPOSITION

ELEMENT	CONCENTRATION AT %
Cu	Basis material
Ti	34.0
Zr	11.0
Ni	8.0

## PHYSICAL PROPERTIES

PROPERTY	VALUE
Density [g cm <sup>-3</sup> ]	6,89
Hardness [HV5]	576
Yield strength (tension) [MPa]	1.800
Yield strength (bending) [MPa]	2.900
Elast. strain limit (tension) [%]	~ 1,8
Elast. strain limit (bending) [%]	~ 2,5
Plast. fracture strain (bending) [%]	~ 7
Young's modulus [GPa]	109
Fracture toughness [MPa m <sup>1/2</sup> ]	~ 80
Poisson's ratio	0,39
Spec. heat capacity (25°C) [J g <sup>-1</sup> K <sup>-1</sup> ]	0,39
Lin. expansion coef. [µm K <sup>-1</sup> m <sup>-1</sup> ]	~ 10
Thermal conductivity [W K <sup>-1</sup> m <sup>-1</sup> ]	~ 10
Glass transition temperature [°C]	401
Crystallization temperature [°C]	446
Operational temperature [°C]	< 250
Solidus temperature [°C]	838
Liquidus temperature [°C]	891
Electrical resistance [Ω mm <sup>2</sup> m <sup>-1</sup> ]	~ 1,6

## POSSIBLE PART DIMENSIONS:

- min. wall thickness: 100 µm
- max. wall thickness: up to 2 mm wall thickness
- max. mass: up to 15 g

## SPECIAL FEATURES:

- Thin structures castable
- High hardness (without post-treatment)
- High amount of titanium

## PROCESSING OPTIONS:

- Machinable: very good
- Polishable: very good
- Cold formability: good

## FIELDS OF APPLICATION:

- Thin-walled plug connections
- Hinges for eye-wear

# MEDALIUM T1

## ALLOY COMPOSITION

ELEMENT	CONCENTRATION AT%
Ti	Basis material
Zr	35.0
Cu	17.0
S	8.0

## PHYSICAL PROPERTIES

PROPERTY	VALUE
Density [g cm <sup>-3</sup> ]	5,9
Hardness [HV5]	509
Yield strength (tension) [MPa]	-
Yield strength (bending) [MPa]	3.000
Elast. strain limit (tension) [%]	~ 1,8
Elast. strain limit (bending) [%]	~ 2,5
Plast. fracture strain (bending) [%]	~ 2
Young's modulus [GPa]	96
Fracture toughness [MPa m <sup>1/2</sup> ]	-
Poisson's ratio	0,39
Spec. heat capacity (25°C) [J g <sup>-1</sup> K <sup>-1</sup> ]	0,3
Lin. expansion coef. [μm K <sup>-1</sup> m <sup>-1</sup> ]	~ 10
Thermal conductivity [W K <sup>-1</sup> m <sup>-1</sup> ]	~ 10
Glass transition temperature [°C]	398
Crystallization temperature [°C]	451
Operational temperature [°C]	< 250
Solidus temperature [°C]	807
Liquidus temperature [°C]	1070
Electrical resistance [Ω mm <sup>2</sup> m <sup>-1</sup> ]	~ 1,6

## POSSIBLE PART DIMENSIONS:

- min. wall thickness: 250 μm
- max. wall thickness: up to 1,5 mm wall thickness
- max. mass: up to 7 g

## SPECIAL FEATURES:

- Highest corrosion resistance
- High tribological wear resistance
- Manufacturing tolerances: +/- 5μm

## PROCESSING OPTIONS:

- Machinable: very good
- Polishable: very good
- Cold formability: low

## FIELDS OF APPLICATION:

- Lightweight parts
- Casings
- Well suited for tribological load

# MEDALIUM N1

## ALLOY COMPOSITION

ELEMENT	CONCENTRATION AT %
Ni	Basis material
Nb	38.0

## POSSIBLE PART DIMENSIONS:

- min. wall thickness: 200 µm
- max. wall thickness: up to 1,5 mm wall thickness
- max. mass: up to 5 g

## PHYSICAL PROPERTIES

PROPERTY	VALUE
Density [g cm <sup>-3</sup> ]	8,5
Hardness [HV5]	900
Yield strength (tension) [MPa]	-
Yield strength (bending) [MPa]	4.500
Elast. strain limit (tension) [%]	~ 1,8
Elast. strain limit (bending) [%]	~ 2,5
Plast. fracture strain (bending) [%]	~ 0,5
Young's modulus [GPa]	170
Fracture toughness [MPa m <sup>1/2</sup> ]	-
Poisson's ratio	0,39
Spec. heat capacity (25°C) [J g <sup>-1</sup> K <sup>-1</sup> ]	0,3
Lin. expansion coef. [µm K <sup>-1</sup> m <sup>-1</sup> ]	~ 10
Thermal conductivity [W K <sup>-1</sup> m <sup>-1</sup> ]	~ 10
Glass transition temperature [°C]	651
Crystallization temperature [°C]	704
Operational temperature [°C]	< 400
Solidus temperature [°C]	1190
Liquidus temperature [°C]	1249
Electrical resistance [Ω mm <sup>2</sup> m <sup>-1</sup> ]	~ 1,6

