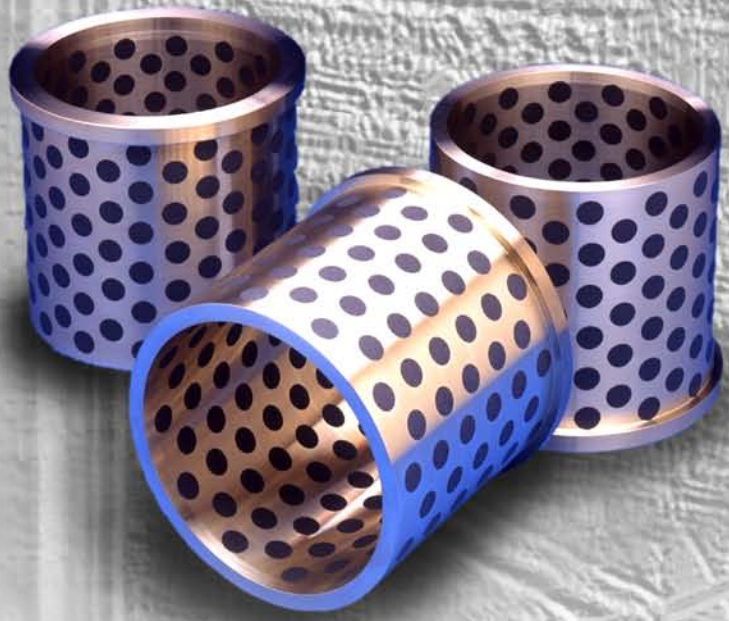
Hydro Turbines

Lubron® HP

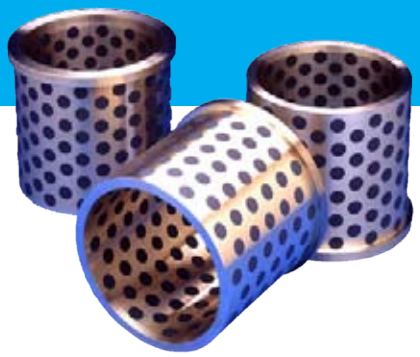
Self-Lubricating Bearings



Lubron Bearing Systems

Bearings to move the world.

Lubron HP
Self-Lubricating Bearings



LUBRON® HP self-lubricating bearings feature a proprietary PTFE-filled solid lubricant embedded in a cast bronze backing. Specifically designed for hydropower turbine wicket gate applications, LUBRON HP bearings require no maintenance and provide superior perfomance throughout long service life.

LUBRON HP self-lubricating bearings have been specifically designed to satisfy the demanding requirements of hydropower turbines. Developed to permit small running clearances by eliminating water swell, Lubron HP bearings combine the low friction of PTFE with the rigidity of high strength bronze alloys.

PERMANENTLY LUBRICATED & MAINTENANCE-FREE

LUBRON HP solid lubricants, specially formulated for underwater immersion, compliment a wide selection of "oilless" lubricants available from Lubron Bearing Systems.

LUBRON HP bearings are designed to accommodate high static loads for prolonged periods of dwell, and completely eliminate the need for lubrication and maintenance. LUBRON HP bearings are able to withstand foreign debris and erosion from severe water flow, and do not contain graphite or other ingredients which could promote electrolysis.

LUBRON HP lubricants are integrally molded and compressed into recesses provided for permanent containment of the lubricant. Drilled circular recesses are provided over a minimum 30% of the entire bearing surface area in uniform, geometric and overlapping patterns to assure optimum lubricating coverage. LUBRON HP solid lubricants are machined flush with the bearing surface. Adequate lubrication is the single most important factor for successful operation of a bearing, especially for high strength bearing alloys that require continuous lubrication to prevent seizing, scoring and galling. LUBRON HP self-lubricating bearings are effective in hydroelectric turbine applications where relative motion is not sufficient enough to promote circulation of oil or grease.

