Self Lubricating Bearings

Self Lubricating Bronze Bearings Technical Characteristics

The JDB bearing material you described consists of a base material, typically bronze or high-tensile brass, embedded with solid lubricating inserts covering 20-30% of the sliding surface. This design leverages the strengths of both components:
Base Material: High-strength copper alloys (bronze or high-tensile brass) provide excellent load-bearing capacity and durability, making them suitable for demanding applications.
Solid Lubricants: These are embedded in machined holes arranged in a specific pattern on the bearing surface. The lubricants reduce friction and wear, particularly under dry friction conditions.
Lubricating Film: A 20-micron pre-lubrication film is applied to the bearing surface to facilitate the initial transfer of solid lubricant to the mating part. This helps establish an effective solid lubrication film, minimizing stick-slip (a phenomenon where static friction causes jerky motion) and ensuring smooth operation during startup.
This combination enhances performance by providing low-friction, self-lubricating properties while maintaining high structural integrity. If you need further details on specific applications, alloy compositions, or performance metrics, let me know!

Self Lubricating Bronze Bearings General Characteristics

Table of General Characteristics of Self Lubricating Bronze Bearings

The table you provided compares the general characteristics of self-lubricating bronze bearings (like the JDB bearings described earlier) with standard bronze bearings. Below is a concise summary and analysis of the key differences and characteristics based on the provided data, formatted for clarity:

Characteristic	Unit	Self-Lubricating Bronze Bearings	Bronze Bearings
Specific/Dynamic/Static Load	MPa	50* / 140*	50* / 140*
Temperature Range	ºC	-10 to +400*	-10 to +250*
Friction Coefficient	μ	0.04–0.20	0.80–0.15
Maximum Speed	m/min	18*	30
Shaft Tolerance	-	e7–e8	f7–f8
Shaft Rugosity	Ra	0.8–1.6	0.8–1.6
Housing Tolerance	-	H7	H7
Shaft Hardness	HBW	180–400*	180–400*
Self-Lubricating	-	Highly recommended	Inadequately
Dirt Acceptance	-	Suitable	Inadequately
Corrosion Resistance	-	Suitable	Suitable
High Loads	-	Highly recommended	Neutral
Impact/Vibration	-	Suitable	Suitable
High Shaft Rugosity	-	Suitable	Suitable
Small Play	-	Inadequately	Inadequately
Misalignment	-	Suitable	Suitable
Price	-	Neutral	Neutral

Note: Values marked with an asterisk (*) may vary depending on the specific alloy used.

Material Type

Codes	GB1176-87	ISO 1338	DIN	JIS	ASTM(UNS)	BS	NF
JDB650	ZCuZn25Al6 Fe3Mn3	GCuZn25Al6 Fe3Mn3	DIN1709 G-CuZn25Al5	H5102 CAC304	B30-92 C86300	HTB2	
JDB650 S1	ZCuZn25Al6 Fe3Mn3	GCuZn25Al6 Fe3Mn3	DIN1709 G-CuZn25Al5	H5102 CAC304	B30-92 C86300	HTB2	
JDB650 S2	ZCuSn5 Pb5Zn5	GCuPb5 Sn5Zn5	DIN1705 G-CuSn5ZnPb	H5111 BC6	B30-92 C83600	LG2	CuPb5 Sn5Zn5
JDB650 S3	ZCuAl9Fe4 Ni4Mn2	GCuAl10 FeNi5	DIN17656 G-CuAl10Ni	H5114 AlBC3	B30-92 C95500	AB2	CuAl10 Fe5Ni5
JDB(HT250)	GB5675-85 HT250			FC250	ASTM Class40		

Material composition and properties

Code	JDB650	JDB650 S1	JDB650 S2	JDB650 S3	JDB650 S4	JDB (HT250)
Material Grade	CuZn25Al6Fe3Mn3	CuZn25Al6Fe3Mn3	CuAl9Fe4Ni4Mn2	CuSn5Pb5Zn5	CuSn12	HT250
Density	8	8	8.5	8.9	9.05	7
Hardness (HB)	>210	>250	>150	>70	>80	>190
Tensile Strength (N/mm²)	>750	>800	>800	>200	>260	>250
Elongation (%)	>12	>8	>15	>10	>8	>5
Coefficient of Linear Expansion 10-5/°C	1.9	1.9	1.9	1.8	1.8	1
Operating Temperature (°C)	-40~+300	-40~+150	-40~+400	-40~+400	-40~+400	-40~+400
Max. Dynamic Load (N/mm²)	100	120	150	60	70	90
Max. Linear Speed (m/min) (Dry)	15	15	20	10	10	8
Max. PV (N/mm² * m/min)	200	200	60	60	80	40
Compressive Permanent Deformation at 300N/mm²	<0.01	<0.005	<0.04	<0.05	<0.005	<0.015