## SPECIAL FEATURES:

- High hardness
- Extremely high yield strength
- Very corrosion and wear resistant

## PROCESSING OPTIONS:

- Machinable: good
- Polishable: good
- Cold formability: middle

## FIELDS OF APPLICATION:

- Mechanical watch parts
- Bearing rings
- Small, high performance gear parts

# MEDALIUM PLATINGGLASS

## ALLOY COMPOSITION

ELEMENT	CONCENTRATION AT %
Pt	Basis material (85% weight percent)
Cu	21.0
P	21.0

## PHYSICAL PROPERTIES

PROPERTY	VALUE
Density [g cm <sup>-3</sup> ]	15,2
Hardness [HV5]	430
Yield strength (tension) [MPa]	-
Yield strength (bending) [MPa]	2.000
Elast. strain limit (tension) [%]	~ 2-3
Elast. strain limit (bending) [%]	~ 0,5
Young's modulus [GPa]	85
Poisson's ratio	0,39
Spec. heat capacity (25°C) [J g <sup>-1</sup> K <sup>-1</sup> ]	0,33
Lin. expansion coef. [μm K <sup>-1</sup> m <sup>-1</sup> ]	~ 10
Thermal conductivity [W K <sup>-1</sup> m <sup>-1</sup> ]	~ 10
Glass transition temperature [°C]	239
Crystallization temperature [°C]	300
Operational temperature [°C]	< 150
Solidus temperature [°C]	555
Liquidus temperature [°C]	583
Yellowness Index	8 - 9

## POSSIBLE PART DIMENSIONS:

- min. wall thickness: 200 μm
- max. wall thickness: up to 4 mm wall thickness
- max. mass: up to 20 g

## SPECIAL FEATURES:

- Hallmarkable (850 Platinum alloy)
- Harder than conventional precious metals & alloys
- Very scratch resistant
- Structurable in nanometer scale

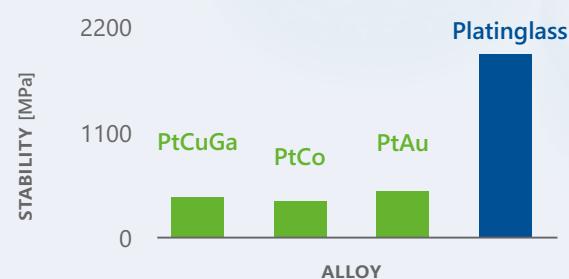
## PROCESSING OPTIONS:

- Machinable: good
- Polishable: good
- Cold formability: middle

## FIELDS OF APPLICATION:

- Ring blanks for wedding rings
- Thin pre-stud rings
- Watch parts
- Electrode material

## COMPARISON WITH CONVENTIONAL PRECIOUS ALLOYS



# MEDALIUM PALLADIUMGLASS

## ALLOY COMPOSITION

ELEMENT	CONCENTRATION AT %
Pd	Basis material (60% weight percent)
Cu	27.0
Ni	9.5
P	21.0

## PHYSICAL PROPERTIES

PROPERTY	VALUE
Density [g cm <sup>-3</sup> ]	9,3
Hardness [HV5]	510
Yield strength (tension) [MPa]	-
Yield strength (bending) [MPa]	2.100
Elast. strain limit (tension)[%]	~ 2,0
Elast. strain limit (bending) [%]	~ 0,5
Young's modulus [GPa]	105
Poisson's ratio	0,39
Spec. heat capacity (25°C) [J g <sup>-1</sup> K <sup>-1</sup> ]	0,33
Lin. expansion coef. [µm K <sup>-1</sup> m <sup>-1</sup> ]	~ 10
Thermal conductivity [W K <sup>-1</sup> m <sup>-1</sup> ]	~ 10
Glass transition temperature [°C]	301
Crystallization temperature [°C]	390
Operational temperature [°C]	< 150
Solidus temperature [°C]	522
Liquidus temperature [°C]	596

## POSSIBLE PART DIMENSIONS:

- min. wall thickness: 200 µm
- max. wall thickness: up to 6 mm wall thickness
- max. mass: up to 20 g

## SPECIAL FEATURES:

- Harder than conventional precious metals & alloys
- Very scratch resistant
- Thin and stable rings
- Structurable in nanometer scale

## PROCESSING OPTIONS:

- Machinable: good
- Polishable: good
- Cold formability: bad

## FIELDS OF APPLICATION:

- Ring blanks for wedding rings
- Thin pre-stud rings
- Watch parts
- Electrode material



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