HIGH LOAD CAPACITY & LOW FRICTION

LUBRON HP bearings have excellent resistance to impact and shock loads, and can tolerate a high degree of shaft misalignment and are ideally suited for applications where the use of oil and grease are not permitted. LUBRON HP bearings are capable of continuous operation up to 8,000 psi (562 kg/cm^2) and short-term operation up to 15,000 psi (1055 kg/cm^2). LUBRON HP bearings exhibit low friction at high loads, and low friction at low speeds, making them ideal for oscillating and reciprocating applications.

CORROSION RESISTANT

LUBRON HP bearings are not affected by most harsh or corrosive environments. Constructed of chemically inert lubricants and corrosion resistant bronze alloys, LUBRON HP bearings are designed to resist galvanic action, cavitation, pitting, erosion and biofouling. Aluminum bronze and manganese bonze, which offer excellent corrosion resistance and high mechanical strength, are most frequently utilized for hydroelectric turbine applications.

SUPERIOR PERFORMANCE & LONG SERVICE LIFE

LUBRON HP's built-in wear resistant solid lubricants, securely embedded in high strength bronze alloys, combine to provide superior performance, exceptional endurance and long-term service life.

MAXIMUM SAFETY & RELIABILITY

The common cause of bearing failure is inadequate lubrication, which greatly increases friction and often leads to seizure. LUBRON HP bearings are designed to avoid bearing failure and premature wear. By offering a unique combination of properties and capabilities, LUBRON HP bearings provide reliable and continuous lubrication of the bearing surface.

APPLICATIONS

LUBRON HP bearings are utilized in a variety of hydroelectric turbine applications subject to medium-to-heavy loads and slow-to-medium speeds. LUBRON HP's versatile properties provide maximum bearing life and trouble-free operation in both immersed and dry environments.

Combining the low friction of PTFE with the rigidity of high strength bronze alloys, LUBRON HP bearings are capable of satisfying the most demanding requirements.

Applications include:

- wicket gates (guide vanes)
- control linkage
- servomotor linkage
- operating rings (regulating rings)
- butterfly valves
- spherical valves

CONSTRUCTION

The key to LUBRON HP's superior performance is its unique structure, composition and method of manufacture. LUBRON HP bearings are comprised of a bronze substrate and a bronze-lubricant inner structure. The bronze substrate provides a high load carrying capacity with excellent dimensional and structural rigidity. The bronze-lubricant inner structure supplies a permanent reservoir of lubricant for continuous restoration of the low friction bearing surface.

Cast Bronze Alloys

Cast bronze alloys have been used for centuries in a broad spectrum of bearing applications. Other bearing materials have been unable to match their versatility. By alloying copper with other elements, the properties of bronze can be altered to suit the requirements of most any application. The choice of a bronze alloy for a particular application is determined by the desired physical, mechanical and metallurgical properties needed. For applications exposed to flowing water, corrosion resistance becomes a critical consideration. Corrosion associated with high water turbulence includes cavitations, erosion, and impingement attack. Pitting, galvanic, and crevice attack are other common forms of corrosion. The extent of corrosion attack depends on the bearing environment and alloy composition. Oxygen and chlorine content, conductivity, water velocity, temperature, salinity, and biofouling affect rates of corrosion. Tensile strength, yield strength, fatigue strength, hardness, and grain refinement influence the ability of an alloy to withstand corrosion.

A wide selection of corrosion resistant alloys are available for hydroelectric turbine applications. Aluminum bronze and manganese bronze are generally preferred, especially where toughness and shock resistance are necessary. Both aluminum bronze and manganese bronze are capable of high bearing loads, and offer good resistance to creep, cavitation, impingement corrosion and chemical attack.

LUBRON HP bearing alloys are manufactured in strict compliance with ASTM and ISO material specifications. Aluminum bronze can be heat treated to enhance surface hardness and corrosion resistance. Centrifugal, continuous, sand, and forged castings are available, depending on the size and shape required. Physical and chemical test reports are available upon request.