Summary of Key Observations: Self-Lubricating vs. Standard Bronze BearingsFriction Coefficient: Self-lubricating bronze bearings (0.04–0.20) have a much lower friction coefficient than standard bronze bearings (0.80–0.15), reducing stick-slip and ensuring smoother operation, especially in dry conditions.
Temperature Range: Self-lubricating bearings handle higher temperatures (up to +400°C) compared to standard bearings (up to +250°C), ideal for extreme environments.
Maximum Speed: Standard bronze bearings support higher speeds (30 m/min) than self-lubricating bearings (18 m/min).
Self-Lubrication & Dirt Acceptance: Self-lubricating bearings excel in low-maintenance and dirty environments due to embedded lubricants, while standard bearings require external lubrication and are less dirt-tolerant.
Load Capacity: Both have similar load capacities (50 MPa specific, 140 MPa dynamic/static), but self-lubricating bearings are preferred for high-load applications due to better lubrication.
Tolerances & Hardness: Both share similar shaft rugosity (Ra 0.8–1.6), housing tolerance (H7), and shaft hardness (HBW 180–400). Self-lubricating bearings have looser shaft tolerances (e7–e8) vs. f7–f8 for standard bearings, potentially affecting fit precision.
Other Factors: Both are suitable for corrosion resistance, impact/vibration, high shaft rugosity, and misalignment but inadequate for tight-clearance applications. Pricing is comparable.
Applications: Self-Lubricating Bearings: Best for high-load, low-maintenance, harsh, or dry environments (e.g., heavy machinery, automotive, high-temperature settings).
Standard Bearings: Suited for higher-speed applications with external lubrication (e.g., well-maintained mechanical systems).

For further details or specific recommendations, please provide additional context or requirements!

Base metal

Alloy		CuSn7Zn4Pb7	CuSn11Pb2	CuSn12	CuAl10Fe5Ni5	CuZn25Al5Mn4Fe3
En 1982		CC493K CuSn7Zn4Pb7-C	CC482K CuSn11Pb2-C	CC483K CuSn12-C	CC333G CuAl10Fe5Ni5-C	CC762S CuZn25Al5Mn4Fe3-C
Material characteristics	Tensile strength MPa	260	280	300	650	750
	Yield point 0,2% MPa	120	150	150	280	480
	Elongation 5D%	12	5	6	13	5
	Hardness HBW 10/1000	70	90	90	150	190
	Max Temperature C	150	170	180	250	250
	Max Pressure MPa	30	50	50	80	98
	Max Speed (m/min)	20	18	18	18	15
	P x V max	60	80	80	120	180

Lubricants，Solid lubricant Bearing

Summary of Solid Lubricant and Startup Film in Self-Lubricating Bronze Bearings： Solid lubricant and start up film

Solid Lubricant Inserts: Material and Positioning: Graphite inserts, a common solid lubricant, are embedded in the bearing surface in an overlapping pattern along the sliding direction. This ensures consistent lubrication across the contact area.
Function: The inserts provide ongoing lubrication during operation, forming a low-friction pair with the high-strength copper alloy base (bronze or high-tensile brass). They replenish the lubricating film as it wears, maintaining performance in dry or harsh conditions.
Startup Film: Composition and Thickness: A 20-micron lubricating film, with a composition similar to the solid lubricant inserts (e.g., graphite-based), is applied to the fully machined bearing surface.
Purpose: This film facilitates the critical startup phase by reducing stick-slip (jerky motion caused by high static friction). It ensures rapid transfer of lubricant to the mating surface, forming an effective solid lubrication film from the outset.
Deterioration and Replacement: The startup film degrades over time due to wear, but the embedded solid lubricant inserts continuously supply lubrication, maintaining low friction and smooth operation.
Key Benefits: The overlapping graphite inserts ensure sustained lubrication, ideal for low-maintenance, high-load, or dry environments.
The 20-micron startup film minimizes initial friction and stick-slip, enhancing bearing performance during the critical break-in period.
This combination makes self-lubricating bronze bearings suitable for applications like heavy machinery or high-temperature settings where external lubrication is impractical.
If you need more details on the composition of the graphite inserts, application methods for the startup film, or performance in specific conditions, let me know!

Type	Description	Micrography
Solid Lubricant	**Properties**	**Typical Applications**
SL1	High-purity graphite + additives; excellent wear resistance and chemical stability, working temperature < 400°C	General machinery applications, suitable for atmospheric conditions
SL4	PTFE + additives; extremely low friction coefficient and excellent water lubrication properties, working temperature < 300°C	Used in water and seawater lubrication, such as in ships, hydraulic gates, turbines, pharmaceutical and beverage machinery, etc.