Permanent Lubrication

LUBRON HP lubricants are “graphite-free” and do not contain any ingredients which promote electrolysis. Graphite has a very noble potential of +0.25V which can lead to severe galvanic corrosion of copper alloys and stainless steels, especially in saline waters. LUBRON HP lubricants consist of PTFE (polytetrafluoroethylene) and special binders compounded to achieve optimum bearing performance. Low friction properties are derived from the natural lubricity and high concentration of PTFE.

LUBRON HP lubricants are embedded into circular recesses provided for containment of the lubricant. Covering 30% to 40% of the bearing surface, these recesses securely anchor the lubricant and provide permanent reservoirs for restoring the bearing surface.

LUBRON HP lubricants are machined flush with the bronze substrate surface. The lubricated surface is continuously replenished by relative movement between the bearing and mating surfaces.

DESIGN CRITERIA

The overall performance of LUBRON HP bearings is directly influenced by a variety of operating factors which in particular include bearing load, speed, PV and type of movement. The following section describes the design criteria needed to properly specify a LUBRON HP bearing. For unusual design problems, additional assistance will be provided.

Alloy Selection

Proper alloy selection is necessary to attain maximum resistance to wear and corrosion. Selection of a suitable alloy depends on a variety of factors, which include bearing load, velocity, type of movement, temperature, environment, shear strength, fatigue strength, deformability, compatibility, hardness differential, corrosion resistance, wear resistance, and cost.

These factors should be evaluated with regard to all bearing system components to obtain long bearing life and maintenance-free operation. High strength bronze alloys frequently used in hydroelectric turbine applications are shown in Table 1 below. Other alloys are also available to satisfy special requirements.

TABLE 1

Alloy No.	Generic Description	ASTM Specification	Maximum Recommended Bearing Load	Maximum Recommended PV
932	High Leaded Tin Bronze	B584-C93200	1500 psi 10 N/mm^2	24,000 psi-ft/min 50 N/mm^2-m/min
954	Aluminum Bronze	B148-C95400	4000 psi 27.5 N/mm^2	48,000 psi-ft/min 100 N/mm^2-m/min
955	Nickel Aluminum Bronze	B148-C95500	6000 psi 41 N/mm^2	72,000 psi-ft/min 170 N/mm^2-m/min
863	Manganese Bronze	B584-C86300	8000 psi 55 N/mm^2	80,000 psi-ft/min 170 N/mm^2-m/min

Bearing Pressure

Bearing pressure (P) is defined as the total load applied on the supporting or projected area of the bearing, and is expressed as psi (pounds per square inch), kg/cm^2 or N/mm^2. For uniformly loaded bearings, bearing pressure can be calculated as follows:

$$P = \frac{\text{LOAD}}{\text{PROJECTED AREA}} = \frac{\text{LOAD}}{\text{ID X LENGTH}} \quad \text{(Bushings)}$$

$$= \frac{\text{LOAD}}{.0785 \text{ X } (\text{OD}^2 - \text{ID}^2)} \quad \text{(Thrust washers \& flange thrust surfaces)}$$

$$= \frac{\text{LOAD}}{\text{WIDTH X LENGTH}} \quad \text{(Plates)}$$

Bearings should be sized to accommodate the total applied load without exceeding the maximum design load. Recommended maximum design loads are shown on Table 1, having been determined by dividing the yield strength of each alloy by an appropriate safety factor. In most cases, the safety factor is extremely high, and actual loads may occasionally exceed the design load with no detrimental effect on bearing life.

Velocity

Surface velocity of a bearing is expressed in surface feet per minute (SFM) or meters per minute (m/min). For rotational motion, the formula for converting revolutions per minute (RPM) into SFM is:

$$V = SFM = RPM \times (\pi d)/12 = RPM \times 0.262 \times d$$

where for sleeve bearings d = ID and for thrust washers
d = mean diameter = (ID+OD)/2

For oscillating motion, cycles per minute (CPM) are converted into SFM using:

$$V = SFM = (4\alpha c)/360 \times (\pi d)/12 = 0.00291 \times \alpha \times c \times d$$

where α = amplitude of motion either side of mean position in degrees
c = frequency in cycles per minute

For linear or reciprocating motion, velocity is generally expressed in SFM or m/min.

The maximum allowable surface velocity for LUBRON HP bearings depends on the applied load and other operating and environmental variables. In general, surface velocity should not exceed 35 SFM for continuous operation.

PV Limit

PV is the product of bearing pressure (P) and surface velocity (V), and is used as a means of measuring bearing performance. Values for pressure and velocity must be considered individually, as well as their combined product. Temperature is the most important factor in determining a bearing's PV limit. For most cases, the PV limit reflects the point where surface temperatures are at a maximum, but still stable. Therefore, anything affecting surface temperature - coefficient of friction, running clearance, hardness and surface finish of the mating material - will also affect the PV limit. Bearings which operate at lower PV limit. Bearings will perform best when the bearing assembly is designed for maximum heat dissipation and the recommended mating materials are used.

SHAPES

LUBRON HP bearings are available in many different configurations depending on the application, direction of load, and type of movement. The most common shapes are listed below:

Bushings - One-piece sleeve bushings are used extensively to accommodate all types of rotary and linear motion. Sleeve or journal bushings are employed when the shaft load is essentially perpendicular to the axis of the shaft (radial loads). Depending on the bearing size, the lubricating recesses may extend completely through the bearing wall, or for larger bushings, the lubricating recesses will only extend partially through the wall. Where disassembly and reassembly make split bushings advantageous, LUBRON HP bearings are available either matched (split before final machining providing perfect 180° halves) or unmatched (split after final machining varying slightly from perfect 180° halves). Perfect halves are match-marked for proper assembly to assure maintenance of concentricity.

Washers - Washers are used to accommodate end thrust when the shaft load is in the direction of the axis of the shaft. Used alone or in conjunction with sleeve bushings, LUBRON HP washers can be lubricated on one or both sides.

Flange Bushings - Flange bushings combine the features of sleeve bushings and washers into one unit. Flange bushings are used when the shaft load has both an axial and a perpendicular component. The flanges may be lubricated for thrust load applications, or provided without lubrication when required to function only as a spacer.

Spherical Bearings - Self-aligning spherical bearing assemblies are designed primarily to accommodate radial loads and some misalignment. Misalignment may be caused by structural or shaft deflections under load. LUBRON HP spherical bearings consist of an inner component (gimbal) with a cylindrical inside diameter for shaft rotation and a spherical convex outside diameter, and a two-piece outer component (race) with a mating spherical concave inside diameter and a cylindrical concave outside diameter for mounting in a housing. Either component can be lubricated.

Operating Ring Plates - Bearing plates are used to accommodate longitudinal and transverse movement under vertical and horizontal loads. LUBRON HP operating or regulating ring bearing plates are available in single piece construction or in multiple segments, depending on the bearing plate radius. LUBRON HP bearing plates are generally fastened with machine screws.

SIZING

While many factors affect bearing design, the following data is applicable for most LUBRON HP bearings. Available in both inch and metric sizes, LUBRON HP bearings are usually supplied finished machined to meet the exacting requirements of each application.

Inside diameter - The nominal inside diameter of a bushing is dependent on the shaft diameter. To obtain the lowest frictional resistance and power loss, the shaft strength and rigidity should be as high as practical to permit the smallest possible shaft diameter.

Outside Diameter - The outside diameter of a bushing is dependent on the required wall thickness and size of the housing bore. To determine the outside diameter, add twice the recommended wall thickness of the inside diameter of the bushing. The following Tables provide the recommended wall thickness for LUBRON HP bushings. The minimum and maximum values shown are suitable for most applications, and are based on the permissible shaft load, bushing diameter and yield strength of the bearing material.