Pressure-Velocity

Pressure-Velocity (PV) Factor in Self-Lubricating Bronze Bearings

Summary of Pressure-Velocity (PV) Factor for Self-Lubricating Bronze BearingsDefinition: The Pressure-Velocity (PV) factor is the product of the bearing's operating pressure (MPa) and sliding velocity (m/min), a key metric for assessing its ability to handle combined load and speed without excessive wear or failure.
Pressure: Self-lubricating bronze bearings support 50 MPa (specific load) and up to 140 MPa (dynamic/static load).
Sliding Velocity: Maximum of 18 m/min for self-lubricating bearings, compared to 30 m/min for standard bronze bearings.
Importance: The PV factor determines the bearing's operational limits. Higher PV values indicate more demanding conditions, requiring effective lubrication and material strength.
Self-Lubricating Advantage: The low friction coefficient (0.04–0.20), graphite inserts (overlapping in the sliding direction), and 20-micron startup film reduce stick-slip and wear, making these bearings ideal for high-pressure, low-speed, low-maintenance applications (e.g., heavy machinery, high-temperature settings).
Standard Bronze Bearings: Better for higher-speed applications but require external lubrication to manage high PV conditions.
Example: A self-lubricating bearing at 50 MPa and 18 m/min has a PV of 900 MPa·m/min, which must stay within the bearing's specified PV limit to ensure durability.
Consideration: Exceeding the PV limit risks overheating or failure, so selecting the right bearing and alloy is critical.
For specific PV calculations or bearing selection, provide additional application details!

Summary of Friction Coefficient and Mating Material Conditions for Self-Lubricating Bronze Bearings

Friction Coefficient

Summary of Friction Coefficient and Mating Material Conditions for Self-Lubricating Bronze BearingsFriction CoefficientRange: The friction coefficient for self-lubricating bronze bearings ranges from 0.04 to 0.20, significantly lower than standard bronze bearings (0.80–0.15), due to solid lubricant inserts (e.g., graphite) covering 20–30% of the sliding surface and a 20-micron startup film that reduces stick-slip during initial operation.
Influencing Factors: Quality of Sliding Surfaces: The friction coefficient fundamentally depends on the surface quality of both the bearing and the mating material.
Load: Decreases with increasing load, as higher pressure enhances lubricant transfer, forming a more effective low-friction film.
Startup Period: Lower friction is achieved after the startup phase due to the establishment of a stable lubrication film from the graphite inserts.
Temperature, Speed, and Rugosity: Increases with rising temperature, sliding speed, and surface roughness (rugosity) of the sliding surfaces, as these factors can disrupt the lubrication film or increase surface interaction.
Design Recommendation: For design purposes, a friction coefficient of 0.15 is recommended as a practical average within the 0.04–0.20 range to ensure reliable performance predictions.
Mechanism: The overlapping graphite inserts and the 20-micron startup film (with a composition similar to the inserts) ensure low friction, especially in dry or low-maintenance conditions, by continuously replenishing the lubrication film as it wears.