Length - Bearing length is usually determined by the amount of projected area necessary to accommodate the radial load, and can be calculated by dividing the shaft load by the desired bearing pressure times the inside diameter. In general, the length-to-diameter (L/D) ratio of a bushing should be between 1.0 and 2.0 for best performance. Shorter lengths may cause the bearings to become over-stressed, while longer lengths may induce edge loading. Bearings designed within the recommended L/D ratio will usually tolerate shaft misalignment and shock load without excessive wear.

Flange and Washer Thickness - The thickness for a bushing flange or thrust washer is generally the same as the corresponding wall thickness for a bushing listed in Tables 2 and 3.

Plate Thickness - Plate thickness should be consistent with the overall plate size. A minimum of one-half inch (12.7 mm) is recommended for most flat plates.

LUBRON HP BUSHINGS

CLEARANCE & INTERFERENCE LIMITS BEFORE PRESS FIT

TABLE 2 (INCHES)

NOMINAL SIZE RANGE OVER TO	SHAFT DIA. (f7)	BEARING I.D.	LIMITS OF CLEARANCE	BEARING O.D. (r7)	HOUSING I.D. (H7)	LIMITS OF INTERFERENCE	RECOMMENDED WALL THICKNESS
1.00 - 2.00	- .001 - .002	+ .008 + .007	.008 .010	+ .003 + .002	+ .001 - .000	.001 .003	.125 .375
2.00 - 3.00	- .0010 - .0025	+ .0100 + .0095	.0105 .0125	+ .003 + .002	+ .001 - .000	.001 .003	.250 .500
3.00 - 5.00	- .001 - .0030	+ .0130 + .0115	.013 .016	+ .0035 + .0025	+ .0015 - .0000	.0010 .0035	.375 .625
5.00 - 7.00	- .0015 - .0030	+ .016 + .014	.0155 .0190	+ .0040 + .0025	+ .0015 - .0000	.001 .004	.500 .750
7.00 - 10.00	- .002 - .004	+ .021 + .017	.019 .023	+ .005 + .003	+ .002 - .000	.001 .005	.625 .875
10.00 - 12.00	- .0025 - .0045	+ .0215 + .0195	.022 .026	+ .0055 + .0035	+ .002 - .000	.0015 .0055	0.750 1.000
12.00 - 16.00	- .003 - .005	+ .0245 + .0220	.0250 .0295	+ .0065 + .0045	+ .0025 - .0000	.0020 .0065	0.875 1.125
16.00 - 20.00	- .0040 - .0065	+ .0275 + .0250	.029 .034	+ .0075 + .0050	+ .0025 - .0000	.0025 .0075	1.000 1.250
20.00 - 30.00	- .005 - .008	+ .033 + .028	.033 .038	+ .010 + .008	+ .003 - .000	.005 .010	1.000 1.500

TABLE 3 (MM)

NOMINAL SIZE RANGE OVER TO	SHAFT DIA. (f7)	BEARING I.D.	LIMITS OF CLEARANCE	BEARING O.D. (r7)	HOUSING I.D. (H7)	LIMITS OF INTERFERENCE	RECOMMENDED WALL THICKNESS
30 - 50	- .025 - .051	+ .209 + .185	.210 .260	+ .076 + .051	+ .025 - .000	.025 .076	3.2 9.5
50 - 80	- .025 - .063	+ .264 + .242	.267 .327	+ .076 + .051	+ .025 - .000	.025 .076	6.3 12.7
80 - 120	- .038 - .076	+ .326 + .294	.332 .402	+ .089 + .063	+ .038 - .000	.025 .089	9.5 15.9
120 - 180	- .038 - .076	+ .404 + .362	.400 .480	+ .102 + .063	+ .038 - .000	.025 .102	12.7 19.1
180 - 250	- .051 - .102	+ .472 + .431	.482 .574	+ .127 + .076	+ .051 - .000	.025 .127	15.9 22.2
250 - 315	- .063 - .114	+ .551 + .498	.561 .665	+ .140 + .089	+ .051 - .000	.038 .140	19.1 25.4
315 - 400	- .076 - .127	+ .629 + .566	.642 .756	+ .165 + .114	+ .063 - .000	.051 .165	22.2 28.6
400 - 500	- .102 - .165	+ .696 + .633	.735 .861	+ .190 + .127	+ .063 - .000	.063 .190	25.4 31.8
500 - 765	- .127 - .203	+ .763 + .701	.828 .966	+ .254 + .203	+ .076 - .000	.127 .254	25.4 38.1

Running Clearance - Running or diametrical clearance, which is the amount the bushing inside diameter exceeds the shaft diameter after press fit closure allowance, is dependent on several factors, including bearing load, speed, size, temperature, and type of application. Tables 2 and 3 provide recommended clearance limits for LUBRON HP bushings prior to assembly for sizes ranging from 1 inch (30 mm) to 30 inches (765 mm). The clearance limits must be adjusted for any closure due to press fit by adding the maximum interference to the limits of clearance. These adjusted values normally permit adequate running clearance after assembly for static to slow speeds and intermediate to heavy loads. LUBRON HP bushings may require larger clearances for special conditions.

Press Fit - LUBRON HP bushings are usually press fit or chill fit into their housings. The bushing outside diameter is slightly larger than the housing bore, resulting in a press or interference fit. The interference fitting will cause the inside diameter of the bushing to close-in, usually in direct ratio of the magnitude of the interference fit. This close-in must be compensated for in the bearing design to achieve the proper running clearance after installation.

Tolerances - Machining tolerances for most LUBRON HP bearings range from ±.001 to ±.002 inches (.025 to .050 mm) for inside diameters, and ±.0005 to ±.001 inches (.012 to .025 mm) for outside diameters. Surface finishes will generally not exceed 63 µ inch (1.6 µ m).

MATING SURFACES

LUBRON HP bearings will operate against most metals, but best performance is achieved with the hardest possible mating surface. A minimum hardness of Rc 20 (BHN 228) is desirable, although softer |materials will generally provided satisfactory performance. Smoother finishes are normally required for harder materials, higher loads, and higher surface speeds. For maximum wear resistance, mating materials should be machined and polished to a surface finish between 16 to 63 µ inch (0.4 to 1.6 µ m). Mating materials should be selected that will most effectively resist corrosion. Austenitic (Types 304 and 316) and precipitation-hardened (17-4 PH) stainless steels are commonly utilized in fresh and salt water mediums.

Carbon steel shafts can be refurbished using stainless steel sleeves, which are available from Lubron Bearings Systems. For larger journal sizes, Monel, Inconel, and stainless steel weld overlays are recommended.

INSTALLATION

LUBRON HP bearings are generally supplied fully machined and ready for installation. Even though LUBRON HP bearings are extremely durable, care must be taken to ensure that the lubricated bearing surfaces are not damaged before or during installation.

LUBRON HP bushings are most often press fit into their housings. The sizes recommended in Tables 2 and 3 provide the proper interference fits for assembly. The bushings must be inserted squarely into the housings. Accurate alignment is particularly important for self-lubricating bearings. Misalignment over the length of the bushing or over the diameter of a thrust washer should not exceed .001 inches per inch. Chamfers are provided on the outside diameter of the bushing to facilitate proper alignment. Shouldered arbor plugs should be used to install smaller bushings. For larger sizes, LUBRON HP bearings can be refrigerated or packed in dry ice prior to installation. Immersion in liquid nitrogen is generally permitted provided the temperature of the bearing does not fall below –112°F (–80°C). LUBRON HP bearings can also be retained in the housings with countersunk set screws, dowel pins, or keyways.