Conditions of the mating material

Conditions of the Mating MaterialThe efficiency of self-lubricating bronze bearings is heavily influenced by the hardness and roughness of the mating material (e.g., the shaft or counter-surface), as well as its compatibility with the bearing's properties.Shaft Hardness:Requirement: The mating material should be at least 100 HB points harder than the bearing (bearing hardness typically HBW 180–400, as per the table). For example, if the bearing is HBW 180, the shaft should be at least HBW 280.
Reason: Higher hardness ensures the mating surface resists wear and maintains durability during sliding, preventing excessive debris generation or surface damage.
Variation: The recommended hardness may vary significantly depending on operating conditions (e.g., load, speed, or temperature). For high-load or high-temperature applications (up to +400°C), even harder materials may be required.
Shaft Roughness (Rugosity): Recommended Range: Ra 0.4–0.8 (tighter than the previously mentioned Ra 0.8–1.6 for general compatibility).
Reason: A surface finish within this range optimizes the transfer of solid lubricant from the bearing to the mating surface, forming a stable, low-friction film. Too Smooth (Ra < 0.4): May hinder lubricant transfer, reducing the effectiveness of the self-lubricating film.
Too Rough (Ra > 0.8): Can increase wear or disrupt the sliding behavior, leading to higher friction or bearing damage.
Advantage: Self-lubricating bearings are suitable for high shaft rugosity (up to Ra 1.6, as per the table), offering flexibility in less precisely finished surfaces, but optimal performance occurs within Ra 0.4–0.8.
Shaft Tolerance: Range: e7–e8 (as specified in the table).
Reason: These looser tolerances accommodate slight misalignments (rated suitable for misalignment) and simplify assembly, though they may slightly reduce fit precision compared to standard bronze bearings (f7–f8).
Material Compatibility: Recommended Materials: Hardened steel, stainless steel, or other high-strength, corrosion-resistant alloys are ideal to complement the bearing's high-strength copper alloy base (bronze or high-tensile brass).
Corrosion Resistance: The mating material should be corrosion-resistant, as self-lubricating bearings are suitable for corrosive environments (per the table).
Avoid: Soft or low-durability materials (e.g., unhardened aluminum), which could wear quickly, generate debris, or compromise the bearing's suitable dirt acceptance.
Operating Conditions: Dry Friction: The graphite inserts and startup film make these bearings highly effective in dry conditions, maintaining low friction without external lubrication.
Temperature: The mating material must withstand temperatures up to +400°C to avoid softening or deformation in high-temperature applications.
Impact/Vibration and Misalignment: Both the bearing and mating material are suitable for impact, vibration, and misalignment, ensuring reliability in dynamic applications.
Dirt Acceptance: The bearing's suitable dirt tolerance requires the mating surface to be initially clean to allow effective formation of the lubrication film.
Pressure-Velocity (PV) Context: The friction coefficient and mating material conditions directly impact the bearing's PV factor (pressure × velocity). For example, at 50 MPa and 18 m/min, the PV is 900 MPa·m/min, which the bearing can handle due to its low-friction design and robust mating material requirements.
Applications: Self-lubricating bronze bearings are ideal for high-load, low-speed, low-maintenance applications in dry, dirty, or high-temperature environments (e.g., heavy machinery, automotive components), where the low friction coefficient and durable mating material ensure long-term performance.
If you need further details, such as specific mating material recommendations, PV calculations, or alloy-specific friction data, please provide additional context or requirements!

Material	Recommended minimum hardness for mating material
CuSn7Zn4Pb7	200 HB
CuSn12	200 HB
CuAl10Fe5Ni5	300 HB
CuZn25Al5Mn4Fe3	300 HB

Bearing dimensions

Summary of Bearing Dimensions and Design Guidelines for Self-Lubricating Bronze Bearings

Bearing DimensionsLength-to-Diameter Ratio (L/DI): Recommended range is 0.5 to 2. For high loads or velocities, use L/DI < 1 to reduce friction and heat buildup, enhancing stability.
Thickness: Calculated as 0.05 × Inner Diameter (DI) + (2 to 6 mm), ensuring structural strength and accommodation of solid lubricant inserts (e.g., graphite).
Chamfering: Bearings are chamfered to ease fitting and reduce assembly damage.
Clearance: Follows a specified graph based on shaft diameter, aligned with e7–e8 shaft tolerances, supporting misalignment tolerance but inadequate for tight clearances (small play).

Friction Coefficient Range: 0.04–0.20, lower than standard bronze bearings (0.80–0.15), due to graphite inserts (20–30% of sliding surface) and a 20-micron startup film that minimizes stick-slip.
Influencing Factors: Decreases with higher load and post-startup due to enhanced lubricant transfer. Increases with rising temperature, speed, and surface roughness.
Use 0.15 for design purposes as a practical average.

Mating Material Conditions Hardness: Shaft should be at least 100 HB points harder than the bearing (HBW 180–400), e.g., ≥ HBW 280 for a HBW 180 bearing, with variations based on conditions.
Roughness: Optimal at Ra 0.4–0.8 for effective lubricant transfer; tolerable up to Ra 0.8–1.6 for less precise surfaces.
Material: Hardened, corrosion-resistant alloys (e.g., steel) to match the bearing's suitable corrosion, impact/vibration, and dirt acceptance properties.
Environment: Suitable for dry friction, temperatures up to +400°C, and dynamic conditions.

Pressure-Velocity (PV) Context PV Factor: Product of pressure (e.g., 50 MPa specific, 140 MPa dynamic/static) and velocity (max 18 m/min). Example: 50 MPa × 18 m/min = 900 MPa·m/min.
Dimensional guidelines (L/DI < 1 for high loads/velocities) ensure the bearing operates within safe PV limits, supported by low friction and robust mating material requirements.

Applications: Ideal for high-load, low-speed, low-maintenance applications in dry, dirty, or high-temperature environments (e.g., heavy machinery, automotive).
Looser tolerances (e7–e8), chamfering, and suitability for misalignment, corrosion, and impact/vibration enhance versatility.

Example: For DI = 40 mm
Length: 20–80 mm (L/DI < 1, e.g., < 40 mm for high loads).
Thickness: 4–8 mm.
Shaft: Hardness ≥ HBW 280, roughness Ra 0.4–0.8, tolerance e7–e8.

For precise clearance values or further customization, please provide the clearance graph or specific application details (e.g., shaft diameter, load, velocity)!