LUBRON HP bearings should be wiped clean and free of all debris prior to installation of the shafts. Proper housing design and sealing of the bearing will prevent the ingress of foreign debris during operation. Application of a supplementary non-soluble lubricant during assembly will permit easier installation and provide better initial performance. The shaft ends should be burr-free and have a minimum of .060 inch (1.5 mm) radius or 15° chamfer. LUBRON HP bearing inside diameters are normally furnished with 30° chamfers.

Unlike most other self-lubricating bearings, LUBRON HP bearings can be machined after assembly to control running clearance or correct minor misalignment. When circumstances necessitate field machining the lubricated bearing surface, consult a LUBRON engineer for specific recommendations.

SUPPLEMENTARY LUBRICATION

LUBRON HP bearings are frequently used where oil and grease lubrication are impractical. However, special operating conditions my exist that require the use of a supplementary lubricant. In such cases, LUBRON HP bearings can be furnished with one of several groove patterns to accommodate most types of loading, movement and lubricating requirements.

Typical patterns include straight, circular, figure 8, and oval grooves. Grooves may be specified in any width and depth, and can run out one or both ends. Seals and seal grooves may also be added for applications subject to ingress of foreign debris.Selection of a suitable oil or grease is dependent on the operating conditions, environment, convenience and cost. While most oils and greases are compatible with LUBRON HP bearings, calcium and lithium multi-purpose Grade 2 greases without graphite and MoS_2 additives are generally more suitable.

MANUFACTURING CAPABILITIES

Our manufacturing facilities are modern, flexible, and complete, capable of complex tasks with precision accuracy. Our diverse design and manufacturing skills combine to assure consistent quality and reliable performance from small bushings to large bearing assemblies.

QUALITY ASSURANCE

Every LUBRON bearing is guaranteed to meet or exceed the quality requirements for each job. From procurement and fabrication to final inspection, every phase of manufacturing is monitored by our quality control personnel. Every step is planned, performed, checked, and certified in writing. All LUBRON bearings are manufactured and inspected in strict accordance with the requirements of ISO 9002. Material certifications are normally provided at no additional cost. Non-destructive testing, including radiograph, ultrasonic, hydrostatic, magnetic particle and liquid penetrate examination, are performed to comply with the specifications of ASTM by certified independent testing laboratories.

ENGINEERING & TESTING

LUBRON engineers have extensive product knowledge and experience in metallurgical, mechanical, structural disciplines. We offer our customers a variety of engineering services. From selection of bearing alloys and mating materials, to prototype and full size production testing to simulate load, movement, temperature, and other environmental conditions present during the actual operation of LUBRON bearings. Coefficient of friction and wear testing is performed in-house or by independent testing laboratories. Bearing design, AutoCAD® drawing preparation, testing, consulting, and on-site engineering services are available upon request.

STANDARD SPECIFICATION FOR LUBRON HP SELF-LUBRICATING BUSHINGS

The following specification is recommended for hydroelectric turbine applications. Specifications for other applications and bearing configurations are available upon request.

Self-lubricating bronze bushings shall be equal to “LUBRON HP” as manufactured by Lubron Bearing Systems, Huntington Beach, California, USA. The bushings shall be composed of supporting metal and a solid lubricant suitable for underwater application. The bushings shall be one-piece construction with a self-lubricating bearing surface on the inside diameter. The supporting metal shall be high strength manganese bronze, Copper Alloy UNS No. C86300, manufactured in strict accordance with ASTM B22 Alloy C86300, ASTM B271-C86300, ASTM B505-C86300 or ASTM B584-C86300. Circular recesses for containment of the lubricant shall be machined perpendicular to the bearing surface, be at least one-fourth inch deep or extend completely through the supporting metal, and be arranged in a uniform, overlapping geometric pattern in the direction of the rotating motion. The pattern of recesses shall have a net cross-sectional area that is not less than 30% of the total area of the surface and shall normally extend to within .125 inches (3.2 mm) of the chamfers at each end of the bushings.

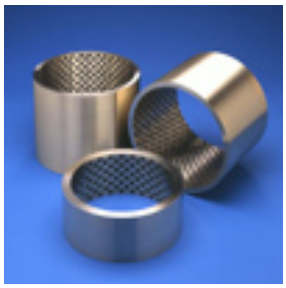
The solid lubricant shall be a dense combination of solids and binders having non-deteriorating characteristics as well as lubricating qualities and shall be capable of withstanding the effects of long-term atmospheric exposure and submersion in flowing water. The lubricant shall not contain graphite, molybdenum disulfide, or any other ingredients that tend to promote electrolytic or chemical action. The use of shellac, tars, resins, solvents, or other non-lubricating binder materials is not acceptable. The self-lubricating compound shall be integrally molded and compressed into recesses provided for containment, and be free of detrimental pits, pinholes and other imperfections that will impair the design load capacity.

The bushings shall not be damaged, scraped, or machined on the lubricating surface after manufacture. The surface finish of the bushing shall not exceed 63 microinches (1.6 micrometers) as measured in accordance with ANSI Standard B46.1. The bearing manufacturer shall recommend the housing and shaft tolerances to assure proper interference fit and running clearance of the bushings. The bushings shall have a design load capacity of at least 8 ksi (55 MPa) of projected bearing area at surface speeds not exceeding 10 fpm (.05 m/s). The static and dynamic coefficients of friction shall not exceed 0.10 when subjected to loads up to 8 ksi.

LUBRON Self-Lubricating Bearings for Hydro Applications

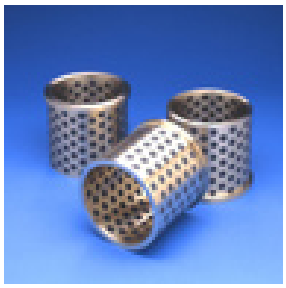
LUBRON AQ

LUBRON AQ bearings are constructed of high strength bronze alloys permanently embedded with PTFE solid lubricants, and are unequaled for toughness and durability. Specified and approved by engineering design firms and water power authorities worldwide, LUBRON AQ bearings are the proven choice for hydro pump-turbine and dam gate applications.



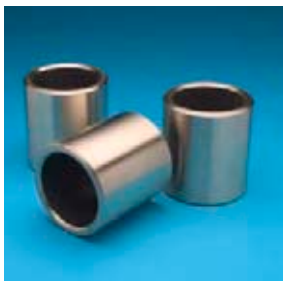
LUBRON HP

LUBRON HP bearings are specifically designed for smaller hydro turbine wicket gates and control linkage, and employ a variety of bronze alloys permanently embedded with PTFE solid lubricants. LUBRON HP bearings eliminate larger running clearances required for water swell, and are especially suitable for small oscillating movements and long periods of dwell.



LUBRON TF

LUBRON TF bearings are constructed of woven PTFE fabric liners permanently bonded and mechanically locked to rigid bronze or stainless steel backings. Capable of very low friction and high wear resistance, LUBRON TF bearings offer exceptional performance for hydro turbine wicket gate, control linkage, butterfly valve and dam gate applications.



LUBRON TX

LUBRON TX bearings consists of synthetic fiber reinforced PTFE polyester materials capable of high loads and low friction. LUBRON TX bearings have excellent dimensional stability in water, and are ideally suited for many hydro turbine applications. LUBRON TX bearings can be machined on-site, and are a lower cost alternative to many other self-lubricating bearings.

Lubron Bearing Systems
17211 Metzler Lane
Huntington Beach, CA 92647
USA

Phone: 714-841-3007
Fax: 714-841-3507

Email: sales@lubron.com
www.lubron.com

Catalog 